STUDENT HANDBOOK

Applicable for students admitted into

M.Tech Programs from 2013-2014

K L University

u/s 3 of UGC Act, 1956

Koneru Lakshmaiah Education Foundation

INSIDE

CONTACT DETAILS

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Note: *While every effort has been made to ensure that this book is accurate and up to date, it may include typographical or other errors. Changes are periodically made to this publication and will be incorporated in new editions.*

ABOUT UNIVERSITY

VISION:

To be a globally renowned university.

MISSION:

To impart quality higher education and to undertake research and extension with emphasis on application and innovation that cater to the emerging societal needs through all-round development of students of all sections enabling them to be globally competitive and socially responsible citizens with intrinsic values.

OBJECTIVES:

Focus	Objective
Academics	1. To offer academic flexibility by means of Choice based credit systems and the like. 2. To identify and introduce new specializations and offer programs in emerging areas therein 3. To incorporate into the curriculum the Application orientation and use high standards of competence for academic delivery 4. To design and implement educational system adhering to outcome based International models. 5. To introduce and implement innovation in teaching and learning process to strengthen academic delivery 6. To offer academic programs at UG, PG, doctoral, Post-Doctoral which are industry focused, and incorporates Trans-discipline, inter-discipline aspects of the education system 7. To deliver higher education that includes technologies and meeting the global requirements
Research	8. To promote inter-disciplinary studies and create needful facilities that enhance inter-disciplinary research and innovation 9. To create an ambience that is conducive for undertaking sponsored research, internal funded research and offering consultancy services to wide spectrum of originations 10. To establish centers of excellence in frontier areas of research, and design innovation centers with industry collaboration 11. To create environment to innovate and incubate the products and services that addresses the societal requirements

	12. To integrate research into all academic programs 13. To maintain high standards in achieving research outcomes 14. To promote International conferences / Seminars / Workshops / in collaboration with professional bodies for creation of avenues for research exchange
Extramural and extension	15. To generate means and avenues for carrying out extramural research for Industry and Academia 16. To organize extension activities covering literacy promotion, health awareness and improve the living standards of comm**UNIT**y 17. To make the research outcomes useful and applicable for the societal needs
Infrastructure	18. To promote and maintain state of the art facilities for academic delivery, research and co & extra-curricular facilities and develop congenial and eco-friendly fully residential campus 19. To create and strengthen focused and modern infrastructure that address the national needs through generation of dedicated funds from Industry, Government and research organizations,
Equity / Access	20. To provide and promote the opport**UNIT**ies to higher education to socially deprived comm**UNIT**ies and remove disparities by promoting women, differently abled and socially deprived 21. To provide equal access to meritorious both in terms of admissions and financial support
ICT	22. To lay emphasis on effective usage of ICT, WEB –resources and train the faculty on the latest advancements thereof and develop effective e-content 23. To develop and maintain world class ICT infrastructure and lay emphasis on its effective usage, extend regular training to both faculty and students on its latest advancements there by ensure interactive academic delivery
Examinations and evaluations	24. To introduce reforms in the examination and evaluation system that brings out knowledge application skills and competencies of the students and ensure transparency

Ecology and Environment	25. To Build into curriculum, issues related to social awareness about ecology and environment towards achieving greener society
Linkages	26. To promote collaborations with international and national organizations for advancements of academics, research, Technology transfer and Intellectual property rights. 27. To Indigenize the global technological solutions and develop the products, and services that transforms the standard of living of rural India 28. Design new products and services that address commercially attractive needs and opport**UNIT**ies while leveraging the available resources in the form of un-employed and under-employed Individuals
Employability	29. To provide skills through curriculum and training that are essential in fostering entrepreneurial thoughts, employability prospects and at the same time provides necessary support for incubating the innovations and assisting them for prospective commercialization. 30. To provide necessary business infrastructure that allows attracting and sustaining the industry to commence their business establishments within the University Campus and aid in life long sustenance of employment. 31. To develop industrial cluster that helps the students to start their industry after incubating the products at the incubating centers which will create Jobs 32. To develop National depositories for meeting the goals of National skill development council 33. Train people to profile neighborhood and comm**UNIT**ies for the needs and commercial opport**UNIT**ies that will support financially sustainable new businesses
Governance	34. To institute measures for transparent administration that aid in improving efficiency, accountability and reliance 35. To comply with regulations of all the statutory bodies. 36. To install professional managers who are global visionaries, thought leaders, and thinkers into the management of the University so as to contribute to the ideals of the University system

Quality	37. To continuously upgrade the faculty in curriculum design, teaching pedagogy, usage of ICT and various processes pertaining to academics, research and University administration 38. To develop mechanism that attracts talented, qualified and experienced faculty from across the globe for pursuing their academic and research careers at the University. 39. To consider and implement norms, metrics, standards, procedures and benchmarks for assessing and improving the quality in every aspect of University system and achieve quality certifications by National and International bodies. 40. To establish Internal quality Assurance cell (IQAC) and install a quality systems that is integral part of all the University processes 41. To continuously upkeep overall quality of the University based on aspects of regular feedback from the stake holders 42. To improve the quality of faculty through faculty incentives, awards and recognitions
Value orientation	43. To mold the students to possess professional ethics, moral values and intrapersonal skills that shape them into effective leaders and who are having the thoughts of equality and unanimity towards all walks and sects of life. 44. To inculcate the self-consistency, self-reliance and self-learning qualities for shaping the students to lead their life on their own. 45. To sharpen the critical thinking and reasoning skills by making students tackle problems and ideas that are yet to be tackled through application of their intellectual discovery. 46. Developing the students towards human intellectual achievement and make them rich in cultural experience 47. Students to be encouraged and provided with necessary support enabling them to choose and pursue careers of their choice & interest that make them professionally satisfied.
National development	48. To expand the University in all its modes of delivery so as to contribute to the Nation's increase in Gross Enrolment Ratio 49. To align the academic programs and courses to match the requirements

	of the National goals 50. To develop technology that helps sustainable socio economic development

History

The President of Koneru Lakshmaiah Education foundation, Er.KoneruSatyanarayana, along with Late Sri.Koneru Lakshmaiah, founded the K L College of Engineering in the Academic year 1980-81. With the mighty vision and restless efforts of Er.KoneruSatyanarayana K L College of Engineering carved a niche for itself through excellence in engineering education, discipline and record numbers of placements and was the leading college in the state of AP. K L College of Engineering achieved NBA Accreditation for all its B.Tech. programs in 2004 and later re-accredited in 2007. K L College of Engineering was transformed into an autonomous engineering college in the year 2006. In 2008 this college received a record grade of 3.76 on a 4 points scale with "A" Grade from NAAC; and in February 2009, the college, through its founding society "KoneruLakshmaiah Education Foundation" was recognized as Deemed to be University by the MHRD-Govt. of India, Under Section 3 of UGC Act 1956. This Deemed to be University is named as "K L University".

Location

Vijayawada is located on the banks of river Krishna in the state of Andhra Pradesh and has been historically a cultural, political and educational center. It is also a part of Andhra Pradesh Capital Region. The city is well connected by National Highway and Rail with Chennai (440 km), Hyderabad (275 km), Vizag (385 km) and is a central junction for trains running from North to South India. Daily flights operate from Hyderabad and Bangalore.

K L University is situated in a spacious 100-acre campus on the banks of Buckingham Canal of river Krishna, eight kilometers from Vijayawada city. Built within a rural setting of lush green fields, the institute is a virtual paradise of pristine nature and idyllic beauty. The campus has been aptly named "Green Fields" and the splendid avenue of trees and gardens bear testimony to the importance of ecology and environment. The campus ambience is most befitting for scholastic pursuits. The University has been situated on a built up area of around 15, 00,000 S. Ft.

ACCREDITATIONS:

- Declared as Deemed to be University u/s 3 of UGC Act 1956.
- Accredited by National Assessment and Accreditation Council (NAAC) of UGC as ‘A’ Grade with 3.16 CGPA on 4 point scale.
- Approved by All India Council for Technical Education (AICTE), New Delhi.
- ISO 9001 - 2008 Certified Institution.

FACILITIES:

Central Library: E-Resources

The Central Library is the largest, and holds materials to serve the whole University community. It has materials relevant to the Engineering, Science & Humanities courses offered by the University.

The library system contains more than one lakh and fifty thousand books and periodicals on all subjects related to the teaching and research interests of the University staff and students. The library has over 15,000 electronic journal titles, academic databases and 5000 eBooks. Access is available on campus on student computers and remotely.

A new library building will be opened shortly on par with international standard with modern IT facilities.

Every department of the college maintains their library to cater the needs of students and faculty. All foreign and Indian journals are made available in the department library for the convenience of faculty and students.

The libraries render following library services.

- Circulation of library documentary.
- Inter-library loan services.
- Photo copying services.
- Reference service.
- CD-ROM search services.
- Inter Net services.
- OPAC
- WEB OPAC
- Audio visual
- Online lectures

The Data Center

A State-of-the-Art Data center with advanced servers provides highly interactive learning environment with full-fledged hardware and software training facilities.

Hardware:

The configuration of high end stream of servers that provides various services is

Super Computer

HPC Infrastructure (Super Computer):

- 5.3 TERA Flops (CPU + GPU)
- HP SL 230 4* SL230s Gen8, (2 * 2.6 GHz, 32GB RAM, 2x500GB HD, 10G IB HCA) providing -1.3TF
- HP SL 250 2* SL250s Gen8, (2 * 2.6 GHz, 32GB RAM, 2x500GB HD, 10G IB HCA + 2 NVIDIA K20 GPU providing -4TF. Master Node:
- HP DL 380P 1* DL380p Gen8 (2* 2.6Ghz, 64GB RAM, 2x2TB HD, 10G IB HCA).
- Compute Switch (48 Port Low latency switch)QLogic IB QDR 36 Port Switch.
- Intel® Composer XE for Linux.

The data centers consists of BYOD Servers& Backup Server, **Sun Servers, Dell and HP Blade Servers**, **Apple Server Xserve:**

SPECIAL LABORATORIES

The institute is equipped with various Industry Collaborated Labs

S. No	Discipline	Name of the Lab	Research Group Associated
1.	Computer Science and Engineering	CISCO	Computer Networks and security
2.	Computer Science and Engineering	IBM	Software Engineering
			Knowledge Engineering
3.	Computer Science and Engineering	Microsoft	Embedded Systems
			Software Engineering
			Knowledge Engineering
4.	Computer Science and Engineering	Adobe	Web technologies
			Image processing
5.	Computer Science and Engineering	Oracle	Knowledge Engineering
6.	Electronics Communication Engineering	NI Lab View	Communications Systems

Physical Education- Sports Facilities:

KL University encourages students to explore their latent talents by providing good games and sports facilities. The institute is equipped with the following.

- Athletic track
- Hockey Field
- Badminton Courts -4
- Tenni-koit Courts -2
- Cricket Field with Net practice - 3
- Volleyball Courts -4
- Tennis Courts - 2
- Handball Court
- Netball Courts - 2
- Throw ball courts - 2
- Beach Volleyball Court
- Football Field
- Basketball Courts – 2
- Kabaddi Courts – 2
- Table Tennis - 6
- Chess
- Caroms
- Kho Kho Court
- Soft Ball
- Archery

The University had State-of- the - Art Indoor stadium of 30000 sq.ft with:

- 4 wooden Shuttle Courts/ Basketball Court
- Yoga and Meditation Center
- Dramatics
- 8 Table Tennis Tables
- Hobby Center
- Gymnasium for Girls
- Gymnasium for Boys
- Multipurpose room with Chess, Carroms etc.
- Power lifting/Weight Lifting

Accommodation- Hostels

- KL University has separate hostels for boys and girls with well furnished rooms and modern amenities. The overall atmosphere is very conducive for the students to concentrate on studies.
- A state- of – the- art kitchen and spacious dining area has been provided for both the hostels.
- Generators have been provided as power back up.
- Emphasis has been laid on hygiene and cleanliness for healthy living. A customized menu caters to the student needs and it keeps changing according to their tastes.
- Teaching staff will have to address academic and personal problems of the students.
- Round-the-clock security, communication, dispensary facilities are also available.

The Girls Hostel

The girl's hostel is within the campus with a capacity of 1192 in 500 rooms. Different rooms accommodating 2 per room, 3 per room with attached toilets as well as A.C. rooms are available. Suite rooms with modern furniture and separate study room are also available.

The Boys Hostel

It is a short walk from the university with a capacity of 2040 in 780 rooms. Different rooms accommodating 2 per room, 3 per room with attached toilets as well as A.C. rooms are available.

Facilities in the Hostels

Protected drinking water, state of the art kitchen, dining hall, newspapers, telephones, toilets and bathrooms are well maintained. Every student in the hostel is provided with a cot, study table, chair and a rack. Fan and light are also provided in each room.

- Gas & Steam based hygienic food preparation
- Palatable regional, national and international cuisines
- Cleanliness and Safety
- STD/ISD Facilities
- Medical Kits and First Aid Boxes
- Soft drinks, snacks, Fruits etc.
- Laundry
- Stationary shop

➢ Hostel Rules & Regulations

- Students are hereby informed that while staying in the hostel, it is essential to be responsible in maintaining dignity by upholding discipline. They must be obedient to the hostel warden/floor in – charges.
- Valuable items like jewelry etc., should not be kept with students while staying in the hostel. It is student's own responsibility to safeguard her/his Laptops, Money by locking suitcases and bags. If any loss is found, management will not take any responsibility.
- Student has to intimate to the hostel authorities before you giving police complaint against losses.
- Students are not allowed to indulge in smoking, consumption of Alcohol, Narcotic drugs etc., and defaulters will be strictly viewed upon.
- Students are directed that after locking their rooms they have to hand over the keys to security and can collect them on returning back to the hostel.
- Students must switch off Fans, Lights, Geysers, A/C's etc., before leaving their rooms.
- Visitors are not allowed inside the hostel at any time, however they are allowed into the visitor's hall with the prior permission of the warden. Only family members listed by the parents are allowed to contact the student. Visiting hours are up to 7.30 pm only and after 7.30 pm visitors are required to leave premises.
- Hostel students are not allowed to come into the hostel after 3.00 pm in case morning shift students and 6.00pm for day shift students. Those students who are utilizing computer lab,

library etc., after the times specified have to submit the permission slip to the security while entering into the hostel.

- During public holiday outings, those who seek permission to leave the hostel will have to obtain a written permission from warden. Permission will be given only to those students who get permission from parents to leave the hostel during holidays/outings. Moving out of campus without permission are strictly prohibited.
- Strict study hours from 7.30 to10.30 pm shall be maintained in the hostel. The hostellers must be in their allotted rooms during study hours.
- The general complaints of any kind should be noted in the complaint register, which is available at the hostel office. Registered complaints only will be entertained.
- Any health problem should be brought to the notice of Warden/Floor In – charge for necessary treatment.

Transportation:

- The institution runs 70 buses covering all the important points in Vijayawada City, Mangalagiri, Guntur & Tenali towns with a total seating capacity of 4000 students in two shifts.
- Transport is available 24 hrs in case of any emergency in the institute / hostels.
- Transportation is available for conducting industrial tours and visits etc.
- Regular transport facility available up to 10 PM.

Health Centre

A full-fledged health center with all the facilities is established to cater to the needs of the students, staff, Faculty and to the general public in the adopted villages. It consists of three doctors (Homoeopathy, Ayurvedic& Allopathy).

Cafeteria

- KL University has a spacious canteen with latest equipment and hygienic environment which provides quality food and prompts service and caters to needs of all the students and the staff.
- A central cafeteria of 1500 Sq.m. is available in the campus. Mini cafes and fast-food centers are available in various blocks.

- The canteen is open from 6:30 a.m. to 8:30 p.m. There is a wide variety of North-Indian and South-Indian cuisine and the students enjoy the pleasure of eating during the breaks. Cool aqua water for drinking is available.

Placements:

K L University has meticulously planned to make all its outgoing students employed. The University had installed the infrastructure, employed well experienced faculty, designed and delivered programs that help enhancing the communication and soft skills which are required for making the students employable. An excellent system is in place that considers all the issues that make a student employable. The University has been successful for the last 7 years, in employing all the students who have registered and eligible for placement through its offices located across the country. About 50 trained personnel work extensively to make the students ready for recruitment by the Industry.

Counselling & Career Guidance

A special Counseling Cell consisting of professional student counselors, psychologists, senior professors counsels/helps the students in preparing themselves to cope with studies, perform well in the tests & various competitions. This Cell provides its services to the students in getting the solutions for their personal problems and also provides career guidance with the help of Industrial Relations and Placements (IRP) department.

A group of 20 students are allotted to a senior faculty member who counsels them regularly and acts as their mentor.

Social Service Wing

KL University has a social service wing which is used to channelizing the social service activities of the faculty, the staff and the students. It has adopted 5 nearby villages and conducts activities like medical camps, literacy camps and educates the villagers regarding hygiene and health care on a regular basis.

NSS Wing of Institute

Regularly organizes Blood donation camps, Blood grouping camps, Fund collection and distribution to poor children and old age homes, distribution of old clothes and free medicines to slum dwellers, tree plantations, AIDS awareness program, teaching basic computer skills to a target group of 500 people in villages.

Hobby Clubs

Wholly and solely managed by the students, the clubs have in the past contributed much to the cultural life of the campus and to the cultural evolution of the students, A number of student bodies and clubs operate in the campus like music society, dance club, drama society, literary and debating club, English press club, drawing club, painting club, mime club, computer club etc. Students manage entire activities and budget of the organization for the entire **SEMESTER** in advance. Around 4000 students are the active members of the Hobby Clubs.

Life Skills and Inner Engineering

KL University feels that it is its responsibility to mould the students as good human beings contributing to the country and to the society by producing responsible citizens. Along with the regular programs every student admitted into KLU undergoes a one week special life skills /orientation program. Through this program, KLU is producing the students with the clarity of thoughts and charity at hearts. Strict regularity, implicit obedience, courtesy in speech and conduct, cleanliness in dress and person is expected of each KLU student. Life skills and inner engineering teach a student his/her obligations towards GOD, himself /herself his/her country and fellow human beings. Every student is encouraged to practise his/her own religious faith and be tolerant and respectful towards other religions.

Technical Festival

KLU organizes various programs for the all round development of the students. The technical festival and project exhibition is being organized in the odd **SEMESTER** (October) every year to elicit the innovative ideas and technical skills of the students.

Cultural Festival

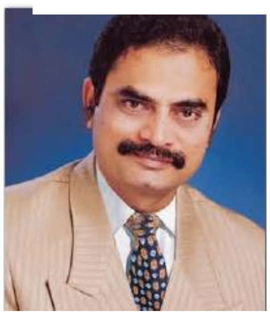
The cultural festival in the even **SEMESTER** (February) of every year is the best platform for the students for exhibiting their talents and creativity. Through these festivals KLU is imparting organizational skills, leadership skills, competitive spirit, and team behavior skills to our students. Along with the knowledge, KLU festivals are providing recreation to the student community.

INNOVATION, INCUBATION AND ENTREPRENEURSHIP CENTER

KLU being a pioneering institute supporting Academics and Research in Engineering, Science and Technology is endowed with all the infrastructure and highly experienced faculty, has an Innovation, Incubation and Entrepreneurship Centre (IIE) that comprises of:

- Innovation centre which aims to inculcate a spirit of innovation.
- Incubation centre which aims to incubate the innovations through prototype product development.
- Entrepreneurship Development Centre (EDC) which aims at fostering entrepreneurial skills among the students.

UNIVERSITY ADMINISTRATION



KoneruSatyanarayana,

President

Sri KoneruSatyanarayana, BE, FIE, FIETE, MIEEE graduated in Electronics and Communication Engineering in the year 1977. Along with Sri KoneruLakshmaiah, he is the co-founder of the Institute which was established in the year 1980. He is an educationist of eminence and also an industrialist of great repute. He runs a number of industries in and around Vijayawada.

Dr. M Ramamoorty

Chancellor

Dr. Ramamoorty assumed charge as Chancellor, K L University with effect from 30th March 2015 after successful career as a Professor in IIT Kanpur and also as first Director General of CPRI.

Dr. Ramamoorty obtained his B.E. (Honors) from Andhra University in 1957 and M.E. from IISc Bangalore in 1959. He obtained his MASc and PhD from Toronto University in 1965 and 1967 respectively.

He was a Commonwealth Fellow at U of T from 1964 to 1967. He then joined IIT Kanpur as a faculty member in the Electrical Engineering Department and became a professor in 1972. He had established the first graduate program in Power Electronics in India in 1968 at IIT Kanpur. He had supervised 12 doctoral projects and was associated with many sponsored research activities with industries like BHEL and Hindustan Steel Limited during his tenure at IIT Kanpur.

Dr.L.S.S Reddy

Vice Chancellor

Dr. L.S.S. Reddy is an eminent Professor in Computer Science and Engineering Department holding Ph.D in Computer Science Engineering from BITS Pilani. Dr. Reddy is an outstanding administrator, a prolific researcher and a forward looking educationist. Dr. Reddy has over 30 years of experience in Teaching, Research and Administration at prestigious institutes like BITS Pilani, CBIT etc.

Dr.L.S.S.Reddy had joined KoneruLakshmaiah College of Engineering in December 1995 and proved his administrative excellence as a Head of Department of Computer Science and Engineering. Dr. Reddy was instrumental and a driving force as Principal (2002-2009) in promoting KLCE as one of leading Institutions in India.

Dr.A.V.S.Prasad

Pro-Vice Chancellor

Dr.A.V.S.Prasad, M.E (Hydraulics & Irrigation Engineering) and Ph.D (Environmental Sciences and Technology) from JNTU, Hyderabad is a Professor in Civil Engineering. He has a rich experience of 27 Years in academics and 20 years in administration at various caders ranging from Head of the Department, Dean, Principal and Director.

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ACADEMIC REGULATIONS

1.0 INTRODUCTION TO THE PROGRAMME

The Koneru Lakshmaiah Education Foundation (K L University), Vaddeswaram shall confer M.Tech Post graduate degree to candidates who are admitted to the Master of Technology Programme and fulfill all the requirements for the award of the degree.

1. Student will be studying 8 CDC courses and 4 electives from the given courses.
2. Evaluation Component Seminar in **SEMESTER**s I/I and I/II will be 2 credits (0-0-2). The students will be registering in the courses of his choice where they will be presenting the seminar on any topic related to the subject but not from the Syllabus.
3. Thesis component in 3rd **SEMESTER** should be continued in the 4th **SEMESTER** until unless a student opts for industry project.
4. The minimum credits required for graduation will be 85 – 90 credits.

2.0 BRANCHES OF STUDY

M.Tech duration: 2 Years with following specializations.

- Bio-Technology
- Computer Science & Engineering
- Computer Networks & Security
- Communication & Radar Systems
- VLSI
- Embedded Systems
- Power Electronics & Drives
- Power Systems
- Thermal Engineering
- Structural Engineering
- Mechatronics
- Wireless Sensor Networks
- Signal Processing

3.0 PROGRAMME MODEL

- The course duration of M.Tech is 2 years.
- KL University operates in the **SEMESTER** pattern.
- Each **SEMESTER** has 90 working days.

- The total number credits to earned is 85 to 90
- The University awards M.Tech for post graduate degree programme.
- The maximum course duration is 4 years
- Academic regulations are approved by the Academic Council.
- The medium of instruction is English.

4.0 PROGRAMME OBJECTIVES

The Programme Educational Objectives (PEOs) are the statements that describe the expected achievements from the programme. They are guided by global and local needs, vision of the Institution, long term goals etc. The Programme Educational Objectives of M.TechProgramme include:

I. To mould the students to become effective global science students in the competitive environment of modern society.

II. To provide students with strong foundation in contemporary practices of Science, different functional areas and scientific environment

III. To emphasize on application oriented learning.

IV. To develop communication, analytical, decision-making, motivational, leadership, problem solving and human relations skills of the students.

V. To inculcate professional and ethical attitude in students.

VI. To pursue lifelong learning as a means of enhancing knowledge and skills necessary to contribute to the betterment of profession.

5.0 PROGRAMME OUTCOMES

The M.Tech programme is designed to meet the following outcomes:

a. Ability to practically apply various technological concepts.
b. Demonstrate knowledge of innovative and modern engineering practices.
c. Ability to apply the specialized expertise in relevant practical fields.
d. Ability to communicate effectively and professionally.
e. Ability to solve critical practical oriented real time problems.
f. Ability to manage people effectively and become good leaders.
g. Develop professional and ethical attitude and become socially responsible citizens.
h. Ability to carry out cutting edge research in the emerging areas.
i. Understand the global business scenario.
j. Demonstrate their role as engineers or entrepreneurs and contribute to the society.

6.0 PROGRAMME STRUCTURE

6.1 Distribution of courses over the SEMESTERs

S No	Course code	SEMESTER – I	L	T	P	Cr
1.		Core Course - 1				
2.		Core Course - 2				
3.		Core Course - 3				
4.		Core Course 4				
5.		**ELECTIVE-I**	3	0	0	3
6.		**ELECTIVE-II**	3	0	0	3
7.		Seminar	0	0	4	2
		TOTAL Credits:				**24-26**

S No	Course code	SEMESTER – II	L	T	P	Cr
1.		Core Course - 5				
2.		Core Course - 6				
3.		Core Course - 7				
4.		Core Course 8				
5.		**ELECTIVE-III**	3	0	0	3
6.		**ELECTIVE-IV**	3	0	0	3
7.		Term Paper	0	0	4	2
		TOTAL Credits:				**24-26**

S.No	Course Code	Second Year	Credits
1		Dissertation	36
	TOTAL Credits:		**85-90**

6.2 Course Precedence

To impart quality higher education and to undertake research and extension with emphasis on application and innovation that caters to the emerging societal needs through all-round development of students of all sections enabling them to be globally competitive and socially responsible citizens with intrinsic values.

6.3 Specialization Streams

A student will be awarded a *Degree with Specialization* if he/she completes 4 courses from a particular stream within the discipline. By a careful selection of electives within a particular stream, a student can get a degree with specialization. That is, a student can get a Degree with Specialization during regular M.Tech programme, without overloading himself / herself.

7.0 ELIGIBILITY CRITERIA

Admissions to the M.Tech programme shall be made subject to the eligibility, qualifications and specialization prescribed by the University for each Programme, from time to time.

Admissions shall be made either on the basis of merit rank obtained by the qualifying candidates at an Entrance Test conducted by the K.L.University or on the basis of GATE / PGECET score, subject to reservation prescribed by the University or Government policies from time to time.

8.0 ATTENDANCE AND DETENTION

Attendance

a) It is mandatory for, a student to attend all the classes, tutorials, laboratories and other evaluation components conducted by the University. A student may be detained from appearing for an examination on grounds of shortage of attendance.

b) In each course attendance will be treated as evaluation component and marks are awarded as shown below:

% of Attendance in Theory & Practical classes	Marks awarded
≥ 95	5
≥ 90 and < 95	4
≥ 85 and < 90	3
≥ 80 and < 85	2
≥ 75 and < 80	1

Detention

a) 75% attendance and 40% internal marks (internal evaluation components) are mandatory to attain eligibility to appear for the comprehensive examination in a course. If a student fails to maintain 75% attendance and 40% internal marks in a course he/she will be awarded with *NA* Report in that course. In such cases, student will not be permitted to attend the comprehensive examination of that course(s) where he/she has obtained *NA* Report. He/she has to register and repeat the course whenever it is offered.

b) However, some relaxation to this rule is possible in the case of students participating in extra - curricular activities as identified below:

- One week for state level competitions.
- Two weeks for National level competitions and
- Three weeks for International events irrespective of the number of events and/the number of participations in a **SEMESTER**.

c) If the period of absence in a **SEMESTER** is for a short duration (of not more than one week) prior application for leave should be submitted to the Head of the Department clearly stating the reasons for absence along with supporting documents. The Head of the Department will grant such leave at his/her discretion. He/ She may be allowed for makeup of Laboratory/workshop classes conducted during the period of absence.

d) Absence for a period not exceeding one week in a **SEMESTER** due to sickness or any other unavoidable reason for which prior application could not be made may be condoned by the Dean-Academics, provided he is satisfied with the explanation.

e) If the period of absence is likely to exceed one week, a prior application for grant of leave should be submitted to the Head of the Department.

f) In special cases and for sufficient cause shown, the Dean-Academics on the recommendation of the Head of the Department may condone the deficiency not exceeding 10% in attendance due to ill-health, when the application submitted at the time of the actual illness is supported by a certificate from an authorized medical officer.

g) A student must intimate his/her absence to the Superintendent /Warden of the Hostel in which he/she is residing, before availing of any leave. Failing to do so will be construed as breach of discipline.

9.0 REGISTRATION

A student (newly admitted or on rolls) has to register for the course on the day of registration for each **SEMESTER**. Students failing to register for the course will not be permitted to attend classes.

Students will be permitted to register only if they have:

1. Cleared all the fees, outstanding dues of University and / or hostel of previous **SEMESTER**s, paid all prescribed fees for the current **SEMESTER**, and not been debarred from registering for a specified period on disciplinary or any other ground.

2. Normally, no late registration shall be permitted. However, considering any compelling reason, a student may be permitted for late registration (within one week of commencement of **SEMESTER**) with prior approval from the Director (AcademicRegistration). Late registration may be done with payment of requisite fine.

3. The University reserves the right to cancel the registration of a student from a course or **SEMESTER** or debar from the degree on disciplinary grounds.

4. Registration of students in each **SEMESTER** will be organized by the Academic Section. The registration will be done in respective departments; the course details being verified by the faculty mentor of the batch. Payment of dues etc., will be verified by the Academic Section.

5. A student who does not register on the day announced for the purpose may be permitted by Dean Registration, in consideration of any compelling reason, late registration within next 5 working days on payment of an additional fee as prescribed by the University.

   Normally no late registration shall be permitted after the fifth working day from the scheduled date, except in special cases, a serious medical problem, a family calamity or participation in a national event, to be approved by the Director on recommendation of Dean Registration.

9.1 Fees and payments

A student admitted to any course shall be required to pay, at the time of joining, and also in subsequent **SEMESTER**s, prevalent tuition and other fees as prescribed by the University till he/she is on roll including the period beyond the normal four-year duration.

There is no discount in fees for reduced academic load. Normally the fee structure will not change during the programme; but if the University revises the structure in the middle of a programme, a student is obliged to comply. The fee will be collected under the broad heads: Admission fee, Tuition fee, Student Activity fee, Hostel rent, Caution deposit, Convocation fee and miscellaneous fees. Caution deposit collected will be returned at the end of the programme after due adjustment, if any, except for those who leave the University prematurely.

When a student leaves the University on successful completion of the course, caution deposit is refundable after deduction of dues and charges, if any.

- If a student is removed or he withdraws/leaves the University in the mid-session without completing the entire course, all fees paid including the caution deposit will be forfeited by the University. Mess advance may be refunded after deduction of dues, if any.
- If a student does not register in three consecutive **SEMESTER**s his name will be struck off the rolls.

Exceptions

Notwithstanding anything stated in the rules, the Academic Council can make special provisions and exceptions depending on the merit of a case. Such cases shall not be cited as precedence in future occasions of similar nature.

9.2 Pre-Requisites

Admission to the M.Techprogramme shall be made subject to the eligibility, qualifications and specialization prescribed by the University for each Programme, from time to time.

Admissions shall be made either on the basis of merit rank obtained by the qualifying candidates at an Entrance Test conducted by the K.L.University or on the basis of GATE / PGECET score, subject to reservations prescribed by the University or Government policies from time to time.

10.0 PROGRAMME DELIVERY SYSTEM
LTP Structure

Learning well is understood as acquiring knowledge and skills at higher cognitive levels, which include Apply, Analyze, Evaluate and Create. Such learning is ensured by making it heavily activity and practice oriented rather than lecture oriented.

Based on the nature of the course the learning pedagogy will change that is reflected by **L-T-P** structure for a course. **'L' (L**ecture classes) stands for class room contact sessions. **'T'** stands for **T**utorial sessions for reinforced learning through participatory discussion/self-study/desk work and such other novel methods that make a student absorb and assimilate more effectively the contents delivered in the lecture classes. '**P'** stands for **P**ractice/**P**ractical sessions for laboratory/field studies that equip students to acquire the much required skill component. A credit is defined to be as one hour of lecture or two hours of laboratory per week or one hour of tutorial per week over a **SEMESTER**.

11.0 BACKLOG COURSES

A course is considered to be a backlog if the student has obtained 'F' grade / *NA* Report in the course; the following regulations apply to a student who has backlog(s):

a) A student having backlogs has to clear backlog courses first.

b) If the backlog course(s) becomes prerequisite for any other course, he cannot register for those prescribed courses.

c) A student, who has backlog courses, when he/she appears in Academic Counseling Board, shall come under all regulations mentioned in ACB.

d) A student detained due to lack of credits / more number of backlogs in a **SEMESTER** has to register only for that **SEMESTER** after acquiring the eligibility for promotion. Under no circumstances he/she is allowed to register for next **SEMESTER** without registering for the detained one. This is applicable for those joined from 2010-11 academic year onwards.

12.0 GRADES AND REPORTS

A candidate shall be eligible for the award of the respective degree if he satisfies the minimum academic requirements in every course and secures 'satisfactory' or higher grade in the courses/report on his dissertation/dissertation and viva-voce.

For the award of M.Tech degree a student must have earned stipulated credits (as approved by respective B.O.S) and obtained a minimum CGPA of 5.5.

- M.Tech Degree with Second class will be offered to those having CGPA < 6.5.
- M.Tech Degree with First class will be offered to those having CGPA ≥ 6.5.
- First class with distinction will be offered to those having CGPA ≥ 7.5 provided the student has cleared all the courses in first attempt (Regular) within the stipulated time.

At the end of all evaluation - components based on the performance of the student in courses and seminars, each student is awarded with **letter grade** on a **relative scale**. The list of letter grades and its connotation are given below:

Grade	Qualitative Meaning	Grade
X	Excellent	10
A	Very Good	8
B	Good	7
C	Fair	6
D	Satisfactory	5
E	Pass	4
F	Fail	0

The grades '*X*' and *'F'* will be earned and remaining grades will be awarded. A student scoring 80% or more of overall score will earn an 'X' grade.

A student getting less than 50% of overall score and 40% in the comprehensive examination will be considered to have earned *F* grade.

a) To earn an *X* grade, the student should have scored aggregate marks of ≥ 80%.

b) A student who obtains '*F*' grade has to reappear for the comprehensive examination. However, such a student need not attend the classes and marks obtained in internal evaluation components and attendance will be carried forward to the subsequent attempts of the student.

c) In case of a student who has earned *F* grade, after the student has fulfilled all the requirements for passing it will be converted into a valid grade by considering grade cutoffs of the batch in which he/she had appeared for the course for 1st time.

d) The overall performance of the student is described by Cumulative Grade Point Average (*CGPA*) and is calculated taking into consideration grade obtained by the student in all credited courses and credits attached to it. It is the weighted average of the grade points of all the letter grades obtained in credited courses by the student from his entry into the University. *CGPA* is computed as follows:

where c_1,c_2 ….. c_g denotes credits associated with the course applied and g_1, g_2…denotes grades

$$CGPA = \frac{c_1 g_1 + c_2 g_2 + ... + c_n g_n}{c_1 + c_2 + ... + c_n}$$

obtained by the student.

e) At the end of each **SEMESTER** the University issues grade sheet indicating the *CGPA* of the student. However, grade sheet will not be issued to the student if he/she has any outstanding dues.

f) The Instructor/Course Coordinator can award the following reports depending on the cases:

(i) **NA (Not Attended)** is awarded to the student if the student has shortage of attendance. When student is given *NA* he/she has to repeat the course. It should be noted here that *NA* is different from *F* grade. For a student with *F* grade his/her internal marks, attendance and attendance marks will be carried forward. While for a student awarded with *NA* Report has to attend the classes.

(ii) **NR (Not Registered)** is awarded when a student has not registered for a course. When a student is given NR grade he/she has to register for the course when offered next. If a course in which a student is given NR grade is pre-requisite grade for another course, the student shall not be registered for such a course.

(iii) **GP (Grade Pending)** is awarded in situations where Course Coordinator cannot communicate the grade in time because of operational difficulties. The *GP* report has to be converted into valid grade by the Course Coordinator at a later stage.

(iv) **RC (Registration Cancelled)** is awarded to a student for various reasons when the registration for the course is cancelled by the University. Such a student will have a register for the course in subsequent **SEMESTER** / summer **SEMESTER** whenever the course is offered next.

(v) **DIP (Discontinued from Programme)** is awarded in situations where a student wants to discontinue with the prior approval of the University.

13.0 ACADEMIC COUNSELING BOARD (ACB)

1. A student will be put under Academic Counseling Board under the following circumstances:

    a. Has CGPA of less than 5.5 for Post graduate degree programmes.

    b. Has ‘F’ grade in more than two courses.

2. The students under Academic Counseling Board may not be allowed to register for all regular courses in the **SEMESTER** based on the recommendation of Academic Council Board. That is, University reserves all rights to decelerate the degree programme of the student.
3. Remedial classes will be conducted for students who are in ACB.

14.0 OVERLOADING AND UNDERLOADING

A student is permitted to overload himself/herself (registering for more courses) in a **SEMESTER** subject to certain restrictive conditions.

15.0 ACCELERATION AND DECELERATION

University offers flexibility for M.Tech degree students in doing the courses. In addition to the prescribed courses, a student can register for more electives, summer term courses, evening courses provided his/her timetable and University facility permits. Any extra courses done by acceleration would be reflected in the transcript but not in the CGPA. The University permits a student to decelerate his degree programme as well. Any student is permitted to withdraw from the courses for which he/she has registered, owing to his personal problems or any other valid reason.

16.0 ELECTIVE COURSE

The University offers a pool of electives in all disciplines. A student is permitted to choose the elective courses of his/her choice within his own discipline.

17.0 RE-APPEARANCE

The University permits a student to repeat a course to improve the grade subject to certain restrictive conditions.

18.0 BETTERMENT BY RE-REGISTRATION

A candidate having low SGPA / CGPA can reappear in the end examination when he has obtained C or D grade for improvement before the completion of M.Tech programme. The internal evaluation components in such case will be carried forward and grading will be done with the current batch of students. However the grades obtained out of improvement will not be considered for award of distinction or Gold medal.

19.0 WITHDRAWAL AND SUBSTITUTION OF COURSE

a) A Student is permitted to withdraw from an elective course within one week after the commencement of the **SEMESTER** with the approval of Dean-Academics.

b) A Student is normally not permitted to withdraw from compulsory course(s) of the discipline. However if a student desires to withdraw from compulsory courses of the discipline, he/she should seek prior permission from Dean-Academics.

However, a student is not permitted to withdraw from compulsory course and substitute the same with an elective course.
In situations, when a student withdraws from a compulsory course, he/she must have to complete the course before graduation.

c) Whenever a student withdraws from compulsory course(s), the student has to register for the course(s) from which he/she is permitted to withdraw whenever the course(s) are offered. This implies, a student has to complete all the compulsory courses prescribed by the Department for graduation.

Within one week of the commencement of the **SEMESTER**, a student is permitted to substitute an elective course (substitution) with prior approval of Dean-Academics subject to availability.

20.0 SUMMER TERM AND EVENING COURSES

If the number of F grades and/or registration cancelled (detained) in a course taught in even or odd **SEMESTER** is significant, a department may offer the course during the summer vacation. When a summer course is offered, it will be compulsory for all students who have secured an ‘F’ grade in that course. There will be no alternative mid **SEMESTER** or supplementary examination in that course. Students who need to sit for supplementary or alternative mid **SEMESTER** exams on medical, family calamity or any other reason except poor academic performance may sit in the corresponding exams of the summer course, without attending classes if they satisfy the attendance requirement.

The summer courses will be identical in scope and manner of execution to the corresponding courses of regular **SEMESTER**s, except that the number of class hours per week may be higher. Attendance requirement will also be identical. The examinations will be conducted by the academic section in the usual manner. No separate examination will be arranged for students who miss the summer course, or any other examination.

21.0 DEGREE WITH SPECIALIZATION

A student will be awarded a *Degree with Specialization* if he/she completes courses from a particular stream within the discipline. By a careful selection of electives within a particular stream, a student can get a degree with specialization. That is, a student can get a Degree with Specialization during regular programme, without overloading himself / herself.

22.0 GRADUATION REQUIREMENTS

A student must fulfill the following requirements for graduating:

1. Must have cleared a minimum of 85-90 credits.
2. Cleared all the requirements of discipline.
3. Obtained a minimum GPA of 5.5.
4. Must have finished all the above mentioned requirements in less than twice the period mentioned in the Academic structure for each programme which includes deceleration period chosen by the student, deceleration imposed by University or debarred from the University.

Credit Distribution

The four **SEMESTER** M.Tech. Programmes offered in various disciplines and streams by different departments of the institute are based on the credit system and provide a student with wide choice of courses. Each programme comprises of several core and elective courses and project work. These programmes, along with the course structure, are indicated here under.

The Programme is spread over a period of four **SEMESTER**s that embodies 12 courses with a credit load of 85-87 credits.

S. No	Type of the course	Number	Credits	Percentage
1	Core courses	8	33-38	40.2

2	Professional electives	4	12-14	13.7
3	Term Paper	1	2	0.25
4	Seminar	6	2	0.25
5	Dissertation work	1	36	41.3
	Total	20	85-90	100

Core Courses

A paper which should compulsorily be studied by a candidate as a core-requirement to complete the requirements of a degree is defined as a Core Paper. A student has to compulsorily undergo 8 core courses.

Elective Courses

The students can pursue elective courses in different areas of his interest. Each student must choose four elective courses.

23.0 EXAMINATIONS

The Examination office of the Academic Section will centrally conduct the Mid-**SEMESTER** and End-**SEMESTER** Examinations in respect of theory courses unless otherwise arranged. The examinations will normally be "closed book type", where the students are not permitted to bring any material. All necessary charts and tables will be provided by the University. It is the responsibility of the course faculty to recommend the material to be provided, and to check with the examination office that the arrangement has indeed been done.

While normal scientific calculators are permitted, other electronic devices such as programmable calculators and calculators containing communication devices are forbidden. Any exception to these provisions must be specially approved by the Academic Council.

24.0 EVALUATION

Teaching and Evaluation

I. Teaching

a. Course(s) taught by a single instructor (theory) is referred to as single section course and course(s) taught by group of instructors in more than one section is referred to as multi-section courses.

b. The teacher for single section courses or associated with multi-section courses is referred to as Instructor.

c. In case of multi- section courses, the team is led by an instructor known as Course Coordinator. For single section courses, an Instructor will be designated as Course Coordinator. Course Coordinator is also an instructor in multi-section course.

d. A team of instructors, under the leadership of Course Coordinator, work together for meeting all requirements of teaching, evaluation and administrative aspects of the course. The Course Coordinator has the responsibility of conducting the course with the cooperation of all instructors in the team.

e. Course Handout shall be given to the students. It shall also be placed on the E-Learning portal.

f. Students will be assessed on formative basis with a weightage of 40 per cent. The summative assessment carries a weightage of 60 per cent.

24.1 Evaluation of Internal Examinations

Evaluation Scheme

a) Formative Assessment: Max Marks: 40

S.No	Component	Duration	Weightage
1	Internal assessment Exams (Test 1 & 2) (75% of the higher score and 25% of the lower score will be considered)	1½ hours	15
2	Assignment/Assignment Test/Written Case Analysis/ Live Project/Reading Seminar/Mini-project/Paper Presentations/Operation workout		15
3	Surprise Test - Objective or Descriptive (Average of two tests will be considered)	10 to 20 minutes	5
4	Class attendance		5
		Total	**40**

i. Two internal assessment exams (Test 1 & Test 2) will be conducted for all courses during the **SEMESTER**. The internal exams will be conducted for 30 marks which in turn will be scaled to 15 marks. The schedule of exams will be notified by the Principal.

ii. A Surprise Test is of objective or subjective nature decided by the Course Coordinator and is conducted without prior intimation. There will be two such tests in a **SEMESTER**.

iii. Assignment /Assignment Test/ Live Project /Reading Seminar /Written Case Analysis/ Mini-project / Paper Presentations / Operation workout:

   One or two of these components as detailed in Table No. 1 will be implemented for each course. Applicable component(s) will also be detailed in the Course Handout. Wherever applicable, presentation by a student would be integrated with the component.

iv. Class attendance is monitored by each Instructor and based on the percentage of attendance marks are awarded.

v. In order to maintain transparency in evaluation, the answer sheets of all formative assessment components shall be shown to the students within THREE days of conducting the tests. If a student is not convinced with the marks awarded he/she can apply for recheck. However, the student can apply for recheck on the day of returning the answer sheet within the classroom only.

vi. It shall be the responsibility of the Course Coordinator to display solution key on the notice board immediately after the evaluation component with evaluation scheme. The Instructor should stick to the evaluation scheme announced while checking the answer sheets.

vii. Where there are multiple Course Instructors, the Coordinator shall ensure that a common question paper is administered for Test 1 and Test 2.

Distribution of Weightage

S. No	Nature of examination	Marks %	Type of examination and mode of Assessment		Scheme of examination
1	*Theory	60	**SEMESTER** end examination (external evaluation)		This examination question paper in theory subjects will be for a maximum of 60 marks.
		40	20	Test 1 / Test 2	2 mid - exams each for 20 marks and of 1 1/2 hr duration are to be conducted. For a total of 20 marks, 75% of better of the two and 25% of the other are added and reported.
			5	Assignment Test	6 Question to be released in advance. 2 Questions allotted by Examiners choice to be answered. Duration 45 min.
			5	Home Assignment	Average of Home Assignments minimum 2 per subject.
			5	Surprise Quiz	A maximum of two surprise quizzes per subject
			5	Attendance/ Class notes	5 marks are allotted for attendance and class notes
2	*Practical	60	**SEMESTER** end Lab exam (ext. evaluation)		60 marks are allotted for **SEMESTER** end laboratory/ drawing examination.
		40	20	Internal evaluation	Mid-term Lab Tests in lab experiments/ drawing/Job works and Record.
			15	Internal evaluation	Continuous Viva Voce evaluation.
			5	Attendance.	
3	Dissertation work **SEMESTER**-IV	100 %	300	Internal evaluation	Two Status reports and two seminars in first **SEMESTER**-50 marks Two Status reports and

				External evaluation	two seminars in second **SEMESTER**-50 marks Final report – 100marks Viva-voce – 100 marks

*Note:

1. For pure Theory & pure Lab courses follow the above Evaluation.
2. For Combined Theory & Lab courses follow the proportion ruleas given below:

a) 3-0-2 nature Theory Credits & Lab Credits are in 3:1 ratio Hence the Internal marks evaluated for Theory & Lab as above to be divided in the ratio 3:1 and clubbed.

b) 3-1-2 nature Theory & Lab credits are in 4:1 ratio. Hence the Internal marks evaluated for Theory & Lab as above to be divided in the ratio 4:1 and clubbed.

The performance of the candidate in each **SEMESTER** shall be evaluated course wise, with a maximum of 100 marks for pure Theory courses and 100 marks for theory and practicals, on the basis of continuous Internal Evaluation and **SEMESTER** end comprehensive Examination.

Evaluation of Dissertation

Every candidate shall be required to submit dissertation after taking up a topic approved by the Department /University.

- A DAC consisting of HOD and Supervisor shall monitor the progress of the dissertation.
- The duration of the dissertation shall be two **SEMESTER**s. The candidate shall submit dissertation with the approval of DAC at the end of 4th**SEMESTER**.
- A candidate shall be allowed to take viva voce examination only after completion of all the course papers. The Viva-voce examination may be conducted once in two months for all the candidates submitted during that period.
- Three copies of the dissertation in the prescribed format certified by the supervisor & HOD shall be presented to DAC. One copy which is sent to the examiner will be forwarded to the dept. library after adjudication and one copy to the supervisor.
- Besides the supervisor, one senior faculty from the Department of English will adjudicate the dissertation.
- If the report of the examiner is favorable, Viva-voce examination shall be conducted by a board consisting of the Supervisor, HOD and an external examiner. The board shall jointly report on candidate’s work based on the total marks obtained in dissertation through both internal evaluation and external evaluation.

If the report of the Viva-voce is not satisfactory the candidate will retake the Viva-voce examination after three months.

25.0 RUSTICATION

A Student may be rusticated from the University on disciplinary grounds based on the recommendations of a committee constituted by theVice Chancellor.

26.0 AWARD OF DEGREE

A candidate shall be eligible for the award of respective degree if he satisfies the minimum academic requirements in every course and secures 'satisfactory' or higher grade in the courses/report on his Dissertation/dissertation and viva-voce.

- For the award of M.Tech degree a student must have earned stipulated credits (as approved by respective B.O.S) and obtained a minimum CGPA of 5.50.
- M.Tech Degree with Second class will be offered to those having CGPA<6.5
- M.Tech Degree with First class will be offered to those having CGPA≥6.5
- And first class with distinction will be offered to those having CGPA≥7.5 provided the student has cleared all the courses in first attempt within the stipulated time.

With – Holding of Results

If the candidate has not paid dues to the University or if any case of in-discipline is 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.

DEPARTMENT OF BIOTECHNOLOGY
M-TECH COURSE STRUCTURE WITH SYLLABUS

DEPARTMENT OF BIOTECHNOLOGY				
S.No	**Course Code**	**Course Title**	**L-T-P**	**Credits**
		SEMESTER -1		
1	12BT501	Mathematics and Biostatistics	4-0-0	4
2	12BT502	Biochemical Reaction Engineering	3-1-2	5
3	12BT503	Molecular biology and rDNA Technology	3-0-2	4
4	12BT504	Applied bioinformatics	3-1-2	5
5	12BTE531	Food Biotechnology(Elective-1)	3-0-0	3
6	12BTE530	Medical Biotechnology(Elective-2)	3-0-0	3

7	KLUC501	Seminar	0-0-4	2
	Total Credits			26
SEMESTER -2				
1	12BT505	Plant and Animal Biotechnology	3-1-2	5
2	12BT506	Immuno technology	3-0-2	4
3	12BT507	Bioreactor modeling and simulation	4-0-0	4
4	12BT508	Down stream Processing	3-0-2	4
5	12BTE534	Stem cell Technology(Elective-3)	3-0-0	3
6	12BTE533	Molecular modeling and drug design(Elective-4)	3-0-0	3
7	KLUC502	Term paper	0-0-4	2
	Total Credits			25
SEMESTER -3				
1	14TM602	Internship		18
	Total Credits			18
SEMESTER -4				
1	BTCT02			18
Total Credits				18
Total Course credits				**87**

MATHEMATICS & BIOSTATISTICS

Course Code: 12BT501 **L-T-P: 4-0-0**
Prerequisites: Nil **Credits: 4**

Syllabus

Numerical Methods Solutions of algebraic & transcendental equations - Bisection Method,New-Raphson Method, Solution of linear simultaneous equations, Simpson’s rule, Trapezoidalrule.

Linear-Differential equation:1st order differential equations, solutions of 1st order, variableseparable, homogeneous equation linear and enact equations. Linear differential equations ofhigher order with constant co efficient. Rules for finding complementary function and particularintegral.

Presentation of data & Measures of central tendency-Frequency distribution, graphicalpresentation of data by histogram, frequency curve and cumulative frequency curves. Mean,medium, mode, and their simple properties (without derivation), range, mean deviation, standarddeviation and coefficient of variation.

Correlation, Regression and Tests of significance- Simple correlation and regressioncoefficients and their relations. Limits of correlationcoefficient, effect of change of origin andscale on correlation coefficient, Linear regression and equations of line of regression, associationand independence of attributes. Paired and unpaired t-test for correlation and regressioncoefficient. T-test for comparison of variances of two populations. Chi-square testindependence
of attributes, goodness of fit, and homogeneity of sample.

Experimental designs- Principles of experimental design, completely randomized design,randomized block design and Latin square design. Analysis of variance (ANOVA) and its use inthe analysis of RBD. F-test.

Recommended Text Books:

1. Norman T.J. Bailey, Statistical methods in biology (3rd edition), Cambridge University
2. Press(1995).
3. Bernard Rosner, Fundamentals of Biostatistics, 5th edition, Thomson Brooks/ Cole, 2000.
4. Higher engineering mathematics by B.S Grawel

Reference Text Books:

1. S.C.Gupta and V.K. Kapoor – Fundamentals of Mathematical Statistics, 9th Extensively
2. revised edition, Sultan Chand & Sons, 1999.
3. Advanced Engineering Mathematics, Michael D.Greenberg, Pearson Education.
4. Advanced Engineering Mathematics by Ervin Kreyszic.
5. Higher engineering mathematics by Bird john

BIOCHEMICAL ENGINEERING

Course Code: 12BT502 **L-T-P: 3-1-2**
Prerequisites:Nil **Credits:5**

Syllabus

Introduction to Biochemical reactions : Types of reactions (Simple stepwise and Parallel) andtheir applications in fermentations, reaction rates, kinetics of homogenous reactions,molecularity and order of reaction and temperature dependency of reaction rate.

Design and Operation of Bioreactors : Mass transfer aspect, Bioreactor types and design,Continuous stirred tank bioreactors, fed batch bioreactors, airlift bioreactors, Fluidised bedbioreactor, Bioreactors for plant and animal cell, scale up of bioreactor using constant p/v andconstant KLa

Mass Transfer in Bioprocess Operation : Mass transfer by diffusion, Theories of Diffusionalmass transfer film theory, Penetration theory, Surface renewal theory Mass transfer byconvection, Gas-liquid mass transfer, correlation for mass transfer coefficient, measurement ofKLa, O2 transfer, methodology in fermenters, specific oxygen uptake rate, critical oxygenconcentration, maximum cell concentration.

Heterogeneous reactor systems : Classification of reaction systems, (homogenous,heterogeneous), mass transfer consideration in heterogeneous systems, Intra particle diffusionand reaction rates, Effectiveness factor and Thiele modules, observed Thiele modules, criterionfor mass transfers limitations.

Non-ideal flow in bioreactors: Reasons for non-ideality, RTD studies (F-Curve, C-Curve forideal and non-ideal CSTR and plug flow reactors), mean and variance of residence time,conversion using tracer information, modeling of non-ideal flow behavior by dispersion model.

Recommended Text Books:

1. Introduction to Biochemical Engineering by D.G.Rao
2. Biochemical Engineering fundamentals by Bailey and Oliss

Reference Books:

1. Bioprocess Engineering Principles by Pauline and Doran

MOLECULAR BIOLOGY & R-DNA TECHNOLOGY

Course Code: 12BT503 **L-T-P: 3-0-2**
Prerequisites: Nil **Credits: 4**

Syllabus

DNA Structure &Replication: Structure of DNA:-Watson & Crick's model, Types of DNA,Denaturation and renaturation Kinetics, Replication of DNA- Semi conservative, bi-directionalreplication. DNA damage and repair: Types of DNA damages- deamination, alkylation,pyrimidine dimmers; Repair Mechanisms-Excision, mismatch and SOS repair, Recombination:Homologous and non homologous; **rec** gene and its role in DNA repair.

Transcription And Translation: Structure of Promoters-RNA Polymerases of Prokaryotic andEukaryotic Organism; Transcription- Initiation, Elongation and Termination; Prokaryotic &Eukaryotic transcription; Post Transcriptional Processing of Eukaryotic RNA. Translation inprokaryotic and Eukaryotes: initiation of translation, elongation of polypeptide chain,termination of translation. Post-translational modifications.

Regulation of Gene Expression : Regulation of Gene expression in bacteria- Operon concept,***lac, trp, ara*** operons. Control of gene expression by sigma factor and post transcriptional control.Absolute control by antisense RNA's; enhancers, upstream controlling elements, structuralMotifs of transcription factors: helix turn, zinc finger motifs, leucine zippers and homeotic genes.

Enzymes And Vectors In Cloning : Restriction Enzymes; DNA ligase, Alkaline phosphatase;Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA:Nick translation, Random priming, Radioactive and non-radioactive probes, Hybridizationtechniques: Northern, Southern, Colony hybridization & FISH, Plasmids; Phagemids; Cosmids;Shuttle vectors, Artificial chromosome vectors (YACs; BACs); Expression vectors: Baculovirusand pichia vectors system; Plant based vectors: Ti and Ri vectors, Construction of cDNA andgenomic libraries; cDNA and genomic cloning; Expression cloning; Yeast two hybrid system;Phage display.

PCR, Sequencing & RNA Technologies : Primer design; Fidelity of thermostable enzymes;DNA polymerases; Types of PCR; PCR Applications Sequencing methods; Enzymatic DNAsequencing; Chemical sequencing of DNA; Automated DNA sequencing; Introduction tosiRNA; siRNA technology; Micro RNA; Principle and application of gene silencing; Geneknockouts and Gene Therapy; knockout mice; Disease model; Transgenics; Differential geneexpression and protein array.

Text Books:

1. Fundamentals of Molecular Biology by Avinash & Kakoli Upadhyay; Himalaya

Reference Books:

1. Current protocols in Molecular biology; Wiley Publishers.

APPLIED BIOINFORMATICS

Course Code: 15BT504 **L-T-P: 3-1-2**
Prerequisites:Nil **Credits:5**

Syllabus

Comparative Genomics Genetic mapping, Physical mapping, SNPs, ESTs, GSS, Gene prediction methods, Geneprediction tools, Gene annotation, Molecular Predictions with DNA sequence, Human GenomeProject.

Protein Structure Prediction and Evaluation methods

Structure of Protein – PDB, MMDB; Ramachandran Plots; Structure visualization – Rasmol;Methods of Structure prediction – Homology modeling - SPDBV, Threading, Ab-initio method;Structure Evaluation – DSSP, ProCheck, Verify 3D; Structure comparison.

Protein Identification And Interactions

Proteomics approaches for protein analysis; Protein identification Programs – Mascot, GFS;Comparative Proteomics methods; Protein interactions; Protein Interaction dbs – GRID, MINT;Network Mapping; Biological Pathway dbs – EcoCyc, KEGG; Pathway prediction; Metabolicpathway reconstruction.

Gene Expression Analysis

Introduction; Serial Analysis of Gene Expression; Microarray, Types of Microarrays, MicroarrayFabrication, Microarray hybridization and detection, Microarray Image Processing and analysis,Expression ratios, Transformations of the Expression ratio, Data Normalization.

System Biology

Foundations of System Biology- Objectives of System Biology-Strategies relating to In SilicoModeling of biological processes- Metabolic Networks- Signal Transduction pathways, GeneExpression patterns – Applications of System Biology Markup Language (SBML), E-cell, V-cellsimulations and Applications

Recommended Text Books:

1. G. Gibson and SV Muse, A Primer of Genome Science, Second Edition – Sinauer Associates, Inc.
2. CW Sensen, Essentials of genomics and Bioinformatics, Wiley-VCH publication.

Reference Text Books:

1. Speed T. (ed.) Statistical analysis of gene expression microarray data (CRC, 2003)

PLANT AND ANIMAL BIOTECHNOLOGY

Course Code: 12BT505 **L-T-P: 3-1-2**
Prerequisites: Nil **Credits: 5**

Syllabus

Introduction & Overview

Introduction & Historical Overview of Plant Tissue Culture, Totipotency, Growth &Cytodifferentiation of Cultured Plant Tissues Nutritional Media- Obligatory & OptionalConstituents, Growth Regulators. Concept of sterilization and aseptic technique, IncubationSystems: Light & Dark, Static & Agitated, And Problems in Plant Tissue Culture:Contamination, Phenolics, Recalcitrance and Seasonal variation.

Micro Propagation and Secondary Metabolites

Homozygous Plant Production through Anther Culture. Callus & Suspension Culture Systemsand Organogenesis: Direct & Indirect- Basic aspects, Somatic Embryogenesis, Somaclonal &Gametoclonal Variation. Plant Secondary Metabolites: Commercial Production using appropriatemedia supplements (Elicitors, Growth Factors, Stress Factors, Precursors, Anti-metabolites andDefense Proteins.

Gene Transfer Techniques and Applications

Gene transfer methods (Direct and Indirect), current status and limitations. Agro bacteriummediated genetic transformation and application in crop improvement. Herbicide, stress anddisease resistant plants and callus/cell line selection for resistance. Applications of Plant Tissueculture.

Animal cell culture

Basic requirements for animal cell culture; Cell culture media and reagents; Animal cell, tissueand organ cultures; Primary culture, secondary culture; Continuous cell lines; Suspensioncultures; Somatic cell cloning and hybridization. Transfection and transformation of cells;Commercial scale production of animal cells; Stem cells and their application; Application ofanimal cell culture, for in vitro testing of drugs; Testing of toxicity of environmental pollutants incell culture; Application of cell culture technology in production of human and animal vaccinesand pharmaceutical proteins.

Animal Reproductive Biotechnology

Culture of embryos; Micromanipulation of animal embryos; Cryopreservation of embryos;Embryo transfer; Embryo-splitting; Embryo sexing; Transgenic animal technology and itsdifferent applications; Animal viral vectors; Animal cloning- basic concepts; Cloning fromembryonic cells and adult cells; Ethical, social and moral issues related to cloning. Introductionto animal genomics; Different methods for the characterization of animal genomes, SNP, STR,QTLS, RFLP, RAPD, Genetic basis for disease resistance; Biocrimes and Bioterrorism.

Recommended Text Books:

1. Experiments in Plant Tissue Culture (Dodds, J.H. and Roberts, L.W.) 1985.
2. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, OUP, 2000.
3. Ed. Martin, Clynes Animal Cell Culture Techniques, Springer, 1998.
4. Plant Tissue Culture methods and application in agriculture (Thorpe, T.A.) 1981;

Reference Books:

1. An Introduction to Plant Tissue Culture.MK Razdan.2nd Ed.2003. Oxford and IBH.
2. Plant Biotechnology by C.Chawla.2004.Oxford and IBH.
3. Animal Cell Biotechnology. Portner, 2nd Edition, Humana Press, 2007.

4. Plant Biotechnology and its applications in Plant tissue culture by Ashwani Kumar and ShikhaRoy.

IMMUNO TECHNOLOGY

Course Code :12BT 506 **L-T-P: 3-0-2**
Prerequisites: Nil **Credits: 4**

Syllabus
Immune system overview, innate and acquired immune system. Components of immunesystem.Phagocytosis; Inflammation, opsonization. Primary and secondary lymphoid organs.Complement. B cell, T cell ontogeny. Characteristics of antigen, T cell dependent andindependent antigens and Super antigens. Types and applications of Hapten and Adjuvant.

Immune response
Generation of immune response - Primary and Secondary immune responses. Structure,functions of antibody and BCR.. Generation of Antibody diversity. TCR structure, δγTCR. MHCI and II gene, polymorphism. T helper, T cytotoxic cells. MHC peptide interaction. Antigenpresentation, secondary signaling.

Immunological disorders
Immunological disorders; Hypersensitivity and autoimmune diseases. Immune response to viraland bacterial lymphatic infection. Kinetics of immune response. Techniques in humoral andcellular immunology.

Immunotechnology
Animal models and transgenic animals and their use in immunology. Experimental immunology.Hybridoma technology. Chimeric antibodies, phage display, antibody engineering; Large scalemanufacture of antibodies. Manufacturing of immunodiagnostics.

Disease diagnosis and Vaccines
Concept of vaccination & Vaccine development. Strategies for development of vaccines againstdreadful diseases – malaria, tuberculosis, HIV. Diagnostic tools and Kit developmenttechnology.

Recommended Text Books:

1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002.
2. Janeway et al., Immunobiology, 4th Edition, Current Biology publications., 1999.

Reference Books:

1. Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower MedicalPublishing, 2002.
2. Paul.W.E, Fundamental of Immunology, 4th edition, Lippencott Raven.

BIOREACTOR MODELING AND SIMULATION

Course Code: 12BT 507 **L-T-P: 4-0-0**
Prerequisites: Nil **Credits: 4**

Syllabus

Fundamentals of Modeling

Different approaches towards modeling, (Empirical and Modeling approach), applications andadvantages of modeling and simulations, general flow diagrams for model building, simulationtools (Berkeley-Madonna, Mat Lab- Simu Link)

Enzymes and growth kinetic models

Michaelis-Menten equation, graphical determination of Km and Vmax, Double MichaelisMenten kinetic model, inhibition models (Competitive, Non-Competitive, Uncompetitive,Deactivation Kinetics models) Monad growth kinetics model, equation for inhibition of growth,Product inhibition, , Teisser equation for growth, Contoin equation, Moses equation for growthmodels.

Modeling of batch cultures

Unstructured growth models, structural kinetic model, metabolic models for batch cultures.

Product formation Kinetics

Product formation kinetic models, unstructured models, chemically structured models,genetically structured models.

Case studies of simulations

Programme for simulation of Batch fermentation, continuous fermentation, steady state and fedbatch fermentation.

Recommended Text Books:

1. Biological reaction Engineering- J.J.Dunn, E.Heinzle, J.Ingham, J.E.Presnosil
2. Biochemical Engineering fundamentals- James.E.Bailey and David.F.Ollis, TMH Edition
3. Franks.R.G.E (1973), Modeling and simulation in chemical Engineering, Wiley, NY

Reference Books:

1. Modeling and simulation in Biochemical Engineering. Adv, Biochemical Engineering, 3, 127-165
2. Hanm, B, Ruth. B (1997) Modeling dynamic biological systems, Springer-Verlag, NY.

DOWN STREAM PROCESSING

Course Code: 12 BT 508 **L-T-P: 3-0-2**
Prerequisites:Nil **Credits:4**

Syllabus

Down Stream Processing In Biotechnology
Overview of bioseparations, Characterization of Biomolecules, characterization of Bioprocess,characterization of fermentation broth: Morphology of cells, structure of the cell wall, productconcentrations, Biomass density, Rheological Behavior of fermentation broth.
Primary Separation and Recovery Processes : **Recovery of intracellular products:** Celldisruption methods-physical methods (osmotic shock, grinding with abrasives, solid shear, liquidshear) – chemical methods (alkali, detergents)- enzymatic methods.
Removal of suspendedsolids:
Foam separation, filtration. Filtration equipment, centrifugation, tubular bowl centrifuge,disk. Bowl centrifuge, basket centrifuge, scale up of centrifuges.
Product Enrichment Operations : Membrane based separations – Classification &characteristics of membrane separation, merits of the process. Micro filtration, ultra filtration,Reverse osmosis, dialysis & electro dialysis. Selection of membrane, operational requirementsof membrane. Retention coefficient, concentration factor, permeate yield & solid yield inmembrane separation processes. Membrane modules: Plate & Frame, hollow fiber, spiral wound,shell & tube, cross flow micro filtration.
Aqueous two-phase extraction process: Applicationsof aqueous two-phase extraction, reversed micelles extraction principle, micellar structures,critical micelle concentration. Protein solubilization, limitation of reversed micelles.Precipitations of proteins with salts and organic solvents, kinetics of protein aggregation.
Product Purification : Chromatographic Separations: Classification of chromatographictechniques, column chromatography, elusion frontal displacement techniques, partitioncoefficient, retention time and volume, capacity factor, column efficiency, design and scale up ofchromatography. Principles & practices of Gel Filtration, Ion Exchange and Affinitychromatography.
Alternative Separation Methods and Product Polishing
Super critical extraction: principles of SCE, Flow scheme of a simple SCE system.
Formulationstrategies: Importance of formulation, formulation of beakers yeast, Enzymes, formulation ofpharmaceutical products.
Polishing: Crystallization, Principles of crystallization and equipment.Principles of drying and lyophilization, Freeze dryer.

Recommended Text Books:

1. Butterworth and Heinmann. Product recovery in bioprocess Technology-Biotol series,
2. B.Siva Sankar. Bioseperations

Reference Books:

1. Harvey Blanch. Biochemical Engineering
2. Christie J.Geankoplis., Transport processes and **UNIT** operations

MEDICAL BIOTECHNOLOGY

Course Code: 12 BTE530 **L-T-P: 3-0-0**
Prerequisites:Nil **Credits:3**

Syllabus

Introduction to medical technology

Introduction and applications of medical Biotechnology. Artificial organs – methods andproduction principles. Artificial pancreas, Liver and Heart. Therapeutic proteins: Production ofinterferons, cytokinins, insulin etc.

Medical diagnosis

Immunodiagnostic techniques: monoclonal antibodies production as diagnostic reagents;Diagnosis by ELISA and Western blot. DNA sequencing and diagnosis. PCR and Array basedtechniques in diagnosis; Present methods for diagnosis of Specific diseases like Tuberculosis,Malaria and AIDS; ethics in Molecular Diagnosis

Gene transfer technology

Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquireddiseases for gene therapy, Retro and adeno virus mediated gene transfer. Liposome andnanoparticles mediated gene delivery Cellular therapy.

Stem cell technology

Stem cells; definition, properties and potency of stem cells; Sources; embryonic and adult stemcells; Concept of tissue engineering; Role of scaffolds; Role of growth factors; Role of adult andembryonic stem cells. Clinical applications; Ethical issues.

Hybridoma technology

Hybridoma techniques and monoclonal antibody production. Production, purification,characterization and applications of monoclonal antibodies. Antibody engineering – chimericantibody, diabody.

Recommended Text Books: (Latest Edition):

1. F.C. Hay, O.M.R. Westwood, Practical Immunology, 4th Edition-, Blackwell Publishing, 2002
2. Pratibha Nallari, V. Venugopal Rao; Medical Biotechnology, oxford University press, 2010.

Reference Books:

1. James W. Goding , Monoclonal antibodies; Principles and Practice , 3rd Edition , AcademicPress 1996.
2. George Patrinos and Wilhelm Ansorage, Molecular Diagnostics, 1st Edition , Academic Press,2005.

STEM CELL TECHNOLOGY

Course Code: 12 BT E54 **L-T-P: 3-0-0**
Prerequisites:Nil **Credits:3**

Syllabus

Introduction

What are stem cells, types, origin and nature of stem cells? Characteristic features, pluripotentstem cells and its types, Molecular basis of pluripotency. Cell surface markers of stem cells.Embryonic stem cells, factors requirements for maintain stem cells. Differences between humanand mouse stem cells. Development of epithelial stem cell concept. Stem cell niches.

Stem cell characterization

Cell cycle regulation in stem cell. Mechanism of stem cell renewal, Changes of phenotypiccharacters, Characterization of human embryonic stem cells, Isolation and maintenance of Stemcell. Genetic manipulation of Embryonic Stem cell, homologous recombination of stem cells.Surface antigenic markers, lineage marking, Genomic reprogramming. Microarray analysis ofstem cells & differentiation. Zebra fish and Stem cell research.

Tissue engineering

Neural stem cells and applications in neurodegenerative diseases, Treatment of heart diseases,diabetes, burns & skin ulcers, muscular dystrophy, regeneration of epidermis, orthopedicapplications. Embryonic applications in tissue engineering. Novel sources of multipotent stemcells. Adult stem cells, Stem cell gene therapy.

Biopharming

What is biopharming? Applications of stem cell technology in animal biotechnology. Productionof artificial organs using stem cell technology. Artificial pancreas, kidney, heart, liver etc.

Regulations and Ethics

Ethics of human cell research-immortal cells and moral selves, Ethical considerations, stem cellbased therapies. FDA products and preclinical regulatory considerations. Patent advocacy,Science policies, ethics in stem cell research, primordial germ cells and germ cell developmentepigenetics and reprogramming in stem cell biology, norms in clean room.

Recommended Text Books:

1. Rober Lanza, Essentials of Stem cell biology, Elsevier academic press, 2009
2. Joseph D. Bronzino Tissue engineering and artificial organs, Biomedical engineering hand book.volume -2, 3rd edition, CRC press, Taylor & Francis publications, 2006

Reference Book:

1. Daniel R. Marshak, Stem Cell Biology, *Johns Hopkins University and Cambrex Corp.;* Richard L. Gardner, *University of Oxford;* David Gottlieb, *Washington University, St. Louis*, 2001.

MOLECULAR MODELING AND DRUG DESIGN

Course Code: 12 BT E533 **L-T-P: 3-0-0**
Prerequisites: Nil **Credits: 3**

Syllabus

Empirical Force Fields and Molecular Mechanisms

Models, Approximations and Reality, Force Field concepts and Mathematical Expressions,Molecular Mechanical and Quantum Mechanical Force Fields, Parameterization, Generation ofPotential energy surfaces. Bond Stretching, Angle bending, Torsional I terms, Out of plane,Bonding Motions, Electrostatic interactions, Vander Walls interactions, Effective pair potentials,Hydrogen Bonding, Simulation of liquid water.

Computer Simulation Methods

Time averages, Ensemble averages, Free energy methods, Thermo dynamic PerturbationMethods, Thermodynamic Integration Methods. Calculation of thermodynamics properties.Phase space; Practical aspects of computer simulation; Boundaries monitoring Equilibrium;Long range process; Analyzing results of simulation and estimation errors.

Molecular Dynamics Simulation Methods

Molecular Dynamics using simple modules; Molecular Dynamics with continuous potentials;Running Molecular Dynamics Simulation; Constant Dynamics; Time dependent properties;Molecular Dynamics at constant temperature and pressure.

Monte Carlo Simulation Methods

Metropolis methods; Monte Carlo simulation of molecules; Monte Carlo simulation of Polymers;Calculating Chemical potentials; Monte Carlo simulation and molecular dynamics.

Molecular Modeling In Drug Discovery

Molecular modeling in drug discovery-Deriving and using 3D Pharma cores, Molecular dockingStructure Based methods to identify lead components-Denovo ligand design. QSARs andQSPRs, QSAR Methodology, Various Descriptors used in QSARs: Electronic; Topology; Quantum Chemical based Descriptors

Recommended Text Books:

1. Molecular Modeling Principles and Applications- AR Leach, Longman, 1996.
2. Molecular Dynamics Simulation-Elementary Methods- John Wiley and Sons, 1997.

Reference Books:

1. Current Protocols in Protein Science, Wiley Publishers, 2005; Deuflhard P., et al.
2. Computational molecular dynamics - Challenges, methods, ideas.(Springer,1999)

FOOD TECHNOLOGY

Course Code: 12BTE531 **L-T-P: 3-0-0**
Prerequisites:Nil **Credits:3**

Syllabus

Food associated Microbes

History of microorganisms in food, historical developments. Biotechnology in relation to thefood industry, nutritive value of food, types of microorganism's associated with food, its sources,types and behavior in foods. Role and significance of microorganisms in food. Intrinsic andextrinsic parameters of foods that affect microbial growth.

Food processing

Bioprocessing of meat, fisheries, vegetables, diary product, enzymes and chemicals used in foodprocessing, biochemical engineering for flavor and food productions. Emerging processing andpreservation technologies for milk and dairy products.

Food preservation

Food preservation using irradiation, Characteristics of Radiations of interest in food preservation.Principles underlying the destruction of Microorganisms by irradiation, processing of foods forirradiation. Application of radiation, Radappertization, Radicidation, and Radurization of foods.Legal status of food irradiation. Effect of irradiation of food constituents.

Storage of foods

Stability of food preservation with low temperatures, high temperatures, drying. Indicator andfood borne pathogens. Food borne illness, quality control, HFCS (High Fructose Corn Syrup)and mycoproteins. Air sampling, metabolically injured organisms, enumeration and detection offoodborne organisms.

Food microbiology

Utilization of microorganisms in food industries, genetic manipulations. Thermophiles andRadiation-resistant microorganisms, characteristics and growth of thermophilic microorganisms,Nature of Radiation resistance in microorganisms. Rheology of food production.

Recommended Text Books:

1. Lidsay, Willis Biotechnology, Challenges for the flavour and food industries, Elsevier Applied Science. 1988.
2. Food Science and Food Biotechnology by F.F.G. Lopez & G.V. B. Canovas (2003), CRC Press, Florida, USA.

Reference Books:

1. George J.B. Basic Food Microbilogy, CBS Publishers & Distributors, 1987.
2. Roger, A., Gordan B., and John T. Food Biotechnology, 1989.

DEPARTMENT OF CIVIL ENGINEERING
M-TECH COURSE STRUCTURE WITH SYLLABUS

M.TECH- STRUCTURALENGINEERING

FirstYear [FirstSEMESTER]						
SNo	**Code**	**CourseTitle**	**L**	**T**	**P**	**Cr**
1	11CE501	Applied Mathematics	3	2	0	4
2	11CE502	Theoryof Elasticity	3	2	0	4
3	11CE503	Structural Dynamics	3	0	2	4
4	11CE504	Advanced Prestressed Concrete	3	0	2	4
5	11CE531	REPAIR AND REHABITAITON OF STRUCTURES	3	0	0	3
6	11CE541	GEO TECHNICAL EARTH QUAKE ENGINEERING	3	0	0	3
7	11CE551	Seminar	0	0	4	2
		Total Credits:				24

FirstYear[SecondSEMESTER]						
SNo	**Code**	**CourseTitle**	**L**	**T**	**P**	**Cr**
1	11CE601	Finite Element Analysis	3	0	2	4
2	11CE602	BridgeEngineering	3	2	0	4
3	11CE603	EarthquakeResistant Design of Structures	3	0	2	4
4	11CE604	Theoryof Plates and Shells	3	2	0	4
5	11CE631	INDUSTRIAL STRUCTURES	3	0	0	3
6	11CE643	GREEN BUILDINGS	3	0	0	3
7	11CE651	Term Paper	0	0	4	2
		Total Credits:				24

SecondYear						
SNo	**Code**	**CourseTitle**	**L**	**T**	**P**	**Cr**
1		DISSERTATION	0	0	72	36
		Total Credits:				36

APPLIED MATHEMATICS

CourseCode : 11 CE 501 **L-T-P:3-2-0**
Prerequisite: Nil **Credits: 4**

Syllabus

OneDimensional Wave andHeatEquations

Laplacetransformmethodsforone-dimensionalwaveequation–Displacementsinalongstring –longitudinalvibrationofanelasticbar–Fouriertransformmethodsforone-dimensionalheat conduction problems in infinite and semi-infinite rods.

EllipticEquation

Laplaceequation–Propertiesofharmonicfunctions–SolutionofLaplace'sequationbymeans ofFouriertransformsinahalfplane,inaninfinitestripandinasemi-infinitestrip –Solutionof Poisson equation byFouriertransform method.

Calculus ofVariations

Conceptofvariationanditsproperties–Euler'sequation–Functionaldependantonfirstand higherorderderivatives–Functionalsdependantonfunctionsofseveralindependentvariables– Variational problems with movingboundaries –Direct methods– Ritzand Kantorovichmethods.

Eigen ValueProblems

Methods of solutions: Faddeev–LeverrierMethod, Power Methodwith deflation– Approximate Methods: Rayleigh–RitzMethod

Numerical Integration

GaussianQuadrature–OneandTwoDimensions–GaussHermiteQuadrature–MonteCarlo Method – MultipleIntegration byusingmappingfunction

Text Books:

1. Introduction to Partial Differential Equations byK. SankaraRao, PrenticeHall of India Pvt.Ltd., New Delhi, 1997.
2. Numerical Methods in Scienceand Engineering A Practical Approach by S. Rajasekaran, A. H. Wheeler and CompanyPrivateLimited, 1986.
3. Calculus of Variations with Applications byA.S.Gupta, PrenticeHallof India Pvt. Ltd., New Delhi, 1997.
4. IntegralTransformsforEngineersbyL.C.AndrewsandB.K.Shivamoggi,PrenticeHall ofIndia Pvt.Ltd., New Delhi, 2003.

THEORY OFELASTICITY

CourseCode:11 CE 502 **L-T-P:3-2-0**
Prerequisite: Nil **Credits: 4**

Syllabus

Two-dimensional problems inrectangular coordinates

Planestress;Planestrain;Differentialequationsofequilibrium; Boundaryconditions;Compatibilityequations;Stress function; Governingdifferentialequation; Solution by Polynomials;Endeffects–Saint-Venant'sPrinciple;Determinationofdisplacements;Bending ofa cantilever loadedat the end; Bendingof abeam byuniform load

Two-dimensional problems in polar coordinates

Generalequationsinpolarcoordinates;Stressdistributionsymmetricalaboutanaxis;Effectof circular holes on stress distribution in plates; Concentrated force at a point of a straight boundary;Concentratedforceacting ona beam;Stressesinacirculardisc,generalsolutionsof the two dimensionalproblem inpolarcoordinates, applications ofthegeneralsolutionsinpolar coordinates.

Strainenergymethods

Totalstrainenergy;Principleofvirtualwork;Griffith'stheoryofrupture;Castigliano'stheorem;Principle of least work (Stationary potential energy), applications of the principle of least work rectangular plates, shear lagAnalysisofstress andstraininthreedimensions Stressatapoint–components of stress; Principalstresses;Stressellipsoidandstressdirectorsurface;Determinationofprincipalstresses;Stressinvariants;Determinationofmaximumshearstresses;Octahedralshearstress;strainatapoint–Components of strain;differentialequations of equilibrium, the principle ofsuperposition

Torsion

Torsion of straight bars–SaintVenant'stheory;Ellipticcrosssection;Membraneanalogy; Torsionofabarofnarrowrectangularcross-section;Torsionofrolledprofilesections;Torsion ofthin tubes

Text Books:

1. Theoryof ElasticitybyTimoshenko, S. and GoodierJ.N., McGraw HillBook Co., Newyork,1988.

Reference Books:

1. Sadhu Singh, "TheoryofElasticity", KhannaPublishers, New Delhi1988.
2. Hearn,E.J. "Mechanics of Materials", Vol.2, Pergamon Press, Oxford,1985
3. Irving H.Shames andJames, M.Pitarresi, "Introduction to Solid Mechanics", PrenticeHallofIndiaPvt.Ltd.,NewDelhi-2002.

STRUCTURAL DYNAMICS

CourseCode: 11 CE 503 **L-T-P:3-0-2**
Prerequisite: Nil **Credits: 4**

Syllabus

EquationofMotions,ProblemStatement,SolutionMethodsofSingleDegreeofFreedom Systems(SDOF):Basicconceptsofstructuraldynamics;singledegreeoffreedomsystem, forcedisplacementrelationship,dampingforce,equationofmotion,mass-spring-dampersystem, methods of solution of differential equation.

FreeVibration (SDOF): Undamped freevibration, viscouslydampedfreevibration, energy in freevibration.

ResponsetoHarmonicandPeriodicExcitations(SDOF):Harmonicvibrationofundamped systems,Harmonicvibrationwithviscousdamping,responsetovibrationgenerator,natural frequencyanddampingfromharmonictest,forcetransmissionandvibrationisolation,vibration measuringinstruments, energydissipated in viscous damping. Responsetoperiodic force. ResponsetoArbitrary, Step And Pulse Excitations (SDOF): Responseto UNIT Impuse, response to arbitrary force, step force, ramp force, response to pulse excitations, solution methods, effects of viscous damping.

Numerical Evaluationof DynamicResponse(SDOF): Time steppingmethods, methods basedoninterpolationofexcitation,centraldifference method,newmark'smethod,stability and computationalerror,analysisofnonlinearresponseby newmark'smethod.EarthquakeResponse toLinear Systems (SDOF)

Earthquakeexcitation,equationof motion,response quantities,response history,response spectrumconcept,deformation,pseudo-velocity andpseudoaccelerationresponsespectra,peak structural responsefromthe response spectrum, response spectrumcharacteristics,elasticdesign spectrum, comparisonand distinctionbetween design and response spectra.

GeneralisedSingleDegreeofFreedom Systems:GeneralisedSDOF systems,rigidbody assemblages,systemswithdistributed mass andelasticity, lumped masssystem-shear building, natural vibration frequencybyRayleigh'smethod.

Multi-degree offreedom systems(MDOF) :Equationof motions:simplesystem-twostorey shear building,generalapproachfor linear systems,staticcondensation,symmetric plansystems: groundmotion. Multiplesupport excitation, methods of solvingthe equation ofmotions.

FreeVibration(MDOF):Naturalfrequenciesandmodes:systemswithoutdamping,modal andspectralmatrices,orthogonality ofmodes,normalizationofmodes.Solutionofundamped freevibration systems, solution methods for eigenvalue problem.

TextBooks:

1. DynamicsofstructuresbyAnilKChopra;Prentice-HallofIndiaLimited,NewDelhi.3rd edition 2006.
2. Dynamics of Structures byR.W. Clough and P.E.Penzien, McGraw-Hill. 1st edition 1975

Reference Books:

1. Structural Dynamics forStructural Engineers byG. C. Hart & K. Wang;JohnWiley&Sons. 1st edition 1991
2. Structural Dynamics byMario Paz, CBS Publishers.1st edition 1991.

ADVANCEDPRESTRESSED CONCRETE

CourseCode: 11 CE 504 **L-T-P:3-0-2**
Prerequisite: Nil **Credits: 4**

Syllabus

Introduction, Prestressing Systems and MaterialProperties

Basicconceptsofpre-stressing;Historicaldevelopment;AdvantagesandTypesofPre-stressing, Pre-tensioning SystemsandDevices,Post-tensioning SystemsandDevices,NeedforHigh strengthsteelandHighstrengthconcrete;**LossesOfPrestress:**Nature of lossesof pre-stress; Lossduetoelasticdeformationofconcrete,shrinkageofconcrete,creepofconcrete,relaxation ofstress in steel, frictionand anchorageslip; Totallosses allowed forin design.

AnalysisofPrestressedMember

AnalysisofMembersunderAxialLoad:AnalysisatTransfer,AnalysisatService,Analysisfor Ultimate Strength,AnalysisofMemberunderFlexure:,AnalysisatTransferandatService, Cracking Moment,KernPoint,PressureLine,AnalysisforUltimateStrength,designloadsand strength,Calculationof Crack Width,Variationof StressinSteel,Analysisof a Rectangular Section, Analysisofa Flanged Section.

DeflectionsofPrestressedConcrete Members:

Importanceofcontrolofdeflections;Factorsinfluencingdeflections;Shorttermdeflectionsof uncrackedmembers.Long termdeflectionofcrackedmember;**TransmissionOfPre-Stress:** TransmissionofPre-stressingforceby bond;Transmissionlength;Bondstresses;Transverse tensile stresses;End zone reinforcement;Flexuralbondstressesinpre–tensionedandpost– tensioned grouted beams, stress distribution in end block, Anchorage zone reinforcements; **Shear And Torsion Resistance Of Prestressed Concrete Member:** Shear and Principal stresses;Ultimate shearresistance ofpre-stressedconcretemembers;Designofshear reinforcement,pre-stressedconcretemembersintorsion,Designofreinforcementsfor torsion, shear and bending.

DesignofPre-StressedMembers: Designofsectionsforflexure,Designof SectionsforAxial Tension,DesignofSectionsforcompressionandbending,designofpre-stressedsectionfor shearandtorsion,designofpre-stressedmemberforbond.Dimensioning offlexuralmember, design for pre-tensioning member, design of post-tensioningmembers.

CompositeConstructionofPrestressedConcrete: Compositestructuralmember,typesof compositeconstruction, analysisofstresses,differentialshrinkages, deflectionofcomposite member,flexuralstrengthofcompositesections,shearstrengthofcompositesection;**Designof ContinuousPrestressedConcreteMember:**Advantagesofcontinuousmembers,ultimateload analysisof continuous pre-stressed member, design of continuous pre-stressed concrete beams.

Text Books :(supplementedwith IS: 1343)

1. Prestressed Concrete by N. KrishnaRaju;Tata McGraw-Hill Publishing Company Limited, New Delhi.3rd edition, 1995.
2. DesignofPrestressedConcreteStructures by T.Y.Lin&NedH.Burns;JohnWiley &Sons,3rd edition, 1981.

Reference Books

1. Prestressed concretebyN. Rajagopalan; Narosa PublishingHouse.2nd edition, 2005.
2. Design of Prestressed Concrete byA.Nilson; John Willey&Sons.2nd edition, 1987

REPAIRAND REHABILITATION OFSTRUCTURES

CourseCode: 11 CE 531 **L-T-P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Syllabus

Introduction
Deterioration ofstructures with aging; Need forrehabilitation
Distress inconcrete/steel structures
Types of damages; Sources or causes fordamages;effects of damages; Casestudies
Damageassessment andevaluationmodels
Damagetestingmethods;Non-destructivetesting methods
Rehabilitationmethods
Grouting; Detailing;Imbalanceof structural stability; Casestudies
Methods ofRepair
Shortcreting; Grouting;Epoxy-cement mortar injection; Crack ceiling
Seismic Retrofitting of reinforcedconcretebuildings
Introduction;Considerations inretrofittingofstructures;SourceofweaknessinRCframebuilding–Structuraldamageduetodiscontinuousloadpath;Structuraldamageduetolackofdeformation;Quality ofworkmanshipandmaterials;Classificationofretrofittingtechniques;RetrofittingstrategiesforRCbuildings–Structurallevel(global)retrofitmethods;Memberlevel (local)retrofitmethods; Comparative analysis of methods of retrofitting

Text Books:

1. DiagnosisandtreatmentofstructuresindistressbyR.N.Raikar,PublishedbyR&DCentreofStructural Designers&Consultants Pvt.Ltd., Mumbai, 1994.
2. HandbookonRepairandRehabilitationofRCCbuildings,PublishedbyCPWD,Delhi,2002.
3. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice-HallofIndia, 2006.

GEOTECHNICAL EARTHQUAKE ENGINEERING

CourseCode: 11 CE 541 **L-T-P:3-0-0**
Prerequisite: Nil **Credits: 3**

Syllabus

Seismology andEarthquakes
Introduction,SeismicHazards,seismicwaves,internalstructureofearth,Continentaldriftand platetectonics,faults,elasticsreboundtheory,geometricnotations,locationofearthquakes,size of earthquakes.

Strong GroundMotion
Stronggroundmotionmeasurement,groundmotionparameters,estimationofgroundmotion parameters.

SeismicHazardAnalysis: IdentificationandEvaluationofEarthquakeSources,deterministic seismic hazard analysis,probabilistic seismic hazard analysis.

Wavepropagation
Waves in unbounded media, waves in a semi – infinite body, waves in a layered media, attenuation ofstress waves.

Dynamicsoilproperties: **M**easurementofdynamic soilpropertiesusingfieldandlaboratory tests(overview),stressstrainbehaviorof cyclically loadedsoils,strengthof cyclically loaded soils.

GroundResponseAnalysis
One– Dimensional Ground response Analysis–Linear and Non-Linear Approaches.

Local Site Effects: Effect of local site conditions on ground motion, design parameters, development of design parameters.

Liquefaction
Flowliquefaction,cyclicmobility,evaluationofliquefactionhazards,liquefactionsusceptibility, initiation ofliquefaction, effects of liquefaction.

Soil Improvement for Remediation of Seismic Hazards: Densification techniques, Reinforcement Techniques, Grouting and Mixingtechniques, Drainagetechniques.

Text Book:

1. Geotechnical EarthquakeEngineeringbyStevenL. Kramer, prenticeHall,1stedition, 1996.

Reference Book:

1. GeotechnicalEarthquakeEngineeringHandbookbyRobertW.Day,McGraw-Hill.2nd edition,2010.

FINITE ELEMENT ANALYSIS

CourseCode:11 CE 601 **L-T-P:3-0-2**
Prerequisite: Nil **Credits: 4**

Syllabus

Basic Principles

Equilibrium equations; Strain-displacement relations; linear constitutive relations;Principle virtual work; Principleofstationarypotential energy

ElementProperties

Differenttypesofelements;Displacementmodels;Relationbetweennodaldegreesoffreedom andgeneralizedcoordinates;Convergencerequirements;Compatibility requirement;Geometric invariance; Naturalcoordinate systems;Shapefunctions;Elementstrainsandstresses;Element stiffnessmatrix;Elementnodalload vector. Isoparametricelements– Definition, Two- dimensional isoparametric elements– Jacobian transformation, Numericalintegration

Direct Stiffness methodand Solution Technique

Assemblageofelements–ObtainingGlobalstiffnessmatrixandGloballoadvector;Governing equilibrium equation forstatic problems; StorageofGlobal stiffness matrixin banded and skyline form; Incorporation of boundary conditions; Solution to resulting simultaneous equations byGauss elimination method

Plane-stress andPlane-strainanalysis

Solvingplanestressandplane-strainproblemsusingconstantstraintriangleandfournodded isoparametricelement

Analysisofplatebending

Basictheory ofplatebending;Sheardeformationplates;Platebendinganalysisusingfournoded isoparametricelements

Text Books:

1. IntroductiontoFiniteElementsinEngineeringbyR.T.ChandrupatlaandA.D.Belegundu
2. PrenticeHallofIndia, 1997.

Reference Books:

1. Finite Element Analysis byAbel and Desai, NewAgePublishers, 2007.
2. Finite Element Analysis:Theoryand ProgrammingbyC. S. Krishnamoorthy, Tata McGraw-Hill, 1995
3. FiniteElement Procedures in EngineeringAnalysis byK.J. Bathe,PrenticeHall Inc.,1996.
4. The Finite Element Method byO.C.Zienkiewicz, and R.L.Taylor,McGraw– Hill, 1987.

BRIDGE ENGINEERING

CourseCode: 11 CE 603 **L-T-P: 3-2-0**
Prerequisite: Nil **Credits: 4**

Syllabus

I.R.C. Specifications ForRoad Bridges

Differenttypesofbridges;I.R.C.specificationsforroadbridges;**DesignOfR.CSlabCulvert:** Loadsconsidered fordesign, Design of R.C. slabculvert.

DesignofT– BeamBridge

Pigeaud'smethod for computation ofslab moments; courbon's method forcomputation of moments in girders; Design of simplysupported T-beamBridge.

DesignofSub StructureForBridges

Pierandabutmentcaps;Materialsforpiersandabutments'Designofpier;Designofabutment; Backfill behind abutment;approach slab.

DesignofBearings ForBridges

Importance of bearings; bearings for slab bridge; bearings for girder bridges; Expansion bearings;Fixedbearings;Designofelastomericpadbearing;**FoundationsForBridges:**Scour at abutments and piers; Grip length;Types of foundations; Design ofwell foundation.

CableSupportedBridge

Differenttypesofcablesupportedbridge,differencebetweensuspensionbridgeandcable stayedbridge.Differentcomponentsandfactorsconsideredfordesignofa)suspensionbridge, b) cable stayed bridge.

Text Books:

1. EssentialsofBridgeEngineering byJohnsonVictor;Oxford&IBHpublishing Co.Pvt. Ltd.2007
2. Cablesupportedbridges,conceptsanddesign by NJGimsing.JohnWilleyandSons,2nd edition

Reference Books:

1. DesignofBridgeStructuresbyT.RJagadeesh,M.AJayaram,PrenticeHallofIndia Pvt.Ltd. 2ndedition.

EARTHQUAKE RESISTANT DESIGN OFSTRUCTURES

CourseCode: 11 CE 603 **L-T-P: 3-0-2**
Prerequisite: Nil **Credits: 4**

Syllabus

Seismic-resistant building architecture

Introduction;Lateralloadresisting systems-momentresistingframe,Building withshearwallor bearing wall system, building with dual system; Building configuration – Problems and solutions;Buildingcharacteristics– Mode shapeand fundamental period, buildingfrequencyand groundperiod, damping, ductility, seismic weight,hyperstaticity/redundancy, non-structural elements,foundationsoil/liquefaction.Foundations;Quality ofconstructionandmaterials– qualityof concrete, construction joints, general detailingrequirements

Design forces forbuildings

Introduction;Equivalentstaticmethod;Modesuperpositiontechnique;Dynamic inelastic-timehistory analysis;Advantagesanddisadvantagesofthesemethods; Determinationof lateralforcesasperIS1893(Part1)–Equivalentstaticmethod,Modelanalysisusing response spectrum

Ductility considerations inearthquake resistant designofRCC buildings

Introduction; Impact of ductility; Requirements for ductility; Assessment of ductility– Member/elementductility,Structuralductility;Factoraffectingductility;Ductility factors; Ductilityconsiderations as perIS13920

Earthquake resistant designofa long two-storey, two-bay RCC building

Determination of lateral forces on an intermediate plane frame using Equivalent static methodandModelanalysisusing responsespectrum;Analysisoftheintermediateframefor various load combinationsasperIS1893(Part 1);Identification of designforcesand momentsin themembers;Designanddetailingof typicalflexuralmember,typicalcolumn,footingand detailingofa exterior joint as perIS13920.

Base isolationofstructures

Introduction;Considerationsforseismicisolation;Basicelementsofseismicisolation;seismic-isolation design principle; Feasibilityof seismic isolation; Seismic-isolation configurations

Text Books:

1. EarthquakeresistantdesignofstructuresbyPankajAgarwalandManishShrikhande,Prentice-HallofIndia, 2006.
2. SeismicdesignofreinforcedconcreteandmasonrybuildingsbyT.PaulayandM.J.N.Priestley, John Wiley&Sons, 1991.
3. Theseismicdesign handbook, Edited byF. Naeim, Kluwer Academicpublishers, 2001.

THEORY OF PLATESAND SHELLS

CourseCode: 11 CE 604 **L-T-P: 3-2-0**
Prerequisite: Nil **Credits: 4**

Syllabus

Introduction:Assumptionsinthetheory ofthinplates–PurebendingofPlates–Relations betweenbending momentsandcurvature-Particularcasesofpurebendingofrectangularplates, Cylindricalbending-immovablesimply supportededges–SynclasticbendingandAnticlastic bending–Strainenergy inpurebendingofplatesinCartesianandpolarco-ordinates– Limitations.

LaterallyLoadedCircularPlates:-Differentialequationof equilibrium–Uniformlyloaded circularplateswithsimply supportedandfixedboundary conditions –Annularplatewith uniform moment and shear force alongthe boundaries.

Laterally LoadedRectangularPlates:-Differentialequationofplates–Boundary conditions–Naviersolutionforsimplysupportedplatessubjectedtouniformlydistributedloadandpoint load–Levy'smethodofsolutionforplateshavingtwooppositeedgessimply supportedwith varioussymmetricalboundary conditionsalong theothertwoedgesloadedwithu.d.l.–Simply supported plates with moments distributed alongthe edges-Approximate Methods.

Effect of transverseshear deformation-platesofvariablethickness–Anisotropic plates-thick plates-orthotropicplatesand grids-LargeDeflection theory.

Deformation of ShellswithoutBending:-Definitionsandnotation,shellsintheformofa surface of revolution,displacements,unsymmetricalloading,sphericalshellsupportedatisolatedpoints, membranetheory of cylindricalshells,theuseofstressfunctionincalculatingmembraneforces ofshells.

GeneralTheory ofCylindricalShells:-Acircularcylindricalshellloadedsymmetricallywith respecttoitsaxis, symmetricaldeformation,pressure vessels, cylindricaltanks,thermalstresses, inextensionaldeformation,generalcase of deformation, cylindricalshellswithsupportededges, approximateinvestigationofthe bending of cylindricalshells,theuseofastrainandstress function, stress analysisofcylindrical roof shells.

Text Books:

1. S.PTimoshenko and S.WKrieger, Theoryof Plates and Shells, McGrawHill, 1989.

Reference Books:

1. R. Szilard, Theoryand Analysisof Plates– Classical Numerical Methods',PrenticeHall inc, 1974.
2. P.LGould, Analysisof Shells andPlates, Springer-Verlag,New York, 1988.

INDUSTRIAL STRUCTURES

CourseCode :11 CE 631 **L-T-P:3-0-0**
Prerequisite: Nil **Credits: 3**

Syllabus

PLANNING ANDFUNCTIONAL REQUIREMENTS

Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety – Protection against noise and vibration - Guidelines of FactoriesAct.

INDUSTRIAL BUILDINGS

RoofsforIndustrialBuildings-SteelandRCC-GantryGirders-DesignofCorbelsandNibs– Machine foundations.

POWERPLANT STRUCTURES

Types of power plants–Design of Turbogenerator foundation– containment structures.

POWER TRANSMISSION STRUCTURES

TransmissionLine Towers-Substation Structures-TowerFoundations-TestingTowers.

AUXILLIARY STRUCTURES

Chimneys andCoolingTowers–Bunkersand Silos– Pipe supportingstructures.

Text Books:

1. Manohar S.N, "TallChimneys-Design and Construction", Tata McGrawHill, 1985
2. SanthakumarA.R.andMurthy S.S.,"TransmissionLineStructures",TataMcGrawHill, 1992.
3. SrinivasuluPandVaidyanathan.C,"HandbookofMachineFoundations",TataMcGraw Hill, 1976.
4. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, "Industrial Buildings: A Design Manual", BirkhauserPublishers, 2004.
5. Proceedings of Advanced course on "Industrial Structures", Structural Engineering Research Centre, Chennai, 1982.

GREEN BUILDINGS

CourseCode :11 CE 643 **L-T-P:3-0-0**
Prerequisite: Nil **Credits: 3**

Syllabus
Introduction

WhatisGreenBuilding,WhytogoforGreenBuilding,BenefitsofGreenBuildings,GreenBuilding MaterialsandEquipmentinIndia,WhatarekeyRequisitesforConstructingaGreenBuilding,Important Sustainable featuresforGreen Building,

GreenBuildingConcepts andPractices
IndianGreenBuilding Council,GreenBuildingMomentinIndia,BenefitsExperiencedinGreenBuildings, Launch of Green Building Rating Systems, Residential Sector, MarketTransformation;

GreenBuildingOpportUNITiesAnd Benefits: Opport**UNIT**iesof GreenBuilding,GreenBuilding Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical EnergySavingApproachin Buildings,LEEDIndia RatingSystem and EnergyEfficiency,

GreenBuilding Design
Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximise SystemEfficiency,StepstoReduceEnergy DemandandUseOnsiteSourcesandSinks,Useof RenewableEnergy Sources.Ecofriendlycaptivepowergenerationforfactory,Building requirement,

Air Conditioning
Introduction,CIIGodrejGreenbusinesscentre,Designphilosophy,Designinterventions,Energy modeling, HVAC System design,Chillerselection,pump selection,Selection ofcooling towers,Selectionofairhanding**UNIT**s,Precoolingoffreshair,Interiorlightingsystem,Key feature ofthe building. Eco-friendlycaptivepowergeneration for factory,Building requirement.

MaterialConservation
Handlingofnonprocesswaste,wastereductionduringconstruction,materialswithrecycledcontent,localmaterials,materialreuse,certifiedwood,Rapidly renewablebuildingmaterialsand furniture;

IndoorEnvironmentQualityAndOccupationalHealth: Airconditioning,Indore airquality, Sickbuilding syndrome,Tobaccosmokecontrol,Minimumfreshairrequirementsavoiduseof asbestosinthebuilding, improvedfreshairventilation,MeasureofIAQ,ReasonsforpoorIAQ, Measures to achieveAcceptableIAQlevels,

Text Books:

1. Handbook on Green Practices published by Indian SocietyofHeatingRefrigerating and Air conditioningEngineers, 2009.
2. GreenBuilding HandBook byTomwoolleyand Samkimings, 2009.

Reference Books:

1. Complete Guide to Green Buildings byTrish riley
2. Standard forthe designforHigh PerformanceGreen Buildings byKent Peterson, 2009

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING
M-TECH COURSE STRUCTURE WITH SYLLABUS

M.TECH (CNS)

DEPARTMENT OF CNS				
S.No	**Course Code**	**Course Title**	**L-T-P**	**Credits**
SEMESTER -1				
1	11CN501	DATA STRUCTURES AND ALGORITHMS	3-1-2	5
2	11CN502	ADVANCED COMPUTER NETWORKS	3-1-0	4
3	11CN503	TCP / IP PROTOCOLS	3-1-2	5
4	11CN504	ADHOC NETWORKS	3-1-0	4
5	11CNE12	WIRELESS COMMUNICATION & NETWORKS	3-0-0	3
6	11CNE21	CLOUD COMPUTING	3-0-0	3
7	11CN505	SEMINAR	0-0-4	2
8				26
SEMESTER -2				
1	11CN506	CRYPTOGRAPHY AND NETWORK SECURITY	3-1-0	4
2	11CN507	NETWORK PROGRAMMING	3-0-2	4
3	11CN508	NETWORK ROUTING	3-1-0	4
4	11CN509	SECURE SYSTEMS DEVELOPMENT WITH UML	3-1-2	5
5	11CNE41	MOBILE COMPUTING	3-0-0	3
6	11CNE32	NETWORK MANAGEMENT	3-0-0	3
7	11CN510	TERM PAPER	0-0-4	2
8				25
SEMESTER -3				
1	**14TM602**	**INTERNSHIP**		18
2				
3				
4				
5				
6				
7				
8				
SEMESTER -4				
1	11 CS 601	THESIS/PROJECT		18
2				
3				
4				
5				
6				
7				
8				

DATA STRUCTURES AND ALGORITHMS

Course Code : 11CN501 **L-T-P : 4 – 0 - 2**

Prerequisite: **Credits: 5**

Syllabus

UNIT I

INTRODUCTION: Algorithms, algorithms as a technology, Analyzing algorithms , Designing algorithms, Asymptotic notations, standard notations, common functions, Recurrences – substitution method, master method.

SORTING AND ORDER STATISTICS: Merge sort, Quick sort, Heap sort, sorting in linear time, Median and order statistics.

UNIT II

DATA STRUCTURES: Elementary Data Structures – Linked lists, Stacks, Queues, Hash Tables – Direct address tables, Hash tables, Hash functions, Open addressing, Search Trees – Binary search trees, Red-Black Trees.

ADVANCED DATA STRUCTURES: B – Trees, Binomial Heaps, Fibonacci Heaps, Data Structures for Disjoint Sets.

UNIT III

GRAPH ALGORITHMS: Elementary graph algorithms – Representation of graphs, BFS, DFS, Topological Sort, Strongly connected components, Minimum Spanning Trees – The algorithms of Kruskal and Prim's. Single-Source Shortest Paths: The Bellman-Ford algorithm, Single source shortest paths in DAG's, Dijkstra's algorithm, All-Pair Shortest paths – Shortest paths and Matrix multiplication, Floyd-Warshall algorithm. Maximum Flow: Flow networks, The Ford-Fulkerson method, Maximum Bipartite matching.

UNIT IV

ADVANCED DESIGN AND ANALYSIS TECHNIQUES: Greedy Algorithms – An activity – selection Problem, Elements of greedy strategy, Huffman codes. Dynamic Programming: Matrix Chain multiplication, Elements of dynamic programming, Optimal Binary Search Trees.

UNIT-V

STRING MATCHING: The naïve string matching algorithm, Rabin-Karp algorithm, Knuth-Morris-Pratt algorithm.

NP-COMPLETENESS: Polynomial time, Verification, NP-Completeness and reducibility, NP-Completeness proofs, NP-Complete problems.

Text Books:

1. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein,PHI Pvt.Ltd./ Pearson Education.

Reference Books:

1. Algorithm Design: Foundations,Analysis and Internet examples, M.T.Goodrich and R.Tomassia,John wiley and sons.
2. Fundamentals of Computer Algorithms,Ellis Horowitz,Satraj Sahni and S.Rajasekharam,Galgotia publications pvt. Ltd.

3. Introduction to Design and Analysis of Algorithms A strategic approach, R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, Mc Graw Hill.

4. Data structures and Algorithm Analysis in C++, Allen Weiss, Second edition, Pearson education.

5. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education.

ADVANCED COMPUTER NETWORKS

Course Code: 11CN502 **L-T-P : 3-1-0**

Prerequisite: **Credits: 4**

Syllabus

UNIT – I (Internetworking)
Introduction, History and Context, Packet switching. Internetworking: Architectural Principles, Names, Addresses. Interdomain Routing.

UNIT – II (Resource Management)
End-to-End Congestion Control , Fair Queuing –WFQ,CSFQ, Router congestion control – RED,XCP. Quality of Service – Future requirements and IntServ, Router Design

UNIT –III (Wireless Networks)
Wireless Networks Overview and Architectures (MACAW, WTCP), Wireless Networks in the Real World - roofnet, Routing in ad-hoc Networks, Sensor networks, topology

UNIT - IV (Applications, Naming, and Overlays)
Overlay Networks, Distributed Hash Tables, DNS and the Web, Names, Identifiers, and Network architecture

UNIT - V
Measurement and Tracing, Internet Measurement, X Trace, Data-oriented networking and DTNs, Multicast, Datacenter Networking,

Text Books:
1. Computer Networks: A Systems Approach, 4th Ed. (2007), by Larry Peterson and Bruce Davie.
2. Computer Networks, Fourth Edition, A. Tanenbaum, Prentice-Hall, 2002.

Reference Books
1. Computer Networking: A Top-Down Approach Featuring the Internet, 4th Ed. (2007), by James F. Kurose and Keith W. Ross.
2. TCP/IP Illustrated, Volume 1: The Protocols by W. Richard Stevens.
3. Unix Network Programming: Networking APIs: Sockets and XTI (Volume 1) by W. Richard Stevens.
4. Advanced Programming in the Unix Environment by W. Richard Stevens, Addison-Wesley, 1993.
5. Computer Networks and Internets with Internet Applications, Third Edition, D.E. Comer,Prentice-Hall, 2001.
6. Communication Networks, Fundamental Concepts and Key Architecture, A. Leon-Garcia and I. Wadjaja, McGraw-Hill, 2000.
7. **Data and Computer Communications**, Sixth Edition, W.S. Stallings, Prentice-Hall, 1999.
8. **Data Communications, Computer Networks and Open Systems**, Fourth Edition, F. Halsall, Addison-Wesley, 1995.
   Data Networks, Second Edition, D. Bertsekas and R. Gallager, Prentice-Hall, 1992

TCP IP PROTOCOLS

Course Code : 11CN502 **L-T-P : 3-1-2**

Prerequisite: **Credits: 5**

Syllabus

UNIT 1
Introduction to Internetworking
Internetworking Concepts – Architectural model(TCP/IP-OSI) – Routing – Internet Addressing – Multicast Address Resolution Protocol (ARP) – Reverse Address Resolutions Protocol (RARP) –BOOTP – DHCP. Fragmentation and Reassembling – Error Processing (ICMP) – Multicast Processing (IGMP).

UNIT 2
Internet Protocol
IPv-4, IPV6 Protocol – Addressing, IP Security Protocol, Routing Algorithms – RIP, OSPF

UNIT 3
TCP/IP – 1
BGP, and MPLS-MPLS fundamentals, signaling protocol, LDP, traffic engineering. In MPLS, Transport Layer – TCP, UDP, SCTP and RTP

UNIT 4
TCP/IP - 2
Data Structures Input Processing – Output Processing – Timer Management – Flow Control and Adaptive Retransmission – Urgent Data Processing

UNIT 5
IP Service Management
Differentiated Services, Integrated Services, RSVP, Traffic Engineering – ECMP, OSPF-TE, IS-IS – TE Dynamic TE.

Text Books:

1. Adrian Farrel, “The Internet and Its Protocols – A Comparative Approach” Morgan Kaufmann, April 2004.
2. Douglas E Comer “Internetworking with TCP/IP principles protocol and architectures”, 4th edition Volume 2, Prentice Hall, 2000.

Reference Books:

1. Pete Loshin “IPV6 Theory, Protocol and Practice, 2nd Edition”, Morgan Kaufmann. December 2003.
2. W.Richard Stevens “TCP/IP Illustrated, the Protocols. Volume I”, Pearson Education India 2003.
3. Comer D.E & Stevens D.L. “Internetworking TCP/IP – Volume III”, Prentice Hall of India 1997

ADHOC NETWORKS

Course Code : 11CN504 **L-T-P : 3-1-0**

Prerequisite: **Credits:4**

Syllabus

UNIT I
Ad hoc network: Introduction & definition, applications, Design challenges, evaluating ad hoc Network protocols.Collision avoidance protocols: performance of collision avoidance protocols, Frame work &mechanisms for fair access in ieee802.11.

UNIT II
Routing in mobile ad hoc networks: Flooding, Proactive routing, On-demand routing, Proactive vs on-demand, Location based routing.Multicasting in ad hoc network: Classification of protocols, Multicasting protocols, broadcasting, Protocol comparisons, and Overarching issues.

UNIT III
Transport layer protocol in ad hoc networks: Tcp &ad hoc networksTcp &ad hoc networks, Transport layer for adhoc networks, Modified TCP,TCP-aware cross-layered solutions, Ad-hoc transport protocol.Energy conservation: energy consumption in adhoc networks, Communication-time energy conservation, Idle-time energy conservation.

UNIT IV
use of smart antennas: Smart antenna basics, Models, Medium access control with directional antennas, Medium access control with directional antennas, Medium access control with directional antennas, Medium access control with directional antennas, Routing with directional antennas, Broadcast with directional antennas, Broadcast with directional antennas.

UNIT V
QoS issues in ad hoc networks: Physical layer, Medium access layer, QoS Routing, QoS at other networking layer, Inter-layer design approaches,
Security in mobile ad hoc network: Security, Potential attacks, Attack prevention techniques, Intrusion detection techniques

Text Books:

1. **Ad hoc Networks technologies & protocols, prasant mohapatra and srikanth Krishnamurthy.**

Reference Books:

1.Adhoc networks, charless E.perkin, person education.

2. William Stallings “Wireless communication and networking” (Pearson Education/ PHI)
3.Vijay K. Garg “Wireless communication and networking” Morgan Kaufmann Publishers 2007.
4.Andrea GoldSmith “Wireless Communication” Cambridge Press
5.Anurag Kumar, D. Manjunath and Joy Kuri “Wireless Networking”, Morgan Kaufmann Publishers.

WIRELESS COMMUNICATION AND NETWORKS

Course Code : 11CNE12 **L-T-P : 3-0-0**

Prerequisite: **Credits: 3**

Syllabus

UNIT I

Overview of communications

Introduction, **Transmission fundamentals**- signals for conveying information, analog and digital data transmission, channel capacity, transmission media, multiplexing.

Antennas and wave propagation- antennas, propagation modes, line-of-sight transmission, fading in the mobile environment.

Modulation techniques- signal encodingcriteria, digital data, analog signals, analog data, analog signals, analog data, digital signals, spread spectrum modulation, frequency hopping spread spectrum, code division multiple access.

Communication networks- LANs, MANs, and WANs, switching techniques, circuit switching, packet switching, asynchronous transfer mode.

UNIT II

Wireless NetworksProtocols and the TCP/IP suite- the need for protocol architecture, the TCP/IP protocol architecture, the OSI model, internetworking.

Cellular wireless networks- principles of wireless networks, first generation analog, second-generation TDMA, CDMA, third-generation systems.

UNIT III

Wireless link improvement techniques- equalization, diversity, error detection, block error correction codes, convolutional codes, automatic repeat request

Multiple access in wireless system- multiple access scheme, frequency, time, code, space division multiple access, packet radio access.

S**atellite communications-** satellite parameters and configurations, capacity allocation-frequency division, time division.

UNIT IV

Wireless system operations and standards

cordless systems, wireless local loop, WiMAX and IEEE 802.16 broadband wireless access standards.

Mobile IP and wireless application protocol- mobile IP, wireless application protocol.

wireless LAN technology- overview, infrared LANs, spread spectrum LANs, narrowband microwave LANs.

UNIT V

Wi-Fi and the IEEE 802.11 wireless LAN standard- IEEE 802 architecture, IEEE 802.11 architecture and services, IEEE 802.11 medium access control, IEEE 802.11 physical layer, other IEEE 802.11 standards, Wi-Fi protected access.

Bluetooth and IEEE 802.15.500

overview, radio specification, baseband specification, link manager specification, logical link control and adaptation protocol, IEEE 802.15,538.

Text Books:

1. William Stallings "**Wireless communication and networking**" (Pearson Education/ PHI)
2. VijayK. Garg "**Wireless communication and networking**"Morgan Kaufmann Publishers 2007.

Reference Books:

1. Andrea GoldSmith "**Wireless Communication**" Cambridge Press
2. Anurag Kumar, D. Manjunath and Joy Kuri "**Wireless Networking**" , Morgan Kaufmann Publishers.

CLOUD COMPUTING

Course Code : 11CNE21 **L-T-P : 3-0-0**

Prerequisite: **Credits: 3**

Syllabus

UNIT I

Cloud Computing Basics: Overview, Applications, Intranet and the Cloud, First Movers on the cloud, the need for Cloud Computing, Benefits of cloud Computing, Limitations of the Cloud Computing, security concerns and regulatory issues, over view of different cloud computing applications which are implemented, Business case for implementing a Cloud

Introduction to Cloud Computing(Book-2): What and what is not cloud computing, Moving from collaboration to cloud, Cloud Architectures, cloud storage, cloud Services, reasons for cloud computing, pros and cons of cloud computing, benefits of cloud computing, users of cloud computing.

UNIT II

Cloud Computing Technologies: Hardware and Infrastructure: Clients, Security, Network, services **Accessing the Clouds**: Platforms, WEB applications, WEB APIS, WB Browsers **Cloud Storage:** Overview, Storage provides, **Cloud Standards**: Applications, Client, Infrastructure, Services

UNIT III

Cloud Computing Mechanisms: Software as a service: Overview, Driving Forces, Company offerings, Industries, Software + services: Overview, Mobile Device Integration, Providers, Microsoft Online **Application development:** Google, Microsoft, Intuit Quick base, Cast Iron Cloud, Bungee Connect, **Development Platforms**: Google, Sales Force, Azure, Trouble shooting, Application management

UNIT IV

Local Clouds: Virtualization, server solutions, Thin Clients **Migrating to the clouds:** Cloud services for individuals, Mid-market, and Enterprise wide, Migration, best practices, analyzing the service

UNIT-V

Using Cloud Services: Collaborating on Calendars, Schedules, and Task Management, Collaborating on Event management, Collaborating on Contact management, collaborating on Project Management, Collaborating on Word Processing, Collaborating on Spread sheets, Collaborating on Databases, Collaborating on presentations, Storing and sharing Files and other online content, sharing Digital Photographs, controlling the collaborations with Web-Based Desktops **Online Collaborations**: Collaborating Via WEB based communication Tools, Collaborating Via Social Networks and Groupware, collaborating Via Blogs and Wikis.

Text Books:

1. Cloud Computing a practical approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter , Tata McGraw-HILL,2010 Edition
2. Cloud Computing-web Based application that change the way you work and collaborate online, Michael Miller, Pearson Eduction,2009 Edition

CRYPTOGRAPHY AND NETWORK SECURITY

Course Code : 11CN506 **L-T-P : 3-1-0**

Prerequisite: **Credits: 4**

Syllabus

Basic Cryptographic Techniques: Encryption —Symmetric Techniques: Substitution Ciphers, Transposition Ciphers, Classical Ciphers: Usefulness and Security, The DataEncryption Standard (DES), The Advanced Encryption Standard (AES), Confidentiality Modes of Operation, Key Channel Establishment for Symmetric Cryptosystems. Encryption —Asymmetric Techniques: Insecurity of "Textbook Encryption Algorithms", The Diffie-Hellman Key Exchange Protocol, The Diffie-Hellman Problem and the Discrete Logarithm Problem, The RSA Cryptosystem (Textbook Version), Cryptanalysis Against Public-key Cryptosystems, The RSA Problem, The Integer Factorization Problem, Insecurity of the Textbook RSA Encryption, The Rabin Cryptosystem (Textbook Version), Insecurity of the Textbook Rabin Encryption, The ElGamal Cryptosystem (Textbook Version), Insecurity of the Textbook ElGamal Encryption, Need for Stronger Security Notions for Public-key Cryptosystems, Combination of Asymmetric and Symmetric Cryptography, Key Channel establishment for Public-key Cryptosystems.

Authentication Protocols —Principles: Authentication and Refined Notions, Convention, Basic Authentication Techniques, Password-based Authentication, Authenticated Key Exchange Based on Asymmetric Cryptography, Typical Attacks on Authentication Protocols. Hash and Message Digests:MD5, SHA1, HMAC. Authentication Framework for Public KeyCryptography: Directory-Based Authentication, NonDirectory Based Public-key Authentication Framework. Formal Approaches to Security Establishment-Formal and Strong Security Definitions for Public-**Key Cryptosystems:**Introduction, A Formal Treatment for Security, Semantic Security — the Debut of Provable Security, Inadequacy of Semantic Security, Beyond Semantic Security.Provably Secure and Efficient Public-Key Cryptosystems:Introduction, The Optimal Asymmetric Encryption Padding, The CramerShoup Public Key Cryptosystem, An Overview of Provably Secure Hybrid Cryptosystems.Formal Methods for Authentication Protocols Analysis: Toward Formal Specification of Authentication Protocols, A Computational View of Correct Protocols — the Bellare-Rogaway Model, A Symbolic Manipulation View of Correct Protocols, Formal Analysis Techniques: State System Exploration, Reconciling Two Views of Formal Techniques for Security Zero- Knowledge Protocols: Basic Definitions, Zero-knowledge PropertiesProof or Argument, Protocols with Two-sided-error, Round Efficiency, Non-interactive Zero-knowledge. Network Security Standards: Kerberos V5, PKI, IPsec: AH and ESP, SSL/TLS, PEM & S/MIME, PGP

Text Books:

1. Modern Cryptography Theory and Practice, Wenbo Mao, Pearson Education 2008
2. Network Security: Private Communication in a Public World, Charlie Kaufman, Radia Perlman Mike Speciner, Prentice Hall 2/E.(Hash and Message Digests,

Reference Text Books:

1. Cryptography and Network Security, William Stallings , 4/E Publisher: Prentice Hall
2. Information Security Principles & Practice, Mark Stamp, WILEY INDIA 2006.
3. Cryptography & Network Security by Behrouz A. Forouzan, TMH 2007.
4. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
5. Computer Security Basics by Rick Lehtinen, Deborah Russell & G.T.Gangemi Sr., SPD O’REILLY 2006.
6. Network Security Essentials (Applications and Standards) by William Stallings, Pearson Education

NETWORK PROGRAMMING

CourseCode:11 CN 507 **L-T-P : 3-0-2**

Prerequisite: **Credits: 4**

Syllabus

PosixIPC,SystemVIPC,PipesandFIFOs,PosixMessageQueues,SystemVMessageQueues,PosixSemaphores,SystemVSemaphores,SharedMemoryIntroduction,PosixSharedMemory,SystemVSharedMemory,Doors,SocketsIntroduction,ElementaryTCPSockets,TCPClient/ServerExample,I/OMultiplexing,TheselectandpollFunctionsSocketOptions,ElementaryUDPSockets, NameandAddressConversions,andFunctions,SunRPC,XDR,UNIXDomain Protocols, RoutingSockets, Threads RawSockets

Text Books:

1. UNIX Network Programming, Volume 1: TheSockets NetworkingAPI,W. RichardStevens,BillFenner,Andrew M. Rudoff,Prentice Hall 3/E, 2008
2. UNIXNetwork Programming,Volume 2: InterprocessCommunications,W. RichardStevens,Prentice Hall 2/E.2007

Reference Books:

1. TCP/IPIllustrated, Volume 2: The Implementation, GaryR. Wright, W.Richard Stevens,Addison Wesley, 2005
2. Internetworking with TCP/IP Volume :IIIClientandServerProgramming and ApplicationsBSDSocket Versions, Douglas E Comer,DavidLStevens, Second editionPHI, 2007
3. AdvancedProgramming in theUNIX®Environment,RichardStevens,StephenA.Rago,Addison WesleyProfessional/Pearson,Second Edition, 2009
4. UNIX Systems Programming: Communication, Concurrency,andThreads,KayA. Robbins,Steven Robbins, Prentice Hall PTR, 2009.

NETWORK ROUTING

CourseCode:15 CN 508 **L-T-P: 3-1-0**

Prerequisite: **Credits: 3**

Syllabus

NetworkRouting:BasicsandFoundations:NetworkingandNetworkRouting:AnIntroduction,:RoutingAlgorithms:ShortestPathandWidestPath,NetworkFlowModelling.**RoutinginIPNetworks:**OSPFandIntegratedIS-IS,IPTrafficEngineering,BGP.**RoutinginthePSTN**:HierarchicalandDynamicCallRoutingintheTelephoneNetwork,TrafficEngineeringintheVoiceTelephoneNetwork.**RouterArchitectures:**RouterArchitectures,IPAddressLookupAlgorithms,QualityofServiceRouting,MPLSandGMPLS.**TowardNextGenerationRouting:**RoutingandTrafficEngineeringwithMPLS,PacketQueuingandScheduling,TrafficConditioning,TransportNetworkRouting,OpticalNetworkRoutingandMultilayerRouting.

Text Book

1. D.MedhiandK.Ramasamy:NetworkRouting:Algorithms,Protocols,andArchitectures, MorganandKaufmann Publ., 2008.

Reference Text Books:

1. G. Varghese: Network Algorithmics,Elsevier2005
2. NetworkRoutingBasics:UnderstandingIPRoutinginCiscoSystems,JamesMacfarlane, Wiley; 1edition, 2006
3. ComputerNetworking:ATop-DownApproach(6thEdition),JamesF.Kurose,KeithW.Ross, Pearson; 6th edition, 2012
4. ComputerNetworksandInternets(6thEdition),DouglasE.Comer,Addison-Wesley;6edition ,2014
5. Internetworkingwith TCP/IPVol.1: Principles,Protocols,andArchitecture,DouglasE.Comer, Prentice Hall;4thedition, 2000.

SECURE SYSTEMS DEVELOPMENT WITH UML

Course Code : 11CN509 **L-T-P : 3-1-2**

Prerequisite: **Credits: 5**

Syllabus

UNIT I:

UML Overview: Use case diagram, Sequence diagram, Collaboration diagram, Class diagram, State Chart diagram, Activity diagram, Component diagram, Deployment diagram, Package Diagram.

UNIT II:

Introduction: Overview,outline,how to use this book. Walk through :Using UML for Security:security requirements capture with use case diagrams,secure business processes with activity diagrams,physical security using deployment diagrams, security-critical Interaction with sequence diagrams.Background: Security Engineering,UML,Analyzing UML Models. Model-based security engineering with UML: UML Security profile,Design principles for secure systems,Applying security patterns.

UNIT III:

Applications: Secure channels,A variant of the IP TLS,Common Electronic Purse Specifications,Developing Secure Java Programs,Further Applications.

UNIT IV:

Tool Support for UML Security: Extending UML CASE Tools with analysis tools,Automated Tools for UML Security,Linking Models to Run time data ,Linking models to code .A Formal Foundation: UML Machines,UML Machine systems, Refinement,Rely-Guarantee Specifications,Reasoning about security properties. (9)

UNIT-V:

Formal Systems development with UML: Formal Semantics for a Fragment of UML,Development with UML .Further material: More on the UML security approach,Other approaches to security Engineering. (9)

Text Books:

1. **Secure Systems Development with UML .JAN, JURJENS. SPRINGER 2004.**
2. Object Oriented systems development .Ali Bahrami

Reference Books:

1. **R.Heldal and F.Hultin,Bridging model based and language based security.**

2. **R.Anderson. Security Engineering, A Guide to building dependable distributed systems, john willey &Sons, Newyork 2001.**

MOBILE COMPUTING

Course Code : 11CNE 41 **L-T-P : 3-0-0**

Prerequisite: **Credits: 3**

Syllabus

An overview of wireless systems, radio propagation models, digital communication and transmission, fundamentals of cellular communications, Architecture of wireless wide area networks, speech and channel coding, speech spectrum, and CDMA systems, security in wireless systems.

Textbook:

1. Vijay.K.Garg,"Wireless communications and networking ,kuffman publishers,2007.

Reference Text Books:

1. Anurag kumar,and joy kuri,"networks communications, kuffman publishers,2007.

NETWORK MANAGEMENT

Course Code: 11CNE 32 **L-T-P : 3-0-0**

Prerequisite: **Credits: 3**

Syllabus

UNIT I

Data communications and Network Management Overview : Analogy of Telephone Network Management, Communications protocols and Standards, Case Histories of Networking and Management, Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network Management.

UNIT II

SNMPV1 Network Management: Organization and Information and Information Models.

Managed Network: Case Histories and Examples, The History of SNMP Management, The SNMP Model, The Organization Model, System Overview, The Information Model

SNMPv1 Network Management: Communication and Functional Models. The SNMP Communication Model, Functional model. **(9)**

UNIT – III

SNMP Management: SNMPv2: Major Changes in SNMPv2, SNMPv2 System Architecture, SNMPv2 Structure of Management Information, The SNMPv2 Management Information Base, SNMPv2 Protocol, Compatibility with SNMPv1.

SNMP Management: RMON: What is Remote Monitoring? , RMON SMI and MIB, RMON1, RMON2, ATM Remote Monitoring, A Case Study of Internet Traffic Using RMON **(9)**

UNIT – IV

Telecommunications Management Network: Why TMN? , Operations Systems, TMN Conceptual Model, TMN Standards, TMN Architecture, TMN Management Service Architecture, An Integrated View of TMN, implementation Issues.

Network Management Tools and Systems: Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Network Management systems, Commercial Network management Systems, System Management, and Enterprise Management Solutions. **(9)**

UNIT – V

Web-Based Management: NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Embedded Web-Based Management, Desktop management Interface, Web-Based Enterprise Management, WBEM: Windows Management Instrumentation, Java management Extensions, Management of a Storage Area Network: , Future Directions**.** **(9)**

Text Books:

1. Network Management, Principles and Practice, Mani Subramanian, Pearson Education.

Reference Books:

1. Network management, Morris, Pearson Education.
2. Principles of Network System Administration, Mark Burges, Wiley Dreamtech.
3. Distributed Network Management, Paul, John Wiley.

M.TECH (CSE)

DEPARTMENT OF CSE				
S.No	**Course Code**	**Course Title**	**L-T-P**	**Credits**
SEMESTER -1				
1	11CS501	DATA STRUCTURES AND ALGORITHMS	3-1-2	5
2	11CS502	COMPUTER ORGANIZATION	3-1-0	4
3	11CS503	OPERATING SYSTEMS	3-1-0	4
4	11CS504	OBJECT ORIENTED PROGRAMMING	3-1-2	5
5	11CSE12	MOBILE COMPUTING	3-0-0	3
6	11CSE21	ENTERPRISE PROGRAMMING	3-0-0	3
7	11CS505	SEMINAR	0-0-4	2
8				26
SEMESTER -2				
1	11CS506	COMPUTER NETWORKS	3-1-2	5
2	11CS507	SOFTWARE ENGINEERING	3-0-0	3
3	11CS508	DATABASE MANAGEMENT SYSTEMS	3-1-2	5
4	11CS509	EMBEDDED SYSTEMS	3-1-0	4
5	11CSE32	CLOUD COMPUTING	3-0-0	3
6	11CSE41	SEMANTIC WEB	3-0-0	3
7	11CS510	TERM PAPER	0-0-4	2
8				25
SEMESTER -3				
1	**14TM602**	**INTERNSHIP**		18
2				
3				
4				
5				
6				
7				
8				
SEMESTER -4				
1	11 CS 601	THESIS/PROJECT		18
2				
3				
4				
5				
6				
7				
8				

DATA STRUCTURES AND ALGORITHMS

Course Code : 11CS501 **L-T-P : 4 – 0 - 2**

Prerequisite: **Credits: 5**

Syllabus

UNIT I

INTRODUCTION: Algorithms, algorithms as a technology, Analyzing algorithms , Designing algorithms, Asymptotic notations, standard notations, common functions, Recurrences – substitution method, master method.

SORTING AND ORDER STATISTICS: Merge sort, Quick sort, Heap sort, sorting in linear time, Median and order statistics.

UNIT II

DATA STRUCTURES: Elementary Data Structures – Linked lists, Stacks, Queues, Hash Tables – Direct address tables, Hash tables, Hash functions, Open addressing, Search Trees – Binary search trees, Red-Black Trees.

ADVANCED DATA STRUCTURES: B – Trees, Binomial Heaps, Fibonacci Heaps, Data Structures for Disjoint Sets.

UNIT III

GRAPH ALGORITHMS: Elementary graph algorithms – Representation of graphs, BFS, DFS, Topological Sort, Strongly connected components, Minimum Spanning Trees – The algorithms of Kruskal and Prim's. Single-Source Shortest Paths: The Bellman-Ford algorithm, Single source shortest paths in DAG's, Dijkstra's algorithm, All-Pair Shortest paths – Shortest paths and Matrix multiplication, Floyd-Warshall algorithm. Maximum Flow: Flow networks, The Ford-Fulkerson method, Maximum Bipartite matching.

UNIT IV

ADVANCED DESIGN AND ANALYSIS TECHNIQUES: Greedy Algorithms – An activity – selection Problem, Elements of greedy strategy, Huffman codes. Dynamic Programming: Matrix Chain multiplication, Elements of dynamic programming, Optimal Binary Search Trees.

UNIT-V

STRING MATCHING: The naïve string matching algorithm, Rabin-Karp algorithm, Knuth-Morris-Pratt algorithm.

NP-COMPLETENESS: Polynomial time, Verification, NP-Completeness and reducibility, NP-Completeness proofs, NP-Complete problems.

Text Books:

1. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein,PHI Pvt.Ltd./ Pearson Education.

Reference Books:

1. Algorithm Design: Foundations,Analysis and Internet examples, M.T.Goodrich and R.Tomassia,John wiley and sons.
2. Fundamentals of Computer Algorithms,Ellis Horowitz,Satraj Sahni and S.Rajasekharam,Galgotia publications pvt. Ltd.
3. Introduction to Design and Analysis of Algorithms A strategic approach, R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, Mc Graw Hill.

4. Data structures and Algorithm Analysis in C++, Allen Weiss, Second edition, Pearson education.

5. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education.

COMPUTER ORGANIZATION

Course Code : 11CS502 **L-T-P : 3 – 1 - 0**
Prerequisite: **Credits: 4**

Syllabus

UNIT I: REGISTER TRANSFER & MICRO-OPERATIONS: Register Transfer Language, Register Transfer, Bus & memory Transfers, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift **UNIT**. (9)
UNIT II: BASIC COMPUTER ORGANIZATION AND DESIGN: Introduction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction cycle, Memory-Reference Instruct ion, Input-Output and Interrupt, Design of Basic Computer, Design of Accumulator Logic. MICRO PROGRAMMED CONTROL: Control Memory, Address Sequencing, Micro-Program example, Design of Control **UNIT**. (9)
UNIT III: CENTRAL PROCESSING **UNIT**: General registers Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC). COMPUTER ARITHMETIC: Addition and Subtraction, Multiplication Algorithms, Division Algorithms Floating-point Arithmetic operations. (9)
UNIT IV: MEMORY ORGANIZATION: Memory Hierarchy, Main Memory, Auxiliary memory, Associative Men Cache Memory, Virtual Memory, Memory Management hardware. (9)
UNIT V: INPUT-OUTPUT ORGANISATION: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA), Input-Output Processor, Serial Communication. (9)

Text Book:
1. Morris M. Mano, ‘Computer Systems Architecture’, 3rd Edition

Reference Books :
1. John P Hayes, ‘Computer Architecture and Organisation’ 2nd edition.
2.V.Carl Hamacher et.al, ‘Computer Organization’ 2nd edition.

OPERATING SYSTEMS

Course Code:11CS503 **L-T-P: 3-1-0**

Prerequisite: **Credits: 4**

Syllabus

UNIT I

Introduction Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Distributed Systems, Special-Purpose Systems.

Operating-System Structures- Operating-System Services , User Operating-System Interface, System Calls , Types of System Calls, System Programs , Operating-System Design and Implementation, Operating-System Structure, Virtual Machines, Operating-System Generation, System Boot.

UNIT II

Processes-Concept, Process Scheduling, Operations on Processes, Inter-process Communication Examples of IPC Systems, Communication in Client-Server Systems

Multithreaded Programming- Multithreading Models, Thread Libraries, Threading Issues.

ProcessScheduling-Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling.

UNIT III

Synchronization-The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization Examples, and Atomic Transactions.

Deadlocks- System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention. Deadlock Avoidance, Deadlock Detection. Recovery from Deadlock.

UNIT IV

Memory Management Strategies-Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation.

Virtual Memory Management- Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory

UNIT V

File-System - The Concept of a File, Access Methods, Directory Structure, File-System Mounting, File Sharing, Protection.

Implementing File system- File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance, Recovery.

Text Book:

1. Silberschatz & Galvin, 'Operating System Concepts', 7^{th} edition, Wiley.

Reference Books:

1. William Stallings-"Operating Systems"- 5^{th} Edition - PHI
2. Charles Crowley, 'Operating Systems: A Design-Oriented Approach', Tata McGraw Hill Co., 1998 edition.
3. Andrew S.Tanenbaum, 'Modern Operating Systems', 2^{nd} edition, 1995, PHI

OBJECT ORIENTED PROGRAMMING

Course Code : 11CS504 **L-T-P : 3 – 1 – 2**

Prerequisite: **Credits: 5**

Syllabus

UNIT I

Introduction to OOPS: Origins of C++, Object Oriented Programming, C++ fundamentals, Headers & Name Spaces, C++ Classes, Function overloading, Operator overloading, Inheritance, Constructors & Destructors.

Classes & Objects: Parameterized Constructors, Friend functions, Default function arguments. Structures, Unions, and Inline functions, passing objects to functions, Returning objects, Object assignment, Arrays of objects, Pointers to objects.

UNIT II

Function & Operator Overloading: Overloading constructors, Localizing variables, Function overloading & Ambiguity, Finding the address of an overloaded function, This Pointer, Operator overloading, Reference **Text Books:** using reference to overload a unary operator, Overloading [] and (), Applying operator overloading. **Inheritance:** Inheritance and the access specifiers, Constructors and Destructors in derived classes, Multiple Inheritance, Multilevel Inheritance, Diamond Inheritance, Hybrid Inheritance, Passing parameters to a basic class.

UNIT III

Polymorphism and Virtual Functions: Pointer Objects, Pointer to Objects, Pointers and Reference **Text Books:** to derived types, Virtual Functions, Pure virtual functions and abstract types, Early vs Late binding, Virtual Base Class. **The C++ 1/0 Class Library:** C++ streams, The C++ Stream classes, Creating own inserter and extractors, Formatting I/O, Creating your own manipulator functions.

UNIT IV

Files in C++: File I/O, Unformatted and Binary I/O. **Templates:** Generic Functions and classes. **Exceptions:** Exception Handling, Fundamentals, options Un-caught exception (), Applying exception Handling, and RTTI, casting operators

UNIT V

Miscellaneous C+ + topics: Dynamic allocation using new and delete, static class members, constant member functions and mutable, volatile member functions, Using the asm keyword, linkage specification, The .* and ->* operators, Creating conversion functions, Copy constructors, Granting access, Namespaces, Explicit constructors. **The standard Template Library and the String Class:** An overview of the STL

Text Book:

1. Herbert Schieldt ,The Complete Reference - Borland C++ Builder ,2007,4th ed., TMH

Reference Books:

1. E. Balaguruswamy, Object Oriented Programming using C++, 2nd ed., TMH
2. Deitel HM and Deitel PJ: C++ How to Program, Third Edition, PHI.

MOBILE COMPUTING

Course Code : 11CSE12 **L-T-P : 3 – 0 – 0**

Prerequisite: **Credits: 3**

Syllabus

UNIT – I

Mobile Communications: An Overview: Mobile communication, Mobile computing, Mobile computing architecture, Mobile Devices, Mobile system Networks, Data dissemination, Mobility management.

Mobile Devices and Systems: Mobile phones, Digital music players, Handheld pocket computers, Handheld devices, Smart systems, Limitations of mobile devices, Automotive systems.

UNIT – II

GSM and Similar Architectures: GSM – Services and system architecture, Radio interfaces, Protocols, Localization, Calling, Handover, Security, New data services, General packet radio service, High speed circuit switched data, DECT.

Wireless Medium Access Control and CDMA-based Communication: Medium access control, Introduction to CDMA- based systems, Spread spectrum in CDMA systems, Coding methods in CDMA, IMT-2000, i-mode, OFDM.

UNIT – III

Mobile IP Network Layer: IP and mobile IP network layers, Packet delivery and handover Management, Location management, Registration, Tunneling and encapsulation, Route optimization, Dynamic host configuration protocol.

Mobile Transport Layer: Conventional TCP/ IP transport layer protocol, Indirect TCP, Snooping TCP, Mobile TCP, Other Methods of TCP-layer transmission for mobile networks, TCPover 2.5G/3G mobile networks.

Databases: Database hoarding techniques, Data caching, Client-Server computing and Adaptation, Transactional models, Query processing, Data recovery process, Issues relating to Quality of service.

UNIT – IV

Data Dissemination and Broadcasting Systems: Communication asymmetry, Classification of data-delivery mechanisms, Data dissemination broadcast models, Selective tuning and indexing techniques, Digital audio broadcast models, Selective tuning and indexing techniques, Digital audio broadcasting, Digital video broadcasting.

Data Synchronization in Mobile Computing Systems: Synchronization, Synchronization software for model devices, Synchronization protocols, SyncML-Synchronization language for mobile computing, Sync4J , Synchronized multimedia markup language.

Mobile Devices: Server and Management: Mobile agent, Application server, Gateways, Protocol, Service discovery, Device management, Mobile file systems, Security.

Mobile Ad-hoc and Sensor Networks : Introduction to Mobile Ad-hoc Networks, MANET, Wireless sensor networks.

UNIT – V

Wireless LAN, Mobile Internet Connectivity, and Personal Area Network: Wireless LAN architecture and protocol, WAP 1.1 and WAP 2.0 architecture, XHTML-MP, Bluetooth-enabled devices network, Layers in Bluetooth protocol, Security in Bluetooth protocol,IrDA,ZigBee

Mobile Application LanguagesXML, Java, J2ME, and JavaCard : Introduction , XML, **JAVA**, Java 2 micro edition, JavaCard.

Mobile Operating Systems: Operating system, palmOS, Windows CE, Symbian OS, Linux for mobile devices.

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Text book:

1. Raj Kamal, “Mobile Computing”, Oxford University Press, New Delhi, 2007.

REFERENCE TEXT BOOKS::

1. Jochen H. Schller, “Mobile Communications”, second edition, Pearson Education, New Delhi, 2007.
2. Jon W. Mark, Weihua Zhuang, “Wireless Communications and Networking”, Prentice Hall, New Delhi, 2007.

ENTERPRISE PROGRAMMING

Course Code : 11CSE21 **L-T-P : 3 – 0 – 0**

Prerequisite: **Credits: 3**

Syllabus

UNIT I:JAVA BASICS REVIEW

Java streaming - Networking - Event handling - Multithreading - Byte code Interpretation - Customizing application - Data Structures - Collection classes. **(9)**

UNIT II:DISTRIBUTED COMPUTING

Custom sockets - Remote Method Invocation - Activation - Object serialization -Distributed garbage collection - RMI - IIOP - Interface definition language - CORBA - JINI overview.

UNIT III: JAVA BEANS AND SWING

Bean concepts - Events in bean box - Bean customization - Persistence - Application - deployment using swing - Advanced swing techniques - JAR file handling. **(9)**

UNIT IV : JAVA ENTERPRISE APPLICATIONS

JNI - Servlets - Java Server Pages - JDBC - Session beans - Entity beans - Programming and deploying enterprise Java Beans - Java transactions

UNIT-V : RELATED JAVA TECHNIQUES

Java Media Frame work - 3D graphics - Internationalization - Case study - Deploying n-tier application, E- commerce applications

Text Book:

1. Deitel & Deitel , "Java How to program" , Prentice Hall , 4 th Edition, 2000.

Reference Books:

1. Gary Cornell and Cay S. Horstmann, "Core Java Vol 1 and Vol 2", Sun Microsystems Press, 1999.
2. Stephen Asbury, Scott R. Weiner, Wiley, "Developing Java Enterprise Applications", 1998.

COMPUTER NETWORKS

Course Code : 11CS506 **L-T-P : 3-1-2**

Prerequisite: **Credits: 5**

Syllabus

UNIT – I

Introduction: Use of Computer Networks, Network Hardware, Network software, Reference models, Example Networks

Physical Layer: The theoretical basis for Data Communication, Guided Transmission media, Modems, ADSL, Trunks and Multiplexing, switching

UNIT – II

Data Link Layer: DLL design issues. Error Detection and Correction, Elementary data link protocols, sliding window protocols. Medium

Access Control Sub layer: Channel allocation problem, multiple access protocols, Ethernet, Data link Layer switching

UNIT – III

Network Layer: Network layer design issues, Routing algorithms, congestion control algorithms, Quality of service, Internetworking, network layer in the Internet

UNIT – IV

Transport Layer: Transport service, Elements of transport protocols, Internet transport protocols: TCP & UDP, Performance Issues

UNIT – V

Application Layer: Domain Name System, Electronic Mail, World Wide Web.

Text Books:

1) Andrew S.Tanenbaum, Computer Networks, 2003,PHI, Fourth Edition.

Reference Books:

1. William Stallings, Data and Computer Communications, Pearson Edition,Seventh Edition ,2007
2. Behrouz A. Fourouzan, TCP/IP Protocol Suite, Tata McGraw Hill, Third Edition, 2006

SOFTWARE ENGINEERING

Course Code : 11CS507 **L-T-P : 3 – 0 – 0**

Prerequisite: **Credits: 3**

Syllabus

UNIT – I

Software and Software Engineering: Nature of software, software application domains, unique nature of web applications, software engineering, software process, software engineering practice, software myths. **Process Models:** Generic process model, prescriptive process models, specialized process models, unified process, personal and team process models, product and process. **Agile development:** Agility, agile process, extreme programming and other agile process models.

UNIT – II

Modeling: Core principles, principles that guide each frame work activity

Understanding Requirements: Identify stakeholders, Recognizing multiple view points, Eliciting requirements, building requirement model, negotiating requirements, validating requirements. **Requirement Modeling:** Analysis, Rules of Thumb, domain analysis, requirement modeling approaches, scenario based modeling, Data modeling concepts, Flow oriented modeling, creating behavioral model, patterns for requirement modeling,

UNIT – III

Design concepts: Design process, Design concepts, design model. **Architecture Design:** Software architecture, architectural styles, architectural design, assessing alternative architectural designs, architectural mappings using data flow. **Component-level design:** Designing class based components, conducting component level design.

UNIT – IV

User interface design: The golden rules, user interface analysis and design, interface analysis, interface design steps**.** **Quality concepts:** software quality, software quality dilemma, achieving software quality. **Software quality assurance:** Elements of software quality assurance, sqa tasks, goals. Formal approaches.

UNIT – V

Software testing strategies: A strategic approach to software testing, strategic issues, test strategies for conventional software, validation testing, system testing**.**

Text Book:

1. Roger S.Pressman ,"Software Engineering – A Practitioner's Approach 7^{th} Edition 2010, Mc Graw Hill.

Reference Book:

1) Ian Sommerville,'Software Engineering', Sixth Edition,2001,Pearson Education.

DATABASE MANAGEMENT SYSTEM

Course Code : 11CS508 **L-T-P : 3-1-2**
Prerequisite: **Credits: 5**

Syllabus

UNIT –I

Database fundamentals, DBMS characteristics & Advantages, Database environment, Data base users, Database architecture, data independence, Languages, tools and interfaces in DBMS. DBMS Types. (9)

UNIT- II

Data modeling – ER Model, Notation used in ER diagram, Constraints, types, relationships in ER Model and other considerations in designing ER diagram.
Enhanced ER Data Model, EER Diagram, Specialization and Generalization, Lattice, Union and Disjoint properties, Constraints and relationships, other issues in designing EER Diagram. Algorithms for ER to Relational mapping

UNIT – III

SQL: Data definition and other languages in SQL, Creating Tables, and Data types, Constraints, DML statements, Functions and writing SQL statements using nested sub queries, complex queries, joining relations. Embedded SQL - Writing Functions and procedures with PL/SQL. Relational Model, Relational Algebra, Operators in Relational Algebra.

UNIT – IV

Normalization: Guidelines for good database design, Normalization – Normal Forms, First, Second, Third Normal Forms, BCNF (Boyce Codd Normal Form). Multi value and join dependencies, 4th and 5th Normal forms. Decomposition algorithms for normalization. File and storage structures: File storage, index structures, indexing and hashing (Basics) Query Processing: Issues in query processing, simple algorithms for insert, project, join and other operators.

UNIT – V

Transaction Processing: Transaction processing issues, Transaction states, problems during multiple transaction processing, ACID properties, System Log.
Concurrency Control techniques: Binary Locks, Exclusive Locks, Lock based Techniques, Timestamp based techniques. Versioning in Locks, Multiversion Locking techniques.

Text Book:

1. Elmasri & Navathe Fundamentals of Data base Systems, 2008,4th edition, Pearson,

Reference Books

1. A Silberschatz , Henry F Korth, S. Sudarshan ,“Database System Concepts” ,2003, Fifth Edition, Tata McGraw-Hill,
2. Raghu Ramakrishnan, Johannes Gehrke, “Database management systems”, 2004 ,
2nd edition, Tata McGraw Hill

EMBEDDED SYSTEMS

Course Code : 11CS509 **L-T-P : 3 – 1 - 0**

Prerequisite: **Credits: 4**

Syllabus

UNIT I

ES BASICS: Introduction to Embedded Systems: Definition, Comparison with Loaded Systems, Challenges of Embedded systems, Application of Embedded Systems.Hardware fundamentals and devices: CHIPS, GATES, PCB, Power and decoupling, Timing Diagrams, Signal Processing related issues, Clocks, Flip Flops, Memories, Micro Processors, PINS, ports, Address Resolution, Address Decoding within Micro Processors, Micro Processors VS Micro Controllers, Busses and Bus Handling, DMA, UART and RS232, PAL, FPGA, Timers, Counters, Pulse width Modulators for speed control, LCD Controllers, Key Pad Controllers, Stepper motor controllers, A/D Converters.Introduction to temp Sensors, Flow Control devices, Humidity Control devices, Speed Control devices**.**

UNIT II

INTERFACING: Communication basics, Basic Terminology, Basic Protocol concepts, I/O Addressing: Port Based Addressing, Bus Based addressing, Memory mapped I/O, Standard I/O, Interfacing Micro Processors through Interrupts and DMA, Arbitration Techniques, Multi Bus Architecture Serial Communication and Protocols: I2C, CAN, Fire-wire, USB, Parallel Communication and protocols: PCI Bus, ARM Bus, Wireless Communication and Protocols: IrDA, Blue Tooth, 802.11g.

UNIT III

ES SOFTWARE PROCESSING PLATFORM: Micro Processor Architecture both CISC and RISC, Interrupt Processing, Shared data problem, Interrupt Latency, Software Architectures: Round Robin, Round Robin with Interrupts, Function Queue Scheduling, RTOS, Selecting architecture.

UNIT IV

REAL TIME OPERATING SYSTEMS: Tasks and Task data, Scheduler, Re-Reentrancy, Semaphores, Semaphore Problems, Message Queues, Mail Boxes, Pipes, Timer Functions, Event Handling, Memory Management, Interrupt Processing, and Power saving Functions. Introduction to μcos and VxWorks.

UNIT V

ANALYSIS, DESIGN AND SOFTWARE DEVELOPMENT: Analysis and designing Embedded Systems using RTOS, Overview, General Design Principles, Hardware and software CO design in Embedded Systems, Encapsulating Semaphores and Queues, Real Time Scheduling Considerations, Software development process and tools Testing and Debugging Techniques, Testing and Debugging Tools.

Text Books:

1. Am embedded Software Premier, David E. Simon, Person Education, 1999.
2. Embedded Systems Design, Frank Vahid /Tony Givargis, John Wiley and sons inc.

Reference Books:

1. Embedded Systems, Raj kamal, Tata McGraw- Hill Publishing Company Limited, 2003.

CLOUD COMPUTING

Course Code: 11CSE32 **L-T-P : 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT -I

Cloud Computing Basics: Overview, Applications, Intranet and the Cloud, First Movers on the cloud, the need for Cloud Computing, Benefits of cloud Computing, Limitations of the Cloud Computing, security concerns and regulatory issues, over view of different cloud computing applications which are implemented, Business case for implementing a Cloud

Introduction to Cloud Computing(Book-2): What and what is not cloud computing, Moving from collaboration to cloud, Cloud Architectures, cloud storage, cloud Services, reasons for cloud computing, pros and cons of cloud computing, benefits of cloud computing, users of cloud computing **(9)**

UNIT II

Cloud Computing Technologies: Hardware and Infrastructure: Clients, Security, Network, services**Accessing the Clouds**: Platforms, WEB applications, WEB APIS, WB Browsers

Cloud Storage: Overview, Storage provides, **Cloud Standards**: Applications, Client, Infrastructure, Services **(9)**

UNIT III

Cloud Computing Mechanisms: Software as a service: Overview, Driving Forces, Company offerings, Industries, Software + services: Overview, Mobile Device Integration, Providers, Microsoft Online**Application development:** Google, Microsoft, Intuit Quick base, Cast Iron Cloud, Bungee Connect, **Development Platforms**: Google, Sales Force, Azure, Trouble shooting, Application management **(9)**

UNIT IV

Local Clouds: Virtualization, server solutions, Thin Clients

Migrating to the clouds: Cloud services for individuals, Mid-market, and Enterprise wide, Migration, best practices, analyzing the service **(9)**

UNIT V (BOOK-2)

Using Cloud Services: Collaborating on Calendars, Schedules, and Task Management, Collaborating on Event management, Collaborating on Contact management, collaborating on Project Management, Collaborating on Word Processing, Collaborating on Spread sheets, Collaborating on Databases, Collaborating on presentations, Storing and sharing Files and other online content, sharing Digital Photographs, controlling the collaborations with Web-Based Desktops**Online Collaborations**: Collaborating Via WEB based communication Tools, Collaborating Via Social Networks and Groupware, collaborating Via Blogs and Wikis **(9)**

TEXT BOOKS:

1. Cloud Computing a Practical approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, Tata McGraw-HILL, 2010 Edition

2. Cloud Computing-Web Based applications that change the way you work and collaborate online, Michael Miller, Pearson Education, 2009 Edition

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SEMANTIC WEB

Course Code : 11CSE41 **L-T-P : 4 – 0 - 0**
Prerequisite: **Credits: 4**

Syllabus

UNIT I

The Semantic Web Vision: Introduction to the WEB and WEB technologies, Introduction to Semantic WEB, Semantic WEB Technologies, Approaches to building Semantic WEB
Structured web Documents in XML: Introducing XML Language, The XML language: Structuring, DTDs, XML schema, Namespaces, Addressing and Querying XML Documents, XML Processing.

UNIT II

Describing web resources in RDF: Overview of RDF, RDF data Model: Basic ideas, XML-Based syntax, RDF Schema, The RDF language, Axiomatic semantics for RDF, A direct inference system for RDF (S), Querying in RQL.
Web Ontology Language: OWL: Overview of WEB Ontology Language, The OWL Language, African wildlife ontology, Printer ontology, OWL, Future extensions of Ontology Language.

UNIT III

Logic and Inference Rules: Introduction to Inference Language: Family Relations, Monotonic Rules: Syntax and Semantics, Non monotonic Rules: Syntax and Semantics, Markup of Rules in XML: Monotonic Rules, Non monotonic Rules.

UNIT IV

Ontology Engineering: Introduction, Manually constructing ontologies, Re-using existing ontologies, using semi-automatic methods, Knowledge Semantics and web architecture.

UNIT V

Applications: Introduction, Horizontal information products from Elsevier, Data integration at Boeing (and elsewhere), Skill-finding at Swiss Life, Think tank portal at Enersearch, eLearning, Web Services, Other applications scenarios.

TEXT Book:

1. Griogoris Antoniou and Frank van Harmelen, “A Semantic Web by primer”, The MIT Press Cambridge, Massachusetts, and London, England.

Reference Books:

1. John Hebeler , Matthew Fisher , Ryan Blace , Andrew Perez-Lopez, Mike Dean, “Semantic Web Programming”, Recursive press
2. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, “Foundations of Semantic Web Technologies”, CRC Press A Chapmann & Hall book

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
M-TECH COURSE STRUCTURE WITH SYLLABUS

M-TECH (CR) COURSE STRUCTURE WITH SYLLABUS

S.NO	Course Code	COURSE TITLE	L-T-P	Credits
	SEMESTER1			
1	13EC501	MODERN DIGITAL COMMUNICATION	3-1-2	5
2	13EC502	RADIATION SYSTEM	3-1-0	4
3	13EC503	MICROWAVE AND MILLIMETERWAVE CIRCUITS	3-1-2	5
4	13EC520	IMAGE AND VIDEO PROCESSING	3-1-0	4
5		ELECTIVE1	3-0-0	3
6		ELECTIVE2	3-0-0	3
7	KLU C503	SEMINAR	0-0-4	2
				26

S.NO	Course Code	COURSE TITLE	L-T-P	Credits
	SEMESTER2			
1	13EC521	ADVANCED DIGITAL SIGNAL PROCESSING	3-1-2	5
2	13EC522	RADAR SIGNAL PROCESSING	3-1-0	4
3	13EC504	WIRELESS CELLULAR COMMUNICATION	3-1-0	4
4	13EC566	CMOS RF CIRCUIT DESIGN	3-1-0	4
5		ELECTIVE3	3-0-0	3
6		ELECTIVE4	3-0-0	3
7	KLU C504	TERMPAPER	0-0-4	2
				25

S.NO	Course Code	COURSE TITLE	L-T-P	Credits
	SEMESTER3			
1	14TM602	INTERNSHIP	0-0-36	18
S.NO	Course Code	COURSE TITLE	L-T-P	Credits
	SEMESTER4			
1	KLU C502	THESIS	0-0-36	18
		TOTAL Credits		87
		ELECTIVE1		
1	13EC523	ARRAY SIGNAL PROCESSING	3-0-0	3
2	13EC524	SPEECH PROCESSING	3-0-0	3
3	13EC533	CODING THEORY	3-0-0	3
4	13EC559	VLSI SIGNAL PROCESSING	3-0-0	3
5	13EC580	BRAODBAND ACCESS TECHNOLOGIES	3-0-0	3
		ELECTIVE2		
1	13EC508	FUNDAMENTALS OF ELECTRONIC WARFARE	3-0-0	3
2	13EC525	WIRELESS COMMUNICATION SIGNAL PROCESSING	3-0-0	3
3	13EC526	BIO-MEDICAL SIGNAL PROCESSING	3-0-0	3
4	13EC550	MOS CIRCUIT DESIGN	3-0-0	3
5	13EC582	OPTICAL NETWORKS	3-0-0	3

ELECTIVE3

1	13EC506	ESTIMATION AND DETECTION THEORY	3-0-0	3
2	13EC530	ADAPTIVE SIGNAL PROCESSING	3-0-0	3
3	13EC556	VLSI SYSTEM DESIGN	3-0-0	3
4	13EC574	VLSI FOR WIRELESS COMMUNICATION	3-0-0	3
5	13EC581	HIGH PERFORMANCE COMMUNICATION NETWORKS	3-0-0	3

ELECTIVE4

1	13EC505	RF AND MW SYSTEM DESIGN	3-0-0	3
2	13EC509	ANTENNA MEASUREMENTS	3-0-0	3
3	13EC534	OPTICAL SIGNAL PROCESSING	3-0-0	3
4	13EC555	LOW POWER VLSI DESIGN CIRCUITS	3-0-0	3
5	13EC583	WIRELESS SENSOR NETWORKS	3-0-0	3

MODERN DIGITAL COMMUNICATION

Course Code: 13EC501 **L-T-P: 3-1-2**
Prerequisite: **Credits: 5**

Syllabus
Modern Digital Modulation Techniques:
Introduction, Information Capacity, Bits, Bit Rate, Baud rate & M-ary Encoding, ASK, FSK, PSK QAM Bandwidth Efficiency Carrier Recovery, Clock Recovery, DPSK, Trellis Code Modulation, Probability of Error & Bit Error Rate, Error Performance.
Baseband Data Transmission:
Introduction – Baseband Binary PAM Systems – Baseband Pulse Shaping, Optimum Transmitting and Receiving Filters – Duobinary Baseband PAM System – Use of Controlled ISI in Duobinary Signaling Schemes, Transmitting and Receiving Filters for Optimum Performance.
M-ary Signaling Schemes
Analysis and Design of M-ary Signaling Schemes, Binary Versus M-ary Signaling Schemes - Shaping of the Transmitted Signal Spectrum – Effect of Pre coding on the Spectrum, Pulse Shaping by Digital Methods - Equalization - Transversal Equalizer, Automatic Equalizers
Block and Convolutional Channel Codes: Linear Block Codes - The Generator Matrix and Parity Check Matrix, Cyclic Codes, Bounds on Minimum Distance of Linear Block Codes, Non Binary Block Codes – Convolutional Codes – Transfer Function of a Convolutional Code, Optimum Decoding of Convolutional Code –Distance Properties of Binary Convolutional Codes
Spread Spectrum Signals for Digital Communication: Model of Spread Spectrum Digital Communication System – Direct Sequence Spread Spectrum Signals – Error Rate Performance of the Decoder, Some Applications of DS Spread Spectrum Signals, Generation of PN Sequences – Frequency Hopped Spread Spectrum Signals – Performance of FH Spread Spectrum Signals in an AWGN Channel, CDMA System Based on FH Spread Spectrum
Signals Emerging Digital Communication Technologies: The North American Hierarchy, Digital Services, Broad band Digital Communication: SONET, Digital Switching Technologies, Broadband Services for Entertainment and Home office Applications, Video Compression, High Definition Television(HDTV)

Text Books:

1. Advanced Electronic Communications Systems, by Wayne Tomasi, 6 Edition Pearson Education.
2. K Sam Shanmugam, Digital and Analog Communication Systems, John Wiley and sons (Asia) Pvt Ltd.

Reference Text Books:

1. Simon Haykin, Digital communications, John Wiley and sons, 1998
2. Wayne Tomasi, Advanced electronic communication systems, 4th Edition Pearson Education Asia, 1998
3. B.P.Lathi Modern digital and analog communication systems, 3rd Edition, Oxford University press
4. Ravindranathan” Communication Systems Modeling Using Matlab & Simulink” Universities Press

RADIATION SYSTEMS

Course Code: 13EC502 **L-T-P: 3-1-2**
Prerequisite: **Credits: 5**

Syllabus

Basics Concepts of Radiation
Radiation from surface current and current line current distribution, Basic antenna parameters, Radiation mechanism-Current distribution of Antennas, Impedance concept-Balanced to Unbalanced transformer
Radiation from Apertures
Field equivalence principle, Rectangular and circular apertures, Uniform distribution on an infinite ground plane, Aperture fields of Horn antenna-Babinets principle, Geometrical theory of diffraction, Reflector antennas, and Design considerations - Slot antennas
Synthesis of Array Antennas
Types of linear arrays, current distribution in linear arrays, Phased arrays, Optimization of Array patterns, Continuous aperture sources, Antenna synthesis techniques
Micro Strip Antennas
Radiation mechanisms, Feeding structure, Rectangular patch, Circular patch, Ring antenna. Input impedance of patch antenna, Microstrip dipole, Microstrip arrays
EMI/EMC/Antenna Measurements:
Log periodic, Bi-conical, Log spiral ridge Guide, Multi turn loop, Traveling Wave antenna, Antenna measurement and instrumentation, Amplitude and Phase measurement, Gain, Directivity, Impedance and polarization measurement, Antenna range, Design and Evaluation

Text Books:
1. Kraus.J.D.,"Antennas"II Edition, John wiley and Sons.
2. Balanis.A, "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 1982

Reference Text Books:
1. RF System Design**,** Peter Kinget Bell Laboratories, Lucent Technologies Murray Hill,
2. Practical RF system design, Wiley-IEEE, 2003 - Technology & Engineering

MICROWAVE AND MILLIMETER WAVE CIRCUITS

Course Code: 13EC503 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Analysis of Microwave Circuits: Introduction, Microwave Components – E-plane Tee, H-plane Tee, Magic Tee, Directional Coupler, Isolator, Circulator & their Scattering
Transformers & Resonators: Parameters, Impedance Transformers – Quarter wave Transformers, Microwave Resonators – Rectangular and Cylindrical Resonators.
Filters And Periodic Structures: Design of Narrow Band Low Pass, Band Pass and High Pass Filters, Maximally flat and Chebyshev Designs, Introduction to Periodic Structures, Floquet's Theorem, Circuit Theory Analysis of Infinite and Terminated Structures
Obstacles In Wave Guides: Introduction, Posts in Waveguides, Diaphragms in Waveguides, Waveguide Junctions, Waveguide Feeds, Excitation of Apertures
Millimeter Wave Circuits: Wave Propagation in microstriplines, Discontinues in Microstrips, Parallel Coupled lines, Power Dividers and Directional Couplers, Microwave and Millimeter Wave Integrated Circuits

Text Books:
1. Roger F. Harrington, "Time-Harmonic Electromagnetic Fields", Mc graw-hill
2. Robert E Collin, "Foundation For Microwave Engineering", Mc Graw-Hill.

Reference Books
1. Analysis Methods for RF, Microwave, and Millimeter-Wave Planar Transmission Line Structures by Cam Nguyun

IMAGE AND VIDEO PROCESSING

Course Code: 13EC520 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms
Image Processing Techniques: 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 Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation
Image Compression Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards
Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations
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.

Text Books:

1. Gonzaleze and Woods ,"Digital Image Processing ", 3rd edition , Pearson
2. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication ",1st edition , PHI

Reference Text Book:

1. M. Tekalp ,"Digital video Processing", Prentice Hall International

Simulation TEXT BOOKS:

1. Relf, Christopher G.,"Image acquisition and processing with LabVIEW", CRC press
2. Aner ozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", John Wiley & Sons
3. Chris Solomon, Toby Breckon ,"Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons

ARRAY SIGNAL PROCESSING

Course Code: 13EC523 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Spatial Signals, Signals in space and time. Spatial frequency, Direction vs. frequency. Wave fields. Far field and near field signals.
Sensor Arrays, Spatial sampling, Nyquist criterion. Sensor arrays. Uniform linear arrays, planar and random arrays. Array transfer (steering) vector. Array steering vector for ULA. Broadband arrays.
Spatial Frequency, Aliasing in spatial frequency domain. Spatial Frequency Transform, Spatial spectrum. Spatial Domain Filtering. Beam Forming. Spatially white signal.
Direction of Arrival Estimation, Non parametric methods - Beam forming and Capon methods. Resolution of Beam forming method. Subspace methods - MUSIC, Minimum Norm and ESPRIT techniques. Spatial Smoothing.

Text Books:

1. Dan E. Dugeon and Don H. Johnson.," Array Signal Processing: Concepts and Techniques. Prentice Hall.
2. Petre Stoica and Randolph L. Moses. "Spectral Analysis of Signals. Prentice Hall.

SPEECH PROCESSING

Course Code: 13EC524 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Basic Concepts: Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

Speech Analysis: Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

Speech Modeling: Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

Speech Recognition: Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word **UNIT**s; Applications and present status.

Speech Synthesis: Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word **UNIT**s for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

Text Books:

1. Lawrence Rabinerand Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education.

Reference Text Books:

1. Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing.
2. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education.
3. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999.
4. Ben gold and Nelson Morgan, “Speech and audio signal processing”, processing and perception of speech and music, Wiley- India Edition, 2006 Edition.
5. Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press.

CODING THEORY

Course Code: 13EC533 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Coding for Reliable Transmission: Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information, 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.

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

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

Burst –Error-Correcting codes: Decoding of Single-Burst error Correcting Cyclic codes, Single-Burst-Error-Correcting Cyclic codes, Burst-Error-Correcting Convolutional Codes, Bounds on Burst Error-Correcting Capability, Interleaved Cyclic and Convolution Codes , Phased-Burst –Error-Correcting Cyclic and Convolution codes.

BCH – Codes: BCH code- Definition, Minimum distance and BCH Bounds, Decoding Procedure for BCH Codes- Syndrome Computation and Iterative Algorithms, Error Location Polynomials and Numbers for single and double error correction

Text Books:

1. K. Sam Shanmugam **,"Digital and analog communication systems",** John Wiley, 1996.
2. Simon Haykin **,"Digital communication"** , John Wiley, 2003.
3. Shu Lin, Daniel J.Costello, Jr, "Error Control Coding- Fundamentals and Applications" –Prentice Hall, Inc.
4. Error Correcting Coding Theory-Man Young Rhee- 1989, McGraw-Hill Publishing.

Reference Text Books:

1. Digital Communications-Fundamental and Application - Bernard Sklar, PE.
2. Digital Communications- John G. Proakis, 5th ed., 2008, TMH.
3. Introduction to Error Control Codes-Salvatore Gravano-oxford
4. Error Correction Coding – Mathematical Methods and Algorithms – Todd K.Moon,
5. 2006, Wiley
6. Information Theory, Coding and Cryptography – Ranjan Bose, 2ndEdition, 2009, TMH.

VLSI SIGNAL PROCESSING

Course Code: 13EC559 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Introduction to DSP Systems: Introduction, representation of DSP algorithms: Block Diagram, signal flow graph, data flow graph, dependence graph.
Iteration Bound: Data flow graph representations, loop bound and iteration bound, longest path matrix algorithm, iteration bound of Multirate data flow graphs.
Pipelining and Parallel Processing: Pipelining and parallel processing of FIR digital filters, pipeline interleaving in digital filters: signal and multichannel interleaving.
Retiming, Unfolding and Folding: retiming techniques; algorithm for unfolding, Folding transformation, systolic architecture design, systolic array design methodogy.
Fast Convolution, Filters and Transforms: Cook-toom algorithm, modified cook-toom algorithm, winogard algorithm, iterated convolution Algorithm strength reduction in filters and transforms.

Text Book:

1. Keshab k. Parhi," VLSI Digital Signal Processing Systems: Design and Implementation", Wiley, inter science.

Reference Books

1. S.Y.kung, H.J.White house, T. Kailath," VLSI and Modern Signal Processing", Prentice hall

BROAD BAND ACCESS TECHNOLOGIES

Course Code: 13EC580 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Review of Access Technologies: Phone-Line modem, cable-access, ISDN, Emerging Broad band Technologies, Cable DSL, Fiber and Wireless

Digital Subscriber Lines: Asymmetric Digital subscriber lines (ADSL) – Rate Adaptive subscriber line (RADSL)-ISDN Digital subscriber line (IDSL) - High bit rate DSL (HDSL)- Single line DSL (SDSL)- very high bit rate DSL (VDSL)- Standards for XDSL & Comparison.

Cable Modem: Cable Modem, DOCSIS – Physical Cabling, Dual Modem Operation, Hub Restriction, Upstream Operation – Downstream operation – Access control – framing Security sub layer – Data link layer – LLC & Higher layers – ATM centric VS IP – centric cable modem.

Fiber Access Technologies: Optical Fiber in access networks, Architecture and Technologies- Hybrid fiber – Coax (HFC) system, Switched Digital Video (SDV) – Passive optical networks (PON) – FTTX (FTTH, FTTB, FTTC, FTT cab) comparison.

Broad Band Wireless: Fixed Wireless, Direct Broadcast Satellite (DBS), Multi channel multi point distribution services (MMDS), Local multi point distribution services (LMDS), and Wideband integrated Digital Interactive Services (WIDIS), Mobile Wireless 3G – IMT 2000.

Text Books:

1. Niel Ransom and Albert A. Azzam, "Broadband Access Technologies: ADSL, VDSL Cable Modem, Fiber and LMDS, McGraw Hill 1999.
2. Gilbert Held, "Next Generation Modems: A Professional Guide to DSL and cable modems", John Wiley & sons.

Reference Books

1. Walter j Woralski, "ADSL and DSL Technologies", McGraw Hill computer Communication series, 1998.
2. William Webb, "Introduction to Wireless Local Loop broadband and narrow band system", Artech House, 2000.
3. Martin P. Clarke, "Wireless Access Network: Fixed Wireless Access and WLL network Design and operation", John Wiley & Sons 2000.

FUNDAMENTALS OF ELECTRONIC WARFARE

Course Code: 13EC508 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Targets of Electronic Warfare Operations: A General Description of Targets of Electronic Warfare Operations, Mathematical Models of Electronic Systems as Targets of Electronic Warfare, Mathematical Models of Automated Systems for the Control of AAD Forces as Targets of EW, Mathematical Models of Automated Systems for the Control of AAD Weapons as Targets of Electronic Warfare
Mathematical Models of Signals, Systems and Techniques for Electronic Jamming: A General Description of the Basic Elements of Electronic Jamming, Mathematical Models of Jamming Signals, Mathematical Models of Systems and Techniques for Jamming.
Electronic Warfare Effectiveness Criteria: General Characteristics of the Criteria, Information Indicators of the Effectiveness of Jamming Signals, Systems and Techniques of Electronic Attack, Energy Effectiveness Criteria of Jamming Signals and Techniques of Electronic Jamming, Operational and Tactical Indicators of EW Effectiveness
Active Jamming of Radar -The Jamming Equation: Fundamental Concepts, The Jamming Equation for Monostatic Radar Using Active Jamming, Reduction of the Jamming Equation to Canonical Form -Methods of Determining Information Damage, Specifics of the Jamming Equation Using Active Jamming against Various Types of Radar, Particulars of Jamming Radar Using Screening Jamming with Limited Information Quality Indicators -Use of the Jamming Equation for Analysis of the Electronic Environment
Passive and Active-Passive Radar Jamming - The Jamming Equation: Types of Passive Jamming - Chaff, Formation Dynamics and Statistical Characteristics of Chaff Clouds, The Equation for Radar Jamming Using Passive Jamming, - The Jamming Coefficient for Noncoherent Radar, The Jamming Coefficient Using Passive Jamming for Coherent Pulse-Radar, Effectiveness of Radar Jamming Using Passive Jamming - Determination of the Required Quantity of Chaff, Active-Passive Jamming
False Radar Targets and Decoys: Types of False Radar Targets, Decoys and Disposable EW Devices, Parameters Simulated by False Radar Targets and Radar Decoys, Thermal Decoys, The Use of Towed and Launched Decoys, Selecting Decoy Launch Time

Text Book:

1. Sergei A. Vakin,Lev N. Shustov, Robert H. Dunwell, "Fundamentals of Electronic Warfare, Artech House

WIRELESS COMMUNICATION SIGNAL PROCESSING

Course Code: 13EC525 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Linear Diversity Techniques for Fading Channels System and Fading Channels Models: Transmission without Diversity, Spectral Diversity, Temporal Diversity, spatial Diversity, Diversity methods for multiuser system

Adaptive Interference Suppression: Multiple Access Signal Model, Elements of multiuser detection, Linear interference suppression, Application to DS-CDMA, Adaptive algorithms

Equalization of Multiuser Channels: Characterization of wireless channels, equalization of known multipath fading, Blind equalization in multipath slowly time varying channel

Blind Space Time Signal Processing : The wireless propagation environment, signal model and structure, channel identification & equalization, Blind techniques

Network Capacity, Power control & effective Bandwidth: Basic spread spectrum model & the MMSE Receiver, performance under random spreading sequences, Capacity and performance under power control, Multiple classes, maximum power constraints, effective Bandwidth

Text Book:

1. H V Poor & G W Wornell," Wireless Communication Signal Processing Perspectives", PHI

BIOMEDICAL SIGNAL PROCESSING

Course Code: 13EC526 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction to Biomedical Signals - Examples of Biomedical signals - ECG, EEG, EMG etc - Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. Origin of bio potentials - Review of linear systems - Fourier Transform and Time Frequency Analysis (Wavelet) of biomedical signals- Processing of Random & Stochastic signals – spectral estimation – Properties and effects of noise in biomedical instruments - Filtering in biomedical instruments

Concurrent, Coupled and Correlated Processes - illustration with case studies – Adaptive and optimal filtering - Modeling of Biomedical signals - Detection of biomedical signals in noise -removal of artifacts of one signal embedded in another -Maternal-Fetal ECG - Muscle-contraction interference. Event detection - case studies with ECG & EEG - Independent Component Analysis - Cocktail party problem applied to EEG signals - Classification of biomedical signals.

Cardio Vascular Applications: Basic ECG - Electrical Activity of the heart- ECG data acquisition – ECG parameters & their estimation - Use of multiscale analysis for ECG parameters estimation - Noise & Artifacts- ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection - Arrhythmia analysis

Data Compression: Lossless & Lossy- Heart Rate Variability – Time Domain measures - Heart Rhythm representation - Spectral analysis of heart rate variability - interaction with other physiological signals.

Neurological Applications: The electroencephalogram - EEG rhythms & waveform - categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, stochastic models – Non linear modeling of EEG - artifacts in EEG & their characteristics and processing – Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis – correlation analysis of EEG channels - coherence analysis of EEG channels.

Text Books:

1. D.C.Reddy, “Biomedical Signal Processing: Principles and techniques” ,Tata McGraw Hill, New Delhi, 2005
2. Willis J Tompkins , Biomedical Signal Processing -, ED, Prentice – Hall, 1993

Reference Text Books:

1. R. Rangayan, “Biomedical Signal Analysis”, Wiley 2002.
2. Bruce, “Biomedical Signal Processing & Signal Modeling,” Wiley, 2001
3. Sörnmo, “Bioelectrical Signal Processing in Cardiac & Neurological Applications”, Elsevier Semmlow, “Bio-signal and Biomedical Image Processing”, Marcel Dekker
4. Enderle, “Introduction to Biomedical Engineering,” 2/e, Elsevier, 2005

MOS CIRCUIT DESIGN

Course Code: 13EC550 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction: Classification of CMOS digital circuits and Circuit design, Overview of VLSI design methodologies, VLSI design flow, Design hierarchy and concepts, VLSI design styles, Design quality, Packing technology, CAD technology, Fabrication process flow, CMOS n-well process, layout design rules.

MOS Transistor and Circuit Modeling: MOS structure, MOS system under external bias, structure and operation of MOS transistor, MOSFET current-voltage characteristics, MOSFET scaling and small-geometry effects, MOSFET capacitances, Modeling of MOS transistor using SPICE.

MOS Inverter static characteristics and Interconnect Effects: Introduction, Resistive-Load Inverter, Inverter with n-type MOSFET load, CMOS Inverter, Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.

Combinational and Sequential MOS logic Circuits: Introduction, MOS logic circuits with depletion nMOS loads, CMOS logic Circuits, Complex logic circuits, CMOS transmission gates (Pass gates), Behavior of bistable elements, SR latch circuit, clocked latch and flip-flop circuits, CMOS D-latch and Edge-triggered flip-flop.

Dynamic logic Circuits: Basic principles of pass transistor circuits, voltage bootstrapping, synchronous dynamic circuit techniques, Dynamic CMOS circuit techniques, High-performance dynamic CMOS circuits.

Text Books:

1. Sung-Mo Kang, Yusuf Leblebici, “CMOS Digital Integrated Circuits” TMH 2003
2. Neil H. E. Weste and David. Harris Ayan Banerjee,, “CMOS VLSI Design” - Pearson Education, 1999.

Reference Text Books:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “Digital Integrated Circuits” Pearson Education, 2003
2. Uyemura, “Introduction to VLSI Circuits and Systems” Wiley-India, 2006.
3. Wayne Wolf, “Modern VLSI Design ", 2nd Edition, Prentice Hall,1998.
4. Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, “Essentials of VLSI Circuits and Systems” – PHI, EEE, 2005 Edition.

Simulation Book:

1. Etienne Sicard, Sonia Delmas Bendhia, “Basics of CMOS Cell Design”, TMH, EEE, 2005.

OPTICAL NETWORKS

Course Code: 13EC582 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus
Optical System Components And Network Design: Optical System Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters; Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations.
Optical Network Architectures: Introduction to Optical Networks; SONET / SDH, Metropoliton-Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies, Media-Access Control Protocols and Testbeds; Wavelength Routing Architecture.
Wavelength Routing Networks: WDM Network Elements; WDM Network Design - Cost tradeoffs, Virtual Topology Design, Routing and wavelength assignment, Statistical Dimensioning Models.
Packet Switching And Access Networks: Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronisation, Header Processing, Buffering, Burst Switching, Testbeds; Access Networks.
Network Management And Survivability: Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface; network Survivability- Protection in SONET / SDH and IP Networks, Optical layer Protection, Interworking between layers.

Text Books:
1. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks: A Practical Perspective", Harcourt Asia Pte Ltd., Second Edition 2006.

Reference Text Books:
1. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks : Concept, Design and Algorithms", Prentice Hall of India, Ist Edition, 2002.
2. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.
3. Biswanath Mukherjee, "Optical WDM Networks", Springer, 2006.

WIRELESS CELLULAR COMMUNICATION

Course Code: 13EC504 **L-T-P: 3-1-2**
Prerequisite: **Credits: 5**

Syllabus
Introduction to Cellular Mobile Systems: Cellular Mobile Telephone Systems, A Basic Cellular System, Operation of Cellular Systems.
Elements of Cellular Mobile Radio System Design: General Description of the problem, Concept of Frequency reuse channels, Co-Channel Interference Reduction Factor, Handoff Mechanism, Cell Splitting.
Speech Coding for Wireless Systems Applications: Introduction to Digital Signal Processing (DSP) Techniques in Wireless Telephone and Broadcast Systems, Speech Coding Techniques for Audio and Voice – Pulse Code Modulation, DPCM, Delta Modulation, Vocoder and Linear Predictive Coding, Performance Comparison of Speech Processing Techniques.
Radio Propagation and Cellular Engineering Concepts: Fundamental Radio Propagation and System Concepts, Propagation Characteristics, Models of Multipath-faded radio signals – Un modulated Carrier, Envelope and Phase faded, Level Crossing rate and fade Duration, Delay Spread Measurements.
Digital Modulation-Demodulation (Modem) Principles and Architectures: Coherent Modem – Baseband Modem Equivalence, Coherent and Differentially Coherent Binary Phase Shift Keying Systems, Synchronization – Carrier Recovery and Symbol Timing Recovery, Differential Encoding and Decoding Requirement, Quadrature Phase shift Keying – Coincident and offset Types, Pi/4 DQPSK Modems – Architecture.
Interference In Wireless Digital Communication: Carrier-to-Interference and Carrier-to-Noise Limited Systems, Cochannel Interference, Adjacent Channel Interference. Externally caused Cochannel Interference, Definitions and performance of Spectral and Power Efficiency, Relationship of the Bit-Energy to Noise-Density Ratio and the Carrier-to-Noise Ratio, Power Efficiency and Bit-Error-Rate performance in an Additive White Gaussian Noise Environment, Concepts of Diversity Branch and Signal paths; Combining and Switching Methods.

Text Books:

1. DR Kamilo Feher Wireless Digital Communications, Prentice Hall of India, New Delhi – 1999
2. William Cy Lee, Mobile Cellular Telecommunications, 2nd Edition, MC Graw Hill.

ADVANCED DIGITAL SIGNAL PROCESSING

Course Code: 13EC521 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus
Multirate Digital Signal Processing Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion
Multirate Digital Signal Processing Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing, Sampling Rate Conversion of Bandpass Signals
Linear Prediction And Optimum Linear Filters: Innovations Representation of a Stationary Random Process, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of linear prediction-Error Filter, AR Lattice and ARMA Lattice-Ladder Filters.
Power Speciral Estimation: Estimation of Spectra from Finite Duration Observations of a signal, the Periodogram, Use DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Tukey methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods
Parametric Method Of Power Spectrum Estimation: Parametric Methods for power spectrum estimation, Relationship between Auto-Correlation and Model Parameters, AR (Auto-Regressive) Process and Linear Prediction, Yule-Walker, Burg and Unconstructrained Least Squares Methods, Sequential Estimation, Moving Average(MA) and ARMA Models Minimum Variance Method, Piscaranko's Harmonic Decomposition Methods, MUSIC Method**.**

Text Books:

1. Proakis JG and Manolakis DG Digital Signal Processing Principles, Algorithms and Application, PHI.
2. Openheim AV & Schafer RW, Discrete Time Signal Processing PHI.

Simulation Text Books:

1. Samuel D Stearns, "Digital Signal Processing with examples in Matlab. " CRC Press.
2. ES Gopi. "Algorithm collections for Digital Signal Processing Applications using Matlab, " Springer.
3. Taan S.Elali, "Discrete Systems and Digital Signal Processing with Matlab, " CRC Press,2005.

RADAR SIGNAL PROCESSING

Course Code: 13EC522 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus
Angle-of-Arrival Estimation in the Presence of Multipath: The Low-Angle Tracking Radar Problem, Spectrum Estimation Background, Thomson's Multi-Taper Method, Test Dataset and a Comparison of Some Popular Spectrum Estimation Procedures, Multi-taper Spectrum Estimation, *F*-Test for the Line Components, Experimental Data Description for a Low-Angle Tracking Radar Study
Time–Frequency Analysis of Sea Clutter: An Overview of Non-stationary Behaviour and Time–Frequency Analysis, Theoretical Background on Non-stationary, High-Resolution Multi-taper Spectrograms
Dynamics of Sea Clutter: Statistical Nature of Sea Clutter: Classical Approach, Is There a Radar Clutter Attractor, Hybrid AM/FM Model of Sea Clutter, Evidence for Amplitude Modulation, Frequency Modulation, and More, Modelling Sea Clutter as a Non-stationary Complex Autoregressive Process
Sea-Clutter Non-stationary: The Influence of Long Waves: Radar and Data Description, Statistical Data Analyses, Modulation of Long Waves: Hybrid AM/FM Model, Non-stationary AR Model, Parametric Analysis of Texture Process
Two New Strategies for Target Detection in Sea Clutter: Bayesian Direct Filtering Procedure, Operational Details, Experimental Results on the Bayesian Direct Filter, Additional Notes on the Bayesian Direct Filter, Correlation Anomally Detection Strategy

Text Books:

1. Haykin, Simon S,"Radar Adaptive signal processing", John Wiley & Sons
2. Mark A Richards, "Fundamentals of Radar signal processing", M C Graw Hill

CMOS RF CIRCUIT DESIGN

Course Code: 13EC566 **L-T-P: 3-0-0**
Prerequisite: **Credits:**

Syllabus

Introduction to RF Design and Wireless Technology: Design and Applications, Complexity and Choice of Technology. Basic concepts in RF design: Nonlinearly and Time Variance, Inter symbol interference, random processes and noise. Sensitivity and dynamic range, conversion of gains and distortion

RF Modulation: Analog and digital modulation of RF circuits, Comparison of various techniques for power efficiency, Coherent and non-coherent detection, Mobile RF communication and basics of Multiple Access techniques. Receiver and Transmitter architectures, Direct conversion and two-step transmitters

RF Testing: RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.

BJT and MOSFET behavior at RF Frequencies: BJT and MOSFET behavior at RF frequencies, modeling of the transistors and SPICE model, Noise performance and limitations of devices, integrated parasitic elements at high frequencies and their monolithic implementation

RF Circuits Design: Overview of RF Filter design, Active RF components & modeling, Matching and Biasing Networks. Basic blocks in RF systems and their VLSI implementation, Low noise Amplifier design in various technologies, Design of Mixers at GHz frequency range, Various mixers- working and implementation. Oscillators- Basic topologies VCO and definition of phase noise, Noise power and trade off. Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers, Design issues in integrated RF filters.

Text Books:

1. B. Razavi, “RF Microelectronics” PHI 1998
2. R. Jacob Baker, H.W. Li, D.E. Boyce “CMOS Circuit Design, layout and Simulation”, PHI

Reference Books:

1. Thomas H. Lee “Design of CMOS RF Integrated Circuits” Cambridge University press 1998.
2. Y.P. Tsividis, “Mixed Analog and Digital Devices and Technology”, TMH 1996

ESTIMATION AND DETECTION THEORY

Course Code: 13EC506 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Detection Theory: Maximum likelihood decision criterion; Neumann-Pearson criterion; Probability of error criterion; Bayes risk criterion; minimax criterion; robust detection; Receiver operating characteristics.

Detection Theory: Vector observations; the general Gaussian problem; Waveform observation in additive Gaussian noise; the integrating optimum receiver; Matched filter receiver.

Maximum Likelihood Estimation; Bayes cost method Bayes estimation criterion – Mean square error criterion; Uniform cost function; absolute value cost function; Linear minimum variance - Least squares method;

Estimation in the presence of Gaussian noise -Linear observation; Non-linear estimation. Properties of estimators**:** Bias, Efficiency, Cramer Rao bound asymptotic properties; Sensitivity and error analysis

Prediction; Kalman filter. Sufficient statistics and statistical estimation of parameters: Concept of sufficient statistics; Exponential families of distributions; Exponential families and Maximum likelihood estimation; uniformly minimum variance unbiased estimation.

Text Books:

1. Steven M. Kay, Statistical Signal Processing: Vol. 1: Estimation Theory, Vol. 2: Detection Theory, Prentice Hall Inc., 1998.
2. Harry L. Van Trees, Detection, Estimation and Modulation Theory, Part 1, John Wiley & Sons

Reference Text Books:

1. James L. Melsa and David L. Cohn, Decision and Estimation Theory, McGraw Hill, 1978.
2. Dimitri Kazakos, P. Papantoni Kazakos, Detection and Estimation, Computer Science Press,
3. Jerry M. Mendel, Lessons in Estimation Theory for Signal Processing,
4. Communication and Control, Prentice Hall Inc.
5. Sophocles J. Orfanidis, Optimum Signal Processing 2nd edn., McGraw Hill.
6. Monson H. Hayes, Statistical Digital Signal Processing and Modelling, John Wiley & Sons
7. Scott C. Statistical Signal Processing, June 14, 2004.

ADAPTIVE SIGNAL PROCESSING

Course Code: 13EC530 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Complex-Valued Adaptive Signal Processing: Optimization in the Complex Domain, Widely Linear Adaptive Filtering, Nonlinear Adaptive Filtering with Multilayer Perceptrons, Complex Independent Component Analysis

Robust Estimation Techniques for Complex-Valued Random Vectors: Statistical Characterization of Complex Random Vectors, Complex Elliptically Symmetric (CES) Distributions, Tools to Compare Estimators, Scatter and Pseudo-Scatter Matrices Array Processing Examples, MVDR Beamformers Based on M-Estimators

Turbo Equalization: Communication Chain, Turbo Decoder: Overview, Forward-Backward Algorithm, Simplified Algorithm: Interference Canceler, Capacity Analysis, Blind Turbo Equalization, Convergence, Multichannel and Multiuser Settings

Subspace Tracking for Signal Processing: Linear Algebra Review, Observation Model and Problem Statement, Preliminary Example: Oja's Neuron, Subspace Tracking,, Eigenvectors Tracking, Convergence and Performance Analysis Issues

Particle Filtering: The Basic Idea, The Choice of Proposal Distribution and Resampling, Some Particle Filtering Methods, Handling Constant Parameters, Rao–Blackwellization, Prediction, Smoothing,

Text Books:

1. Tu¨lay Adalı ,Simon Haykin," Adaptive Signal Processing", John Wiley & Sons

VLSI SYSTEM DESIGN

Course Code: 13EC556 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Design Methodology: Structured design techniques; Programmable logic; Gate array and sea of gates design; cell based design; full custom design; Design flow; Design Economics.
Data path Subsystems: Adders; One/zero Detectors; Comparators; Counters; Shifters; Multipliers; Power and Speed Trade-off.
Memory and Array Subsystems: SRAM, DRAM, ROM, Serial access memories; CAM, PLAs; Array yield, reliability; Power dissipation in Memories.
Special-purpose Subsystems: Packaging; power distribution; I/O pads;
Interconnect: Interconnect parameters; Electrical wire models, capacitive parasitics; Resistive parasitics; Inductive parasitic; Crosstalk; Advanced Interconnect Techniques.
Timing Issues: Timing classification; Synchronous design; Self-timed circuit design;
Clock Synthesis and Synchronization: Synchronizers; Arbiters; Clock Synthesis; PLLs; Clock generation; Clock distribution; Synchronous Vs Asynchronous Design.

Text Books:

1. Neil H. E. Weste, David. Harris and Ayan Banerjee,“CMOS VLSI Design” - Pearson Education, Third Edition, 2004.
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “Digital Integrated Circuits” Pearson Education, Second Edition.

Reference Text Books:

1. Sung-Mo Kang, Yusuf Leblebici, “CMOS Digital Integrated Circuits” TMH, Third Edition, 2003
2. Wayne Wolf, “Modern VLSI Design ", 2nd Edition, Prentice Hall,1998.

Simulation Books:

1. Etienne Sicard, Sonia Delmas Bendhia, “Basics of CMOS Cell Design”, TMH, EEE, 2005.

VLSI FOR WIRELESS COMMUNICATION

Course Code: 13EC574 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Communication Concepts: Wireless Channel Description, Path Loss, Multipath Fading, Channel Model and Envelope Fading, Frequency Selective and Fast Fading

Receiver Architectures: Receiver Front End:, Filter Design, Rest of Receiver Front End, Derivation of NF, IIP3 of Receiver Front End

Low Noise Amplifier: Wideband LNA Design, Narrow Band LNA:, Impedance Matching, Core Amplifier

Active Mixer: Balancing, Qualitative Description of the Gilbert Mixer, Distortion, Low Frequency Case: Analysis of Gilbert Mixer, Distortion, High-Frequency Case, Noise

Passive Mixer: Switching Mixer, Distortion in Unbalanced Switching Mixer, Conversion Gain in Unbalanced Switching Mixer, Noise in Unbalanced Switching Mixer, practical Unbalanced Switching Mixer, Sampling Mixer, Conversion Gain in Single-Ended Sampling Mixer

Analog-to-Digital Converters: Demodulators, A/D converters Used in a Receiver, Low-Pass Sigma-Delta Modulators, Implementation of Low-Pass Sigma-Delta Modulators, Bandpass Sigma-Delta Modulators, Implementation of Bandpass Sigma-Delta Modulators

Text Book:

1. Bosco Leung, "VLSI for Wireless Communication, Second Edition, Springer

Reference Text Books:

1. Emad N Farag, M.I Elmasry, “Mixed Signal VLSI Wireless Design Circuits and Systems”, KluwerPublication.
2. David Tsee, Pramod Viswanath,” Fundamentals of Wireless Communication”, Cambridge Univ Press.

HIGH PERFORMANCE COMMUNICATION NETWORKS

Course Code: 13EC581 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Principles Of Networks networking principles, Network services, High performance networks, Network elements, network mechanisms, layered architecture Packet Switched Networks Principles, OSI & TCP/IP models, transmission media, routing algorithms, Congestion control algorithms, Internetworking, Ethernet(IEEE 802.3), Tokenring (IEEE 802.5),Token bus (IEEE802.4). FDDI,
Network security(cryptography, symmetric key algorithms, private key Algorithms, digital signatures, authtication protocols) The Internet And TCP/IP Networks & Circuit Switched Networks Overview of Internet protocols, Internet control protocols, Elements of transport Protocols, TCP & UDP ,
Performance of TCP/IP networks, SONET, DWDM, Solitons, Optical Networks fiber principles (elements of optical fiber communication, acceptanceangle, Numerical aperture, modes, fiber types), optical links(point to point links,attenuation,optical budgeting, dispersion),splices ,connectors optical Lans,non Semiconductors, opticalamplifiers,Erbium doped Fiber mplifiers, couplers/splitters, optical switches ATM networks Main features of ATM, Addressing ,signaling, routing, ATM header structure

Text Books:

1. Jean Walrand and Pravin variya , " High performance Communication networks", 2nd edition, Harcourt and Morgan Kauffman, London 2000
2. Andrew S. Tanenbaum, "Computer networks", PHI Private limited, new Delhi

Reference Text Books:

1. Gerd Keiser, MC Graw Hill International edition, optical fiber communication , third edition
2. John M Senior, PHI limited, optical fiber communication , third edition
3. Leon Gracia, Widjaja, "Communication Networks", Tata Mc Graw –Hill, New Delhi, 2000.
4. Behroz a. Forouzan, "Data communication and networking ", Tata MC Graw –Hill, New Delhi
5. Sumit Kasera, Pankaj Sethi, " ATM Networks", Tata Mc Graw- Hill, New Delhi , 2000

RF & MICROWAVE SYSTEM DESIGN

Course Code: 13EC505 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction: Importance of RF and Microwave Concepts and Applications- and **UNIT**s- Frequency Spectrum, RF and Microwave Circuit Design, Dimensions - RF Behavior of Passive Components: High Frequency Resistors, High Frequency Capacitors, High Frequency Inductors, General Introduction, Types of Transmission Lines-Equivalent Circuit representation.

The Smith Chart: Introduction, Derivation of Smith Chart, Description of two types of smith chart, Z-Y Smith chart, Distributed Circuit Applications, Lumped Element Circuit Applications. SINGLE AND MULTIPORT NETWORKS: Basic Definitions, Interconnecting Networks.

Scattering Parameters: Scattering Parameters: Definition, Meaning, Chain Scattering Matrix, and Conversion between S- and Z-parameters, Signal Flow Chart Modelling.

Stability and Gain Considerations – RF Design RF Source, Transducer Power Gain, Additional Power Relations-Stability Considerations: Stability Circles, Unconditional Stability, and Stabilization Methods-Unilateral and Bilateral Design for Constant Gain- Noise Figure Circles- Constant VSWR Circles.

RF Filters, Amplifiers and Oscillators Design Generalization-Basic Resonator and Filter Configurations: Low Pass, High Pass, Band Pass and Band Stop type Filters-Filter Implementation using **UNIT** Element and Kuroda's Identities Transformations. Introduction, Types and Characteristics of Amplifiers, Small Signal Amplifiers, Design of different types of amplifiers (NBA, HGA, MGA, LNA, MNA, BBA), Design of Large Signal Amplifiers Oscillator vs Amplifier Design, Design procedure of Transistor Oscillators.

Text Books:

1. Mathew M. Radmanesh, “Radio Frequency & Microwave Electronics”, Pearson Education Asia, Second Edition,
2. Reinhold Ludwig and Powel Bretchko,” RF Circuit Design – Theory and Applications”, Pearson Education Asia, First Edition.

Reference Text Books:

1. Joseph . J. Carr, “Secrets of RF Circuit Design”, McGraw Hill Publishers, Third Edition.
2. Ulrich L. Rohde and David P. New Kirk, “RF / Microwave Circuit Design”, John Wiley & Sons USA, 2000.
3. Roland E. Best, “Phase - Locked Loops: Design, simulation and applications”, McGraw Hill Publishers 5TH
4. Devendra K.Misra ,”Radio Frequency and Microwave Communication Circuits – Analysis and Design “John Wiley & Sons, Inc.
5. Jon B. Hagen, " Radio Frequency Electronics ", Cambridge university press, Cambridge, 1996.
6. James Hardy, " High Frequency Circuit Design ", Resto Publishing Co., NewYork, 1979.
7. Ian Hickman, " RF HandBook ", Butter Worth Heinemann Ltd., Oxford, 1993.
8. Ulrich L.Rohde, T.T.N.Bucher, " Communication Recievers ", McGraw-Hill, New York, 1998.

ANTENNA MEASUREMENTS

Course Code: 13EC509 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Antenna Pattern Measurements: Basic Considerations, Pattern Formats, Fresnel Region Measurements, Modelling Techniques
Antenna Range Design and Evaluation: Introduction, Electromagnetic Design Consideration, Antenna Range Evaluation.
Antenna Testing: Introduction, Types of Ranges: Elevated Ranges, Ground Ranges, Near Field Ranges, Radar Cross Section Ranges.
Far Field Range Design: Introduction, Designing the Range, Source Design, Receiving Site Design, Ground Ranges.
Far Field Antenna Tests: Introduction, Pattern Testing, Gain and Directivity, Polarization.
Far Field Pattern Errors: Introduction, Error Estimates, Error Correction, Antenna Errors.
Compact Ranges: Introduction, Room Design, Feed Design, Reflector Design.
Near Filed Testing: Introduction, Planar Near Field Ranges, Errors, Cylindrical and Spherical Scanning

Text Books:

1. Evans, Gray E," Antenna measurements techniques", Artech House, Inc
2. J S Hollis, T J Lyon, L Clayton," Microwave Antenna Measurements” , Scientific Atlants, Inc

OPTICAL SIGNAL PROCESSING

Course Code: 13EC534 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Basics of signal processing and optics, Characterization of a General signal, examples of signals, Spatial signal. Basic laws of geometrical optics, Refractions by mirrors, the lens formulas, General Imaging conditions, the optical invariant, Optical Aberrations.
Physical Optics, The Fresnel Transforms, the Fourier transform, Examples of Fourier transforms, the inverse Fourier transform, Extended Fourier transform analysis, Maximum information capacity and optimum packing density, System coherence.
Spectrum Analysis and Spatial Filtering, Light sources, spatial light modulators, and the detection process in Fourier domain, System performance parameters, and Dynamic range. Some fundamentals of signal processing, Spatial Filters
Binary Spatial Filters, Magnitude Spatial Filters, Phase Spatial Filters, Real valued Spatial Filters, Interferometric techniques for constructing Spatial Filters. Optical signal processor and filter generator, Applications for optical signal processing.
Acousto-optic cell spatial light modulators, Applications of acousto-optic devices. Basic Acousto-optic power spectrum analyser. Heterodyne systems: Interference between two waves, the optical Radio.

Text Books:

1. Anthony Vanderlugt ,"Optical signal processing" ,Wiley-Interscience
2. Hiroshi Ishikawa ,"Ultrafast All-Optical Signal Processing Devices",Wiley

Reference Text Books:

1. D. Casasent, "Optical data processing-Applications", Springer-Verlag, Berlin,
2. H.J. Caulfield, "Handbook of holography", Academic Press New York 1979
3. P.M. Dufffieux, "The Fourier Transform and its applications to Optics", John Wiley and sons
4. J. Horner ,"Optical Signal Processing ",Academic Press 1988
5. Joseph W. Goodman," Introduction to Fourier Optics", second edition Mc Graw Hill.
6. Francis T. S. Yu, Suganda Jutamulia, "Optical Signal Processing, Computing, and Neural Networks", Krieger Publishing Company; 2nd edition

LOW POWER VLSI CIRCUITS

Course Code: 13EC555 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches.

Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Transistor sizing& gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.

Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.

Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.

Low Power Circuit's: Transistor and gate sizing, network restructuring and Reorganization. Special Flip Flops & Latches design, high capacitance nodes, low power digital cells library.

Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.

Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components.

Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network.

Special Techniques: Power Reduction in Clock networks, CMOS Floating Node, Low Power Bus Delay balancing, and Low Power Techniques for SRAM.

Text Books:

1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002
2. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic

Reference Text Books:

1. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley, 2000
2. Yeo, "CMOS/BiCMOS ULSI Low Voltage Low Power" Pearson Education

WIRELESS SENSOR NETWORKS

Course Code: 13EC583 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Characteristics of WSN: Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Medium Access Control Protocols: Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contention-based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

Routing And Data Gathering Protocols Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP **-** Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

Embedded Operating Systems: Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

Applications of WSN: WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

Text Books:

1. Kazem Sohraby, Daniel Minoli and Taieb Znati, “ Wireless Sensor Networks Technology, Protocols, and Applications“, John Wiley & Sons, 2007.
2. Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, Ltd, 2005.

Reference Books:

1. K. Akkaya and M. Younis, “A survey of routing protocols in wireless sensor networks”, Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
2. Philip Levis, “ TinyOS Programming”
3. Anna Ha´c, “Wireless Sensor Network Designs”, John Wiley & Sons Ltd.

M.TECH (SIGNAL PROCESSING)

S.No	Course Code	COURSE TITLE	L-T-P	Credits
SEMESTER1				
1	13EC520	IMAGE AND VIDEO PROCESSING	3-1-0	4
2	13EC529	MULTIRATE SIGNAL PROCESSING	3-1-2	5
3	13EC531	WAVELET THEORY AND APPLICATION	3-1-2	5
4	13EC532	MATHEMATICAL METHODS FOR SIGNAL PROCESSING	3-1-0	4
5		ELECTIVE1	3-0-0	3
6		ELECTIVE2	3-0-0	3
7	KLU C503	SEMINAR	0-0-4	2
				26

S.No	Course Code	COURSE TITLE	L-T-P	Credits
SEMESTER2				
1	13EC521	ADVANCED DIGITAL SIGNAL PROCESSING	3-1-2	5
2	13EC522	RADAR SIGNAL PROCESSING	3-1-0	4
3	13EC528	DSP PROCESSORS AND ARCHITECTURES	3-1-0	4
4	13EC537	DETECTION AND ESTIMATION OF SIGNALS	3-1-0	4
5		ELECTIVE3	3-0-0	3
6		ELECTIVE4	3-0-0	3
7	KLU C504	TERMPAPER	0-0-4	2
				25

S.No	Course Code	COURSE TITLE	L-T-P	Credits
SEMESTER3				
1	14TM602	INTERNSHIP	0-0-36	18
S.No	Course Code	**COURSE TITLE**	**L-T-P**	**Credits**
SEMESTER4				
1	KLU C502	THESIS	0-0-36	18

TOTAL Credits 87

		ELECTIVE1		
1	13EC523	ARRAY SIGNAL PROCESSING	3-0-0	3
2	13EC524	SPEECH PROCESSING	3-0-0	3
3	13EC533	CODING THEORY	3-0-0	3
4	13EC559	VLSI SIGNAL PROCESSING	3-0-0	3

		ELECTIVE2		
1	13EC501	MODERN DIGITAL COMMUNICATIONS	3-0-0	3
2	13EC525	WIRELESS COMMUNICATION SIGNAL PROCESSING	3-0-0	3
3	13EC526	BIO MEDICAL SIGNAL PROCESSING	3-0-0	3
4	13EC535	STATISTICAL SIGNAL PROCESSING	3-0-0	3

		ELECTIVE3		
1	13EC504	WIRELESS CELLULAR COMMUNICATION	3-0-0	3

2	13EC529	PROCESSING IN NON DESTRUCTIVE EVALUATION	3-0-0	3
3	13EC530	ADAPTIVE SIGNAL PROCESSING	3-0-0	3
4	13EC566	CMOS RF CIRCUIT DESIGN	3-0-0	3
		ELECTIVE4		
1	13EC505	RF AND MW SYSTEM DESIGN	3-0-0	3
2	13EC534	OPTICAL SIGNAL PROCESSING	3-0-0	3
3	13EC536	LINEAR AND NONLINEAR OPTIMIZATION	3-0-0	3
4	13EC555	LOW POWER VLSI CIRCUITS	3-0-0	3

IMAGE AND VIDEO PROCESSING

Course Code: 13EC520 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

Image Processing Techniques: 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 Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation

Image Compression Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations

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.

Text Books:

1. Gonzaleze and Woods ,”Digital Image Processing “, 3rd edition , Pearson
2. Yao wang, Joem Ostarmann and Ya – quin Zhang, ”Video processing and communication “,1st edition , PHI

Reference Text Book:

1. M. Tekalp ,”Digital video Processing”, Prentice Hall International

Simulation Text Books:

1. Relf, Christopher G.,"Image acquisition and processing with LabVIEW", CRC press
2. Aner ozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", John Wiley & Sons
3. Chris Solomon, Toby Breckon ,"Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons

MULTIRATE SIGNAL PROCESSING

Course Code: 13EC529 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus

Fundamentals of Multirate Theory: The sampling theorem - sampling at sub-Nyquist rate - Basic Formulations and schemes - Basic Multirate operations- Decimation and Interpolation - Digital Filter Banks- DFT Filter Bank- Identities- Polyphase representation - maximally decimated filter banks: Polyphase. representation - Errors in the QMF bank- Perfect Reconstruction (PR) QMF Bank - Design of an alias free QMF Bank M-channel perfect reconstruction filter banks: Uniform band and non-uniform filter bank - tree structured filter bank- Errors created by filter bank system- Polyphase representation- perfect reconstruction systems Perfect reconstruction (PR) filter banks: Para-**UNIT**ary PR Filter Banks- Filter Bank Properties induced by para**UNIT**arity- Two channel FIR para**UNIT**ary QMF Bank- Linear phase PR Filter banks- Necessary conditions for Linear phase property

Quantization Effects:-Types of quantization effects in filter banks. - Coefficient sensitivity effects, dynamic range and scaling.

Cosine Modulated filter banks: Cosine Modulated pseudo QMF Bank- Alas cancellation- phase - Phase distortion- Closed form expression- Polyphase structure- PR Systems.

Text Books:

1. P.P. Vaidyanathan. "Multirate systems and filter banks." Prentice Hall. PTR.
2. N.J. Fliege. "Multirate digital signal processing ." John Wiley.
3. Sanjit K. Mitra. " Digital Signal Processing: A computer based approach."

Reference Text Books:

1. R.E. Crochiere. L. R. "Multirate Digital Signal Processing", Prentice Hall. Inc.
2. J.G. Proakis. D.G. Manolakis. "Digital Signal Processing: Principles. Algorithms and Applications", 3rd Edn. Prentice Hall India

WAVELET THEORY AND APPLICATIONS

Course Code: 13EC531 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus
Introduction Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform, Time-frequency analysis, Bases of time frequency: orthogonal, Filter banks, Multi resolution formulation: Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal.
Continuous Wavelet Transform Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain.
Discrete Wavelet Transform And Filterbanks Orthogonal and bi-orthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks, Discrete wavelet transform, Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform, the redundant discrete wavelet transform.
Multi Resolution Analysis Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, Two dimensional, wavelet transforms and Extensions to higher dimensions, wave packets
Applications Signal and Image compression, Detection of signal changes, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction, Wavelets in adaptive filtering, Adaptive wavelet techniques in signal acquisition, coding and lossy transmission, Digital Communication and Multicarrier Modulation, Trans multiplexers , Image fusion, Edge Detection and object isolation.

Text Books:

1. A Wavelet Tour of Signal Processing, 2nd edition, S. Mallat, Academic Press, 1999.
2. Wavelets and Sub band Coding, M. Vetterli and J. Kovacevic, Prentice Hall, 1995.
3. Wavelet transforms: Introduction, Theory and applications, Raghuveer rao and Ajit S. Bopardikar, Pearson Education Asia, 2000.

Reference Text Books:

1. Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011.
2. Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, Jean-Michel Poggi, John Wiley & Sons, 2010 .
3. A premier on Wavelets and their scientific applications, J S Walker, CRC press, 2002.
4. Wavelets and signal processing: An application based introduction, Stark, Springer, 2005.
5. A friendly guide to Wavelets, Gerald keiser, Springer, 2011.
6. Multirate Systems and Filter Banks, P. P. Vaidyanathan, Pearson Education, 2004.
7. Wavelets : from math too practice, Desanka.P.Radunovik, springer, 2009.
8. Insight into wavelets from theory to practice, K P Soman and KL Ramachandran, PHI, 2008.

MATHEMATICAL METHODS FOR SIGNALS AND SYSTEMS

Course Code: 13EC532 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Mathematical Models and Vector Space Concepts: Mathematical models for linear systems and signals, Vector spaces and linear algebra: norms, Hilbert and branch spaces, linear transformations, projections and orthogonalization of vectors.

Least Square and Minimum Mean Square Filtering and Estimation: Approximation problem in Hilbert space, Orthogonality principle, Matrix representation of least square problems, Minimum error in Hilbert-space approximations, Least squares filtering, Minimum mean square estimation, MMSE filtering, Comparison of least squares and minimum mean squares, Frequency-domain optimal filtering, Minimum-norm solution of underdetermined equations, Iterative reweighted LS for LP optimization.

Linear Operators and Matrix Inverses: Linear operators, Operative norms, Adjoint operators and transposes, Geometry of linear equations, Four fundamental sub spaces of a linear operator, Pseudo inverses, Inverse of a block matrix.

Eigen values and Eigen vectors: Eigen values and linear systems, Linear dependence of eigenvectors, Diagonalization of a matrix, Geometry of invariant subspaces, Geometry of quadratic forms subject to linear constraints, Karhunen-Loève approximations, Eigen filters, Signal subspace techniques.

Singular Value Decomposition: Theory of SVD, Matrix structure from the SVD, Pseudo inverses, numerically sensitive problems, Rank-reducing approximations. Applications of the SVD: System Identification, Total least square problems, Partial total least squares, Rotation of subspaces, Computation of SVD.

Text Books:

1. Todd K. Moon, Wynn C. Stirling, ‘Mathematical Methods and Algorithms for signal processing’, Pearson education.
2. Statistical Signal Processing of Complex-Valued Data, Peter J. Schreier and Louis L. Scharf, Cambridge University Press

Reference Text Books:

1. Steven M. Kay, Intuitive Probability and Random Processes using Matlab, Springer, 2006.
2. Richard E. Blahut, Fast Algorithms for Signal Processing Cambridge University Press
3. The Edinburgh Building, Cambridge CB2 8RU

ARRAY SIGNAL PROCESSING

Course Code: 13EC523 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Spatial Signals, Signals in space and time. Spatial frequency, Direction vs. frequency. Wave fields. Far field and near field signals.
Sensor Arrays, Spatial sampling, Nyquist criterion. Sensor arrays. Uniform linear arrays, planar and random arrays. Array transfer (steering) vector. Array steering vector for ULA. Broadband arrays.
Spatial Frequency, Aliasing in spatial frequency domain. Spatial Frequency Transform, Spatial spectrum. Spatial Domain Filtering. Beam Forming. Spatially white signal.
Direction of Arrival Estimation, Non parametric methods - Beam forming and Capon methods. Resolution of Beam forming method. Subspace methods - MUSIC, Minimum Norm and ESPRIT techniques. Spatial Smoothing.

Text Books:

1. Dan E. Dugeon and Don H. Johnson.," Array Signal Processing: Concepts and Techniques. Prentice Hall.
2. Petre Stoica and Randolph L. Moses. "Spectral Analysis of Signals. Prentice Hall.

SPEECH PROCESSING

Course Code: 13EC524 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Basic Concepts: Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

SpeechAnalysis: Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

Speech Modeling: Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

Speech Recognition: Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word **UNIT**s; Applications and present status.

Speech Synthesis: Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word **UNIT**s for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

Text Books:

1. Lawrence Rabinerand Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education.

Reference Text Books:

1. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing.
2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education.
3. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
4. Ben gold and Nelson Morgan, "Speech and audio signal processing", processing and perception of speech and music, Wiley- India Edition, 2006 Edition.
5. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press.

CODING THEORY

Course Code: 13EC533 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Coding for Reliable Transmission: Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information, 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.

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

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

Burst –Error-Correcting codes: Decoding of Single-Burst error Correcting Cyclic codes, Single-Burst-Error-Correcting Cyclic codes, Burst-Error-Correcting Convolutional Codes, Bounds on Burst Error-Correcting Capability, Interleaved Cyclic and Convolution Codes , Phased-Burst –Error-Correcting Cyclic and Convolution codes.

BCH – Codes: BCH code- Definition, Minimum distance and BCH Bounds, Decoding Procedure for BCH Codes- Syndrome Computation and Iterative Algorithms, Error Location Polynomials and Numbers for single and double error correction

Text Books:

1. K. Sam Shanmugam **,"Digital and analog communication systems",** John Wiley, 1996.
2. Simon Haykin **,"Digital communication"** , John Wiley, 2003.
3. Shu Lin, Daniel J.Costello, Jr, "Error Control Coding- Fundamentals and Applications" –Prentice Hall, Inc.
4. Error Correcting Coding Theory-Man Young Rhee- 1989, McGraw-Hill Publishing.

Reference Text Books:

1. Digital Communications-Fundamental and Application - Bernard Sklar, PE.
2. Digital Communications- John G. Proakis, 5th ed., 2008, TMH.
3. Introduction to Error Control Codes-Salvatore Gravano-oxford
4. Error Correction Coding – Mathematical Methods and Algorithms – Todd K.Moon,
5. 2006, Wiley
6. Information Theory, Coding and Cryptography – Ranjan Bose, 2ndEdition, 2009, TMH.

VLSI SIGNAL PROCESSING

Course Code: 13EC559 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction to DSP Systems: Introduction, representation of DSP algorithms: Block Diagram, signal flow graph, data flow graph, dependence graph.
Iteration Bound: Data flow graph representations, loop bound and iteration bound, longest path matrix algorithm, iteration bound of Multirate data flow graphs.
Pipelining and Parallel Processing: Pipelining and parallel processing of FIR digital filters, pipeline interleaving in digital filters: signal and multichannel interleaving.
Retiming, Unfolding and Folding: retiming techniques; algorithm for unfolding, Folding transformation, systolic architecture design, systolic array design methodogy.
Fast Convolution, Filters and Transforms: Cook-toom algorithm, modified cook-toom algorithm, winogard algorithm, iterated convolution Algorithm strength reduction in filters and transforms.

Text Book:

1. Keshab k. Parhi," VLSI Digital Signal Processing Systems: Design and Implementation", Wiley, inter science.

Reference Book:

1. S.Y.kung, H.J.White house, T. Kailath," VLSI and Modern Signal Processing", Prentice hall

WIRELESS COMMUNICATION SIGNAL PROCESSING

Course Code: 13EC525 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Linear Diversity Techniques for Fading Channels System and Fading Channels Models: Transmission with out Diversity, Spectral Diversity, Temporal Diversity, spatial Diversity, Diversity methods for multiuser system

Adaptive Interference Suppression: Multiple Access Signal Model, Elements of multiuser detection, Linear interference suppression, Application to DS-CDMA, Adaptive algorithms

Equalization of Multiuser Channels: Characterization of wireless channels, equalization of known multipath fading, Blind equalization in multipath slowly time varying channel

Blind Space Time Signal Processing : The wireless propagation environment, signal model and structure, channel identification & equalization, Blind techniques

Network Capacity, Power control & effective Bandwidth: Basic spread spectrum model & the MMSE Receiver, performance under random spreading sequences, Capacity and performance under power control, Multiple classes, maximum power constraints, effective Bandwidth

Text Book:

1. H V Poor & G W Wornell, "Wireless Communication Signal Processing Perspectives", PHI

BIOMEDICAL SIGNAL PROCESSING

Course Code: 13EC526 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction To Biomedical Signals - Examples of Biomedical signals - ECG, EEG, EMG etc - Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. Origin of bio potentials - Review of linear systems - Fourier Transform and Time Frequency Analysis (Wavelet) of biomedical signals- Processing of Random & Stochastic signals – spectral estimation – Properties and effects of noise in biomedical instruments - Filtering in biomedical instruments

Concurrent, Coupled and Correlated Processes - illustration with case studies – Adaptive and optimal filtering - Modeling of Biomedical signals - Detection of biomedical signals in noise -removal of artifacts of one signal embedded in another -Maternal-Fetal ECG - Muscle-contraction interference. Event detection - case studies with ECG & EEG - Independent component Analysis - Cocktail party problem applied to EEG signals - Classification of biomedical signals.

Cardio Vascular Applications : Basic ECG - Electrical Activity of the heart- ECG data acquisition – ECG parameters & their estimation - Use of multiscale analysis for ECG parameters estimation - Noise & Artifacts- ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection - Arrhythmia analysis

Data Compression: Lossless & Lossy- Heart Rate Variability – Time Domain measures - Heart Rhythm representation - Spectral analysis of heart rate variability - interaction with other physiological signals.

Neurological Applications: The electroencephalogram - EEG rhythms & waveform - categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, stochastic models – Non linear modeling of EEG - artifacts in EEG & their characteristics and processing – Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis – correlation analysis of EEG channels - coherence analysis of EEG channels.

Text Books:

1. D.C.Reddy, “Biomedical Signal Processing: Principles and techniques” ,Tata McGraw Hill, New Delhi, 2005
2. Willis J Tompkins , Biomedical Signal Processing -, ED, Prentice – Hall, 1993

Reference Text Books: Books

1. R. Rangayan, “Biomedical Signal Analysis”, Wiley 2002.
2. Bruce, “Biomedical Signal Processing & Signal Modeling,” Wiley, 2001
3. Sörnmo, “Bioelectrical Signal Processing in Cardiac & Neurological Applications”, Elsevier
4. Semmlow, “Bio-signal and Biomedical Image Processing”, Marcel Dekker
5. Enderle, “Introduction to Biomedical Engineering,” 2/e, Elsevier, 2005

STATISTICAL SIGNAL PROCESSING

Course Code: 13EC535 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Review of random variables Distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Schwarz Inequality Orthogonality principle in estimation, Central Limit theorem, Random processes, wide-sense stationary processes, autocorrelation and auto covariance functions, Spectral representation of random signals, Wiener Khinchin theorem Properties of power spectral density, Gaussian Process and White noise process. Random signal modelling: MA(q), AR(p) , ARMA(p,q) models.
Parameter Estimation Theory Principle of estimation and applications, Properties of estimates, unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE), Cramer Rao bound, Efficient estimators; Criteria of estimation: the methods of maximum likelihood and its properties ; Bayesian estimation : Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation.
Estimation of signal in presence of white Gaussian Noise Linear Minimum Mean-Square Error (LMMSE) Filtering: Wiener Hoff Equation, FIR Wiener filter, Causal IIR Wiener filter, Noncausal IIR Wiener filter, Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters.
Adaptive Filtering: Principle and Application, Steepest Descent Algorithm Convergence characteristics; LMS algorithm, convergence, excess mean square error, Leaky LMS algorithm;Application of Adaptive filters ;RLS algorithm, derivation, Matrix inversion Lemma, Intialization, tracking of nonstationarity.
Kalman filtering: State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.
Spectral analysis: Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Prametric method, AR(p) spectral estimation and detection of Harmonic signals, MUSIC algorithm.

Text Books:
1. Discrete Random Signals and Statistical Signal Processing, By Charles W. Therrien, Prentice Hall Signal Processing Series

ReferenceText Books:
1. M. H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley & Sons, Inc.,
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon: Statistical and Adaptive Signal Processing, McGraw Hill, 2000.
3. Monson H. Hayes, 'Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc, Singapore, 2002
4. J. G. Proakis et. al., Algorithms for Statistical Signal Processing, Pearson Education, 2002.
5. Simon Haykin: Adaptive Filter Theory, Prentice Hall, 1996.

Simulation Text Books:
1. Statistical Digital Signal Processing and Modeling by Monson Hayes, John Wiley & Sons, Inc.,
2. Statistical Signal Processing Modelling and ESTIMATION BY Chonavel, T., Springer 2001

ADVANCED DIGITAL SIGNAL PROCESSING

Course Code: 13EC521 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus
Multirate Digital Signal Processing Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion
Multirate Digital Signal Processing Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing, Sampling Rate Conversion of Bandpass Signals
Linear Prediction And Optimum Linear Filters: Innovations Representation of a Stationary Random Process, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of linear prediction-Error Filter, AR Lattice and ARMA Lattice-Ladder Filters.
Power Speciral Estimation: Estimation of Spectra from Finite Duration Observations of a signal, the Periodogram, Use DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Tukey methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods
Parametric Method Of Power Spectrum Estimation: Parametric Methods for power spectrum estimation, Relationship between Auto-Correlation and Model Parameters, AR (Auto-Regressive) Process and Linear Prediction, Yule-Walker, Burg and Unconstructrained Least Squares Methods, Sequential Estimation, Moving Average(MA) and ARMA Models Minimum Variance Method, Piscaranko's Harmonic Decomposition Methods, MUSIC Method**.**

Text Books:

1. Proakis JG and Manolakis DG Digital Signal Processing Principles, Algorithms and Application, PHI.
2. Openheim AV & Schafer RW, Discrete Time Signal Processing PHI.

Simulation Text Books:

1. Samuel D Stearns, "Digital Signal Processing with examples in Matlab. " CRC Press.
2. ES Gopi. "Algorithm collections for Digital Signal Processing Applications using Matlab, " Springer.
3. Taan S.Elali, "Discrete Systems and Digital Signal Processing with Matlab, " CRC Press,2005.

RADAR SIGNAL PROCESSING

Course Code: 13EC522 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Angle-of-Arrival Estimation in the Presence of Multipath: The Low-Angle Tracking Radar Problem, Spectrum Estimation Background, Thomson's Multi-Taper Method, Test Dataset and a Comparison of Some Popular Spectrum Estimation Procedures, Multi-taper Spectrum Estimation, *F*-Test for the Line Components, Experimental Data Description for a Low-Angle Tracking Radar Study

Time–Frequency Analysis of Sea Clutter: An Overview of Non-stationary Behaviour and Time–Frequency Analysis, Theoretical Background on Non-stationary, High-Resolution Multi-taper Spectrograms

Dynamics of Sea Clutter: Statistical Nature of Sea Clutter: Classical Approach, Is There a Radar Clutter Attractor, Hybrid AM/FM Model of Sea Clutter, Evidence for Amplitude Modulation, Frequency Modulation, and More, Modelling Sea Clutter as a Non-stationary Complex Autoregressive Process

Sea-Clutter Non-stationary: The Influence of Long Waves: Radar and Data Description, Statistical Data Analyses, Modulation of Long Waves: Hybrid AM/FM Model, Non-stationary AR Model, Parametric Analysis of Texture Process

Two New Strategies for Target Detection in Sea Clutter: Bayesian Direct Filtering Procedure, Operational Details, Experimental Results on the Bayesian Direct Filter, Additional Notes on the Bayesian Direct Filter, Correlation Anomally Detection Strategy

Text Books:

1. I.Haykin, Simon S,"Radar Adaptive signal processing", John Wiley & Sons
2. Mark A Richards, "Fundamentals of Radar signal processing", M C Graw Hill

DSP PROCESSORS AND ARCHITECTURES

Course Code: 13EC528 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Introduction to Digital Signal Processing: Review of a digital signal-processing system, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time Invariant Systems, Digital filters IIR and FIR, Decimation and interpolation.

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic range and precision, Sources of error in DSP implementations, ADC and DAC conversion errors, DSP computational errors, and Compensating filter.

Architectures for Programmable DSP **Devices:** Basic Architectural features, DSP computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation **UNIT**, Programmability and program execution, Speed issues, Features for external interfacing.

Execution Control and Pipelining: Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models.

Programmable Digital Signal Processors: Commercial DSP Devices, Data Addressing modes of TMS320C54XX, DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.

Implementations of Basic DSP Algorithms: The Q-notation, FIR Filters, IIR Filters, Interpola-tion Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing, An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum.

Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA), A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

Text Books:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. DSP Processor Fundamentals, Architectures & Features - Lapsley et al. S. Chand & Co, 2000.

Reference Books:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkata Ramani and M. Bhaskar, TMH, 2004.
2. Digital Signal Processing –Principles, Algorithms Applications by J.G. Proakis & D.G. Manolokis, PHI, 2005.
3. Texas Instruments tutorials and notes.

DETECTION AND ESTIMATION OF SIGNALS

Course Code: 13EC537 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Introduction to Discrete-time signals: Fourier Transform of a discrete time signal, Amplitude and phase spectrum, Frequency content and sampling rates, Transfer function, Frequency response.

Random - Discrete-time signals: Review of probability, random data, Generation of Pseudo-random noise, Filtered signals, Autocorrelation and power spectral density, Sampling band- Limited random.

Detection of Signals in Noise:- Minimum probability of Error Criterion, Neyman-Person criterion for Radar detection of constant and variable amplitude signals, Matched filters, Optimum formulation, Detection of Random signals, Simple problems thereon with multi sample cases.

Estimation of Signals in Noise: Linear mean squared estimation, Non linear estimates, MAP and ML estimates, Maximum likelihood estimate of parameters of linear system, Simple problems thereon.

Recursive linear mean squared Estimation: Estimation of a signal parameter, Estimation of time-varying signals, Kalman filtering, Filtering signals in noise, Treatment restricted to two variable case only, Simple problems.

Text Books:

1. Signal processing: Discrete Spectral analysis, Detection and Estimation, Mischa Schwartz and Leonard Shaw, Mc-Graw Hill Book Company, 1975.
2. Signal Detection and Estimation, 2nd edition, Mourad Barkat, Artech House Inc, Norwood, MA 02062, 2005,
3. Fundamentals of Statistical Signal Processing: Estimation Theory, Steven M. Kay, Prentice Hall New Jersey, 1993,

Reference Text Book

1. "Probability, Random Variables and Random Signal Principles", *Peyton Z.Peebles* Jr, 4th Edition, Tata Mc Graw Hill.
2. Jerry M. Mendel, Lessons in Estimation Theory for Signal Processing, Communication and Control, Prentice Hall Inc., 1995.
3. Shanmugam and Breipohl, 'Detection of signals in noise and estimation', John Wiley & Sons, New York, 1985.
4. Srinath, Rajasekaran & Viswanathan, Introduction to statistical Signal processing
5. with Applications, Prentice Hall of India, New Delhi, 110 001,1989.
6. Steven M. Kay, Intuitive Probability and Random Processes using Matlab, Springer, 2006.

Simulation Text Books:

1. Statistical Digital Signal Processing and Modeling by Monson Hayes, John Wiley & Sons, Inc.,
2. Statistical Signal Processing Modelling and ESTIMATION BY Chonavel, T., Springer 2001

WIRELESS CELLULAR COMMUNICATION

Course Code: 13EC504 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Introduction to Cellular Mobile Systems: Cellular Mobile Telephone Systems, A Basic Cellular System, Operation of Cellular Systems.
Elements of Cellular Mobile Radio System Design: General Description of the problem, Concept of Frequency reuse channels, Co-Channel Interference Reduction Factor, Handoff Mechanism, Cell Splitting.
Speech Coding for Wireless Systems Applications: Introduction to Digital Signal Processing (DSP) Techniques in Wireless Telephone and Broadcast Systems, Speech Coding Techniques for Audio and Voice – Pulse Code Modulation, DPCM, Delta Modulation, Vocoder and Linear Predictive Coding, Performance Comparison of Speech Processing Techniques.
Radio Propagation and Cellular Engineering Concepts: Fundamental Radio Propagation and System Concepts, Propagation Characteristics, Models of Multipath-faded radio signals – Un modulated Carrier, Envelope and Phase faded, Level Crossing rate and fade Duration, Delay Spread Measurements.
Digital Modulation-Demodulation (Modem) Principles and Architectures: Coherent Modem – Baseband Modem Equivalence, Coherent and Differentially Coherent Binary Phase Shift Keying Systems, Synchronization – Carrier Recovery and Symbol Timing Recovery, Differential Encoding and Decoding Requirement, Quadrature Phase shift Keying – Coincident and offset Types, Pi/4 DQPSK Modems – Architecture.
Interference In Wireless Digital Communication: Carrier-to-Interference and Carrier-to-Noise Limited Systems, Cochannel Interference, Adjacent Channel Interference. Externally caused Cochannel Interference, Definitions and performance of Spectral and Power Efficiency, Relationship of the Bit-Energy to Noise-Density Ratio and the Carrier-to-Noise Ratio, Power Efficiency and Bit-Error-Rate performance in an Additive White Gaussian Noise Environment, Concepts of Diversity Branch and Signal paths; Combining and Switching Methods.

Text Books:
1. DR Kamilo Feher Wireless Digital Communications, Prentice Hall of India, New Delhi – 1999
2. William Cy Lee, Mobile Cellular Telecommunications, 2nd Edition, MC Graw Hill.

PROCESSING IN NON DESTRUCTIVE EVALUATION

Course Code: 13EC529 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Signal Processing Principles for NDT: Introduction to signals, Time and frequency domain representations of signals, pulse compression and Cepstral analysis, Spectral analysis of signals using Fourier transform, time frequency analysis using wavelet and Wigner distributions. Signal de-noising methods.

Image Processing Fundamentals for NDT: Image transforms: Fourier, Haar, Daubechies, Hough; Image enhancement, Image Restoration: Optical system and Photographic models, Image Segmentation.

Introduction to NDT Methods: Visual inspection, Liquid penetrant inspection, Magnetic particle inspection, Eddy current testing, Ultrasonic testing, Time of flight diffraction, Radiographic inspection, Computerized tomography, Holographic inspection, Thermography: Passive and Active.

Ultrasonic Imaging and Computerized Tomography: Defect detection in ultrasonic testing using time delay methods. Radon transforms and its properties, Line integrals and projections, Fourier slice theorem, Reconstruction Algorithms for parallel projections, Reconstruction from fan projections.

Infrared Imaging: Data acquisition, Image degradations in thermal imaging. Lock in thermography: Theory, Defect detection and quantification. Pulse thermography: Thermal contrast, logarithmic time scale, data analysis: Thermal signal reconstruction, method of derivatives, differential absolute contrast, Principle component analysis and Quantitative characterization. Pulsed phase thermography: Principles and features, data inversion, quantitative characterization frequency modulated thermal wave imaging: Problems with conventional methods, analysis and modelling of thermal waves, Thermal wave detection and ranging, Advances in FMTWI.

Text Books:

1. Advanced digital signal processing and Noise reduction, Saeed. V. Vaseghi, John Wiley& Sons,
2. Digital image processing, William. K.Pratt, Wiley inter science.
3. Peter J Shull, Marcell," Nondestructive evaluation, theory techniques and applications, Dekker
4. Avinash.C.Kak, Malcolm slaney ,"Principles of computerized tomographic imaging", IEEE
5. X.Maldague , "Theory and practice of infrared technology for nondestructive testing, , John Wiley

Reference Text Books:

1. A.K Jain,"Fundamentals of digital image processing, PHI
2. Charles Hellier,"Hand book of nondestructive evaluation, Mc. Grawhill.
3. C.Chen,"Ultrasonic and advanced methods for nondestructive testing and material evaluation, world scientific corporation, 2007.
4. Frank Natterer ,"Mathematics of computerized tomography, SIAM
5. Otwin Breitenstein, Wilhelm Warta, Martin Langenkamp ,"Lock in thermography: basics and use for evaluating electronic devices and materials", Springer.

ADAPTIVE SIGNAL PROCESSING

Course Code: 13EC530 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Complex-Valued Adaptive Signal Processing: Optimization in the Complex Domain, Widely Linear Adaptive Filtering, Nonlinear Adaptive Filtering with Multilayer Perceptrons, Complex Independent Component Analysis
Robust Estimation Techniques for Complex-Valued Random Vectors: Statistical Characterization of Complex Random Vectors, Complex Elliptically Symmetric (CES) Distributions, Tools to Compare Estimators, Scatter and Pseudo-Scatter Matrices Array Processing Examples, MVDR Beamformers Based on M-Estimators
Turbo Equalization: Communication Chain, Turbo Decoder: Overview, Forward-Backward Algorithm, Simplified Algorithm: Interference Canceler, Capacity Analysis, Blind Turbo Equalization, Convergence, Multichannel and Multiuser Settings
Subspace Tracking for Signal Processing: Linear Algebra Review, Observation Model and Problem Statement, Preliminary Example: Oja’s Neuron, Subspace Tracking,, Eigenvectors Tracking, Convergence and Performance Analysis Issues
Particle Filtering: The Basic Idea, The Choice of Proposal Distribution and Resampling, Some Particle Filtering Methods, Handling Constant Parameters, Rao–Blackwellization, Prediction, Smoothing,

Text Books:
1. Tu¨lay Adalı ,Simon Haykin,” Adaptive Signal Processing”, John Wiley & Sons

CMOS RF CIRCUIT DESIGN

Course Code: 13EC566 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction to RF Design and Wireless Technology: Design and Applications, Complexity and Choice of Technology. Basic concepts in RF design: Nonlinearly and Time Variance, Inter symbol interference, random processes and noise. Sensitivity and dynamic range, conversion of gains and distortion

RF Modulation: Analog and digital modulation of RF circuits, Comparison of various techniques for power efficiency, Coherent and non-coherent detection, Mobile RF communication and basics of Multiple Access techniques. Receiver and Transmitter architectures, Direct conversion and two-step transmitters

RF Testing: RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.

BJT and MOSFET behavior at RF Frequencies: BJT and MOSFET behavior at RF frequencies, modeling of the transistors and SPICE model, Noise performance and limitations of devices, integrated parasitic elements at high frequencies and their monolithic implementation

RF Circuits Design: Overview of RF Filter design, Active RF components & modeling, Matching and Biasing Networks. Basic blocks in RF systems and their VLSI implementation, Low noise Amplifier design in various technologies, Design of Mixers at GHz frequency range, Various mixers- working and implementation. Oscillators- Basic topologies VCO and definition of phase noise, Noise power and trade off. Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers, Design issues in integrated RF filters.

Text Books:

1. B. Razavi, “RF Microelectronics” PHI 1998
2. R. Jacob Baker, H.W. Li, D.E. Boyce “CMOS Circuit Design, layout and Simulation”, PHI

Reference Books:

1. Thomas H. Lee “Design of CMOS RF Integrated Circuits” Cambridge University press 1998.
2. Y.P. Tsividis, “Mixed Analog and Digital Devices and Technology”, TMH 1996

RF & MICROWAVE SYSTEM DESIGN

Course Code: 13EC505 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction: Importance of RF and Microwave Concepts and Applications- and **UNIT**s-Frequency Spectrum, RF and Microwave Circuit Design, Dimensions - RF Behavior of Passive Components: High Frequency Resistors, High Frequency Capacitors, High Frequency Inductors, General Introduction, Types of Transmission Lines-Equivalent Circuit representation.

The Smith Chart: Introduction, Derivation of Smith Chart, Description of two types of smith chart, Z-Y Smith chart, Distributed Circuit Applications, Lumped Element Circuit Applications. SINGLE AND MULTIPORT NETWORKS: Basic Definitions, Interconnecting Networks.

Scattering Parameters: Scattering Parameters: Definition, Meaning, Chain Scattering Matrix, and Conversion between S- and Z-parameters, Signal Flow Chart Modelling.

Stability and Gain Considerations – RF Design RF Source, Transducer Power Gain, Additional Power Relations-Stability Considerations: Stability Circles, Unconditional Stability, and Stabilization Methods-Unilateral and Bilateral Design for Constant Gain- Noise Figure Circles- Constant VSWR Circles.

RF Filters, Amplifiers and Oscillators Design Generalization-Basic Resonator and Filter Configurations: Low Pass, High Pass, Band Pass and Band Stop type Filters-Filter Implementation using **UNIT** Element and Kuroda's Identities Transformations. Introduction, Types and Characteristics of Amplifiers, Small Signal Amplifiers, Design of different types of amplifiers (NBA, HGA, MGA, LNA, MNA, BBA), Design of Large Signal Amplifiers Oscillator vs Amplifier Design, Design procedure of Transistor Oscillators.

Text Books:

1. Mathew M. Radmanesh, “Radio Frequency & Microwave Electronics”, Pearson Education Asia, Second Edition,
2. Reinhold Ludwig and Powel Bretchko,” RF Circuit Design – Theory and Applications”, Pearson Education Asia, First Edition.

Reference Text Books:

1. Joseph . J. Carr, “Secrets of RF Circuit Design”, McGraw Hill Publishers, Third Edition.
2. Ulrich L. Rohde and David P. New Kirk, “RF / Microwave Circuit Design”, John Wiley & Sons USA, 2000.
3. Roland E. Best, “Phase - Locked Loops: Design, simulation and applications”, McGraw Hill Publishers 5TH
4. Devendra K.Misra ,”Radio Frequency and Microwave Communication Circuits – Analysis and Design “John Wiley & Sons, Inc.
5. Jon B. Hagen, " Radio Frequency Electronics ", Cambridge university press, Cambridge, 1996.
6. James Hardy, " High Frequency Circuit Design ", Resto Publishing Co., NewYork, 1979.
7. Ian Hickman, " RF HandBook ", Butter Worth Heinemann Ltd., Oxford, 1993.
8. Ulrich L.Rohde, T.T.N.Bucher, " Communication Recievers ", McGraw-Hill, New York, 1998.

OPTICAL SIGNAL PROCESSING

Course Code: 13EC534 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Basics of signal processing and optics, Characterization of a General signal, examples of signals, Spatial signal. Basic laws of geometrical optics, Refractions by mirrors, the lens formulas, General Imaging conditions, the optical invariant, Optical Aberrations.
Physical Optics, The Fresnel Transforms, the Fourier transform, Examples of Fourier transforms, the inverse Fourier transform, Extended Fourier transform analysis, Maximum information capacity and optimum packing density, System coherence.
Spectrum Analysis and Spatial Filtering, Light sources, spatial light modulators, and the detection process in Fourier domain, System performance parameters, and Dynamic range. Some fundamentals of signal processing, Spatial Filters
Binary Spatial Filters, Magnitude Spatial Filters, Phase Spatial Filters, Real valued Spatial Filters, Interferometric techniques for constructing Spatial Filters. Optical signal processor and filter generator, Applications for optical signal processing.
Acousto-optic cell spatial light modulators, Applications of acousto-optic devices. Basic Acousto-optic power spectrum analyser. Heterodyne systems: Interference between two waves, the optical Radio.

Text Books:
1. Anthony Vanderlugt ,"Optical signal processing" ,Wiley-Interscience
2. Hiroshi Ishikawa ,"Ultrafast All-Optical Signal Processing Devices",Wiley

Reference Text Books:
1. D. Casasent, "Optical data processing-Applications", Springer-Verlag, Berlin,
2. H.J. Caulfield, "Handbook of holography", Academic Press New York 1979
3. P.M. Dufffieux, "The Fourier Transform and its applications to Optics", John Wiley and sons
4. J. Horner ,"Optical Signal Processing ",Academic Press 1988
5. Joseph W. Goodman," Introduction to Fourier Optics", second edition Mc Graw Hill.
6. Francis T. S. Yu, Suganda Jutamulia, "Optical Signal Processing, Computing, and Neural Networks", Krieger Publishing Company; 2nd edition

LINEAR AND NON LINEAR OPTIMIZATION

Course Code: 13EC536 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Mathematical Background: Sequences and Subsequences- Mapping and functions- Continuous functions- Infimum and Supremum of functions- Minima and maxima of functions- Differentiable functions. Vectors and vector spaces- Matrices- Linear transformation- Quadratic forms- Definite quadratic forms- Gradient and Hessian- Linear equations- Solution of a set of linear equations-Basic solution and degeneracy. Convex sets and Convex cones- Introduction and preliminary definition- Convex sets and properties- Convex Hulls- Extreme point- Separation and support of convex sets- Convex Polytopes and Polyhedra- Convex cones- Convex and concave functions- Basic properties- Differentiable convex functions- Generalization of convex functions.
Linear Programming: Introduction -Optimization model, formulation and applications- Classical optimization techniques: Single and multi variable problems-Types of constraints. Linear optimization algorithms: The simplex method -Basic solution and extreme point Degeneracy-The primal simplex method -Dual linear programs - Primal, dual, and duality theory - The dual simplex method -The primal-dual algorithm-Duality applications.
Post optimization problems: Sensitivity analysis and parametric programming- **Nonlinear Programming**: Minimization and maximization of convex functions- Local & Global optimum- Convergence-Speed of convergence.
Unconstrained optimization: One dimensional minimization - Elimination methods: Fibonacci & Golden section search - Gradient methods - Steepest descent method.
Constrained optimization: Constrained optimization with equality and inequality constraints. Kelley's convex cutting plane algorithm - Gradient projection method - Penalty Function methods. Constrained optimization: Lagrangian method - Sufficiency conditions - Kuhn-Tucker optimality conditions- Rate of convergence - Engineering applications Quadratic programming problems-Convex programming problems.

Text Books:

1. David G Luenberger, .Linear and Non Linear Programming., 2nd Ed, Addison-Wesley.
2. S.S.Rao, .Engineering Optimization. Theory and Practice; Revised 3rd Edition, New Age International Publishers, New Delhi

Reference Text Books:

1. S.M. Sinha, Mathematical programming: Theory and Methods, Elsevier, 2006.
2. Hillier and Lieberman *Introduction to Operations Research*, McGraw-Hill, 8th edition, 2005.
3. Saul I Gass, Linear programming, McGraw-Hill, 5th edition, 2005.
4. Bazarra M.S., Sherali H.D. & Shetty C.M., Nonlinear Programming Theory and Algorithms, John Wiley, New York, 1979.
5. Kalyanmoy Deb, Optimization for Engineering: Design-Algorithms and Examples, Prentice Hall (India), 1998

LOW POWER VLSI CIRCUITS

Course Code: 13EC555 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches.
Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Transistor sizing& gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.
Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.
Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.
Low Power Circuit's: Transistor and gate sizing, network restructuring and Reorganization. Special Flip Flops & Latches design, high capacitance nodes, low power digital cells library.
Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.
Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components.
Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network.
Special Techniques: Power Reduction in Clock networks, CMOS Floating Node, Low Power Bus Delay balancing, and Low Power Techniques for SRAM.

Text Books:
1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002
2. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic

Reference Text Books:
1. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley, 2000
2. Yeo, "CMOS/BiCMOS ULSI Low Voltage Low Power" Pearson Education.

M.TECH (VLSI)

S.NO	Course Code	COURSE TITLE	L-T-P	Credits
		SEMESTER1		
1	13EC550	MOS CIRCUIT DESIGN	3-1-2	5
2	13EC551	ALGORITHMS FOR VLSI DESIGN AUTOMATION	3-1-0	4
3	13EC552	HDL AND PLD ARCHITECTURES	3-1-2	5
4	13EC553	IC FABRICATION TECHNOLOGY	3-1-0	4
5		ELECTIVE1	3-0-0	3
6		ELECTIVE2	3-0-0	3
7	KLU C503	SEMINAR	0-0-4	2
				26

S.NO	Course Code	COURSE TITLE	L-T-P	Credits
		SEMESTER2		
1	13EC555	LOW POWER VLSI CIRCUITS	3-0-2	4
2	13EC556	VLSI SYSTEM DESIGN	3-1-0	4
3	13EC570	ADVANCED ANALOG IC DESIGN	3-1-2	5
4	13EC571	TESTING OF VLSI CIRCUITS	3-1-0	4
5		ELECTIVE3	3-0-0	3
6		ELECTIVE4	3-0-0	3
7	KLU C504	TERMPAPER	0-0-4	2
				25

S.NO	Course Code	COURSE TITLE	L-T-P	Credits
		SEMESTER3		
1	14TM602	INTERNSHIP	0-0-36	18
S.NO	**Course Code**	**COURSE TITLE**	**L-T-P**	**Credits**
		SEMESTER4		
1	KLU C502	THESIS	0-0-36	18

TOTAL Credits 87

		ELECTIVE1		
1	13EC559	VLSI SIGNAL PROCESSING	3-0-0	3
2	13EC562	CMOS MIXED SIGNAL CIRCUITS	3-0-0	3
3	13EC575	CAD TOOLS FOR VLSI	3-0-0	3
4	13EC590	EMBEDDED SYSTEM DESIGN	3-0-0	3
5	13EC591	NANO ELECTRONICS	3-0-0	3

		ELECTIVE2		
1	13EC520	IMAGE AND VIDEO PROCESSING	3-0-0	3
2	13EC560	MEMORY DESIGN AND TESTING	3-0-0	3
3	13EC565	RECONFIGURABLE COMPUTING	3-0-0	3
4	13EC573	BICMOS TECHNOLOGY AND APPLICATIONS	3-0-0	3
5	13EC592	SEMICONDUCTOR DEVICE MODELLING	3-0-0	3

		ELECTIVE3		
1	13EC562	SYSTEM ON CHIP DESIGN	3-0-0	3
2	13EC563	PROCESS AND DEVICE CHARACTERIZATION & MEASUREMENTS	3-0-0	3
3	13EC564	ADVANCED VLSI DESIGN	3-0-0	3
4	13EC574	VLSI FOR WIRELESS COMMUNICATION	3-0-0	3
5	13EC593	MEMS SYSTEM DESIGN	3-0-0	3

		ELECTIVE4		
1	13EC558	ADVANCED DIGITAL IC DESIGN	3-0-0	3
2	13EC561	OPTIMIZATION TECHNIQUES AND APPLICATIONS IN VLSI DESIGN	3-0-0	3
3	13EC566	CMOS RF CIRCUIT DESIGN	3-0-0	3
4	13EC568	ASIC DESIGN FLOW	3-0-0	3
5	13EC593	NANO SENSORS AND ITS APPLICATIONS	3-0-0	3

MOS CIRCUIT DESIGN

Course Code: 13EC550 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus

Introduction: Classification of CMOS digital circuits and Circuit design, Overview of VLSI design methodologies, VLSI design flow, Design hierarchy and concepts, VLSI design styles, Design quality, Packing technology, CAD technology, Fabrication process flow, CMOS n-well process, layout design rules.

MOS Transistor and Circuit Modeling: MOS structure, MOS system under external bias, structure and operation of MOS transistor, MOSFET current-voltage characteristics, MOSFET scaling and small-geometry effects, MOSFET capacitances, Modeling of MOS transistor using SPICE.

MOS Inverter static characteristics and Interconnect Effects: Introduction, Resistive-Load Inverter, Inverter with n-type MOSFET load, CMOS Inverter, Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.

Combinational and Sequential MOS logic Circuits: Introduction, MOS logic circuits with depletion nMOS loads, CMOS logic Circuits, Complex logic circuits, CMOS transmission gates (Pass gates), Behavior of bistable elements, SR latch circuit, clocked latch and flip-flop circuits, CMOS D-latch and Edge-triggered flip-flop.

Dynamic logic Circuits: Basic principles of pass transistor circuits, voltage bootstrapping, synchronous dynamic circuit techniques, Dynamic CMOS circuit techniques, High-performance dynamic CMOS circuits.

Text Books:

1. Sung-Mo Kang, Yusuf Leblebici, “CMOS Digital Integrated Circuits” TMH 2003
2. Neil H. E. Weste and David. Harris Ayan Banerjee,, “CMOS VLSI Design” - Pearson Education, 1999.

Reference Text Books:

1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “Digital Integrated Circuits” Pearson Education, 2003
2. Uyemura, “Introduction to VLSI Circuits and Systems” Wiley-India, 2006.
3. Wayne Wolf, “Modern VLSI Design ", 2nd Edition, Prentice Hall,1998.
4. Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, “Essentials of VLSI Circuits and Systems” – PHI, EEE, 2005 Edition.

Simulation Books :

1. Etienne Sicard, Sonia Delmas Bendhia, “Basics of CMOS Cell Design”, TMH, EEE, 2005.

ALGORITHMS FOR VLSI DESIGN AUTOMATION

Course Code: 13EC551 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Introduction to Design Methodologies: Design Automation tools, Algorithmic Graph Theory, Computational Complexity, Tractable and Intractable Problems

Layout: Compaction, Placement, Floor planning and Routing Problems, Concepts and Algorithms

Modelling: Gate Level Modelling and Simulation, Switch level modelling and simulation, Basic issues and Terminology, Binary – Decision diagram, Two – Level Logic Synthesis.

Hardware Models: Internal representation of the input algorithm, Allocation, Assignment and Scheduling, Some Scheduling Algorithms, Some aspects of Assignment problem, High – level Transformations.

FPGA technologies: Physical Design cycle for FPGA's partitioning and routing for segmented and staggered models. MCM technologies, MCM physical design cycle, Partitioning, Placement – Chip array based and full custom approaches, Routing –Maze routing, Multiple stage routing, Topologic routing, Integrated Pin – Distribution and routing, routing and programmable MCM's.

Text Books:

1. S.H.Gerez, "Algorithms for VLSI Design Automation", John Wiley 1999.
2. Naveed Sherwani, "Algorithms for VLSI Physical Design Automation" 3rd edition, Springer International Edition.

Reference Text Books:

1. Hill & Peterson, "Computer Aided Logical Design with Emphasis on VLSI" Wiley,1993
2. Wayne Wolf, "Modern VLSI Design: Systems on silicon" Pearson Education Asia, 2nd Edition.

HDL & PLD ARCHITECTURES

Course Code: 13EC552 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Introduction to Verilog HDL: Basic concepts, Design modelling, Tasks and functions, Timing and delays, user-defined primitives, PLI, Simulation and Synthesis Tools.
Synthesis of Combinational & Sequential Logic: Decoders and encoders, Multiplexers and Demultiplexers, Priority encoder, Priority decoder, Comparators, Adders, synthesis of three-state devices and bus interfaces. **,** Latches & Flip-flops, counters, registers, explicit state machines, implicit state machines.
Programmable Logic Devices: Full Custom Design, Semicustom Design, Programmable Logic Devices, Read Only Memory (ROM), Programmable Read Only Memory (PROM), and Programmable Logic Array (PLA), and Programmable Array Logic (PAL).
Complex Programmable Logic Devices : Basic Architecture, XC9500 CPLD, GAL, Altera series – Max 5000, Max 7000 Series , ALTERA FLEX Logic – 10000 Series CPLDs. AMD's – CPLD (Mach 1 to 5).
Field Programmable Gate Arrays: Introduction, Basic Architecture, Design flow, Xilinx XC3000 & XC4000 Architectures, Actel Architectures, ALTERA's FLEX 8000, and ALTERA's FLEX 10000 FPGAs.

Text Books:

1. Michael D.Celetti "Advanced Digital Design with the Verilog HDL" Prentice Hall.
2. S.Trimberger, Edr., Field Programmable Gate Array Technology, Kluwer Academic Publications.

Reference Books:

1. Verilog Digital System Design RT Level synthesis TestBench and verification by Zainalabedin Navabi, 2008 Mc Graw Hill Publishers
2. Stephen Brown Zvonko Vranesic "Fundamentals of Digital Logic with VHDL Design" McGraw-Hill.

Simulation Books

1. Verilog HDL A Guide To Digital Design And Synthesis, Edition: 2 by Samir Palnitkar.

IC FABRICATION TECHNOLOGY

Course Code: 13EC553 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus
Introduction to IC Technology: Basic fabrication steps and their Importance.
Environment of IC Technology: Concepts of Clean room and safety requirements, Concepts of Wafer cleaning processes and wet chemical etching techniques.
Impurity Incorporation: Solid State diffusion modelling and technology; Ion Implantation modelling, technology and damage annealing, characterization of Impurity profiles
Oxidation: Kinetics of Silicon dioxide growth both for thick, thin and ultrathin films, Oxidation technologies in VLSI and ULSI, Characterization of oxide films, High k and low k dielectrics for ULSI.
Lithography: Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI, Mask generation.
Chemical Vapour Deposition Techniques: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films;
Epitaxial growth of silicon: modelling and technology.
Metal Film Deposition: Evaporation and sputtering techniques, Failure mechanisms in metal interconnects Multi-level metallization schemes.
Plasma and Rapid Thermal Processing: PECVD, Plasma etching and RIE techniques; RTP techniques for annealing, growth and deposition of various films for use in ULSI.

Text Books:

1. S.M.Sze(2nd Edition)”VLSI Technology”, McGraw Hill Companies Inc.
2. C.Y. Chang and S.M.Sze (Ed), **“**ULSI Technology**”**, McGraw Hill Companies Inc.

Reference Text Books:

1. Stephena, Campbell, **“**The Science and Engineering of Microelectronic Fabrication**”**, Second Edition, Oxford University Press.
2. James D.Plummer, Michael D.Deal, ”Silicon VLSI Technology” Pearson Education

VLSI SIGNAL PROCESSING

Course Code: 13EC559 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Introduction to DSP Systems: Introduction, representation of DSP algorithms: Block Diagram, signal flow graph, data flow graph, dependence graph.
Iteration Bound: Data flow graph representations, loop bound and iteration bound, longest path matrix algorithm, iteration bound of Multirate data flow graphs.
Pipelining and Parallel Processing: Pipelining and parallel processing of FIR digital filters, pipeline interleaving in digital filters: signal and multichannel interleaving.
Retiming, Unfolding and Folding: retiming techniques; algorithm for unfolding, Folding transformation, systolic architecture design, systolic array design methodogy.
Fast Convolution, Filters and Transforms: Cook-toom algorithm, modified cook-toom algorithm, winogard algorithm, iterated convolution Algorithm strength reduction in filters and transforms.

Text Book:
1. Keshab k. Parhi," VLSI Digital Signal Processing Systems: Design and Implementation", Wiley, inter science.

Reference Book:
1. S.Y.kung, H.J.White house, T. Kailath," VLSI and Modern Signal Processing", Prentice hall

CMOS MIXED SIGNAL CIRCUITS

Course Code: 13EC562 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Data Converter Modeling and SNR: Sampling and Aliasing: A modeling Approach, SPICE models for DACs and ADCs, Quantization noise, Viewing the quantization noise spectrum using simulations, quantization noise voltage spectral density, Data converter SNR: an overview, Improving SNR using averaging, Decimating filters for ADC, Interpolating filters for DACs, Using feedback to improve SNR.

Submicron CMOS Circuit Design: Submicron CMOS overview and models, Digital circuit design, Analog circuit design.

Implementing Data Converters: R-2R topologies for DACs, Op-Amps in data converters, Implementing ADCs.

Noise-Shaping Data Converters: Noise-shaping fundamentals, Second-order noise-shaping, noise-shaping topologies.

Integrator-Based CMOS Filters: Integrator building blocks, filtering topologies, Filters using Noise-shaping.

Text Books:

1. R. Jacob Baker, “CMOS: Mixed-Signal Circuit Design”, Wiley-Student Edition, IEEE Press,

Reference Books:

1. Behzad Razavi, "Principles of Data Conversion System Design,"John Wiley & Sons.
2. P. Allen and D. Holberg, “CMOS Analog Circuit design,” Oxford Press.
3. E. Bogatin, “Signal and Power –Simplified,” 2nd edition, Prentice Hall.

CAD TOOLS FOR VLSI

Course Code: 13EC575 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction to VLSI design methodologies and supporting CAD environment.

Schematic editors: Parsing: Reading files, describing data formats, Graphics & Plotting Layout. Layout Editor: Turning plotter into an editor. Layout language: Parameterized cells, PLA generators, Introduction to Silicon compiler, Data path. Compiler, Placement & routing, Floor planning. Layout Analysis: Design rules, Object based DRC, Edge based layout operations. Module generators.

Simulation: Types of simulation, Behavioural simulator, logic simulator, functional simulator & Circuit simulator. Simulation Algorithms: Compiled code and Event-driven.

Optimization Algorithms: Greedy methods, simulated annealing, genetic algorithm and neural models.

Testing ICs: Fault simulation, Aids for test generation and testing. Computational complexity issues: Big Oh and big omega terms.

Recent topics in CAD-VLSI: Array compilers, hardware software co-design, high-level synthesis tools and VHDL modelling.

Text Books:

1. Stephen Trim Berger," Introduction to CAD for VLSI", Kluwer Academic publisher, 2002
2. Naveed Shervani, "Algorithms for VLSI physical design Automation", Kluwer Academic Publisher, Second edition.

Reference Books:

1. Gaynor E. Taylor, G. Russell, "Algorithmic and Knowledge Based CAD for VLSI", Peter peregrinus ltd. London.
2. Gerez, "Algorithms VLSI Design Automation", John Wiley & Sons.

EMBEDDED SYSTEM DESIGN

Course Code: 13EC590 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Introduction to Embedded systems: Embedded systems, processor embedded into a system, embedded hardware **UNIT**s and devices in a system, embedded software in a system, examples of embedded systems, embedded SOC and use of VLSI circuit design technology, Complex systems design and processors, Design process in embedded system, formalization of system design, design process and design examples, classification of embedded systems, skills required for an embedded system designer.
PIC Microcontrollers: PIC 16 Series family overview, An architecture overview of the 16F84A, Status register, 16F84A memory, Some issues of timing, Power-up and Reset, PIC 16F84A parallel ports, 16F84A clock oscillator, 16F84A operating conditions, 16F84A interrupt structure.
Larger systems and the PIC 16F873A: The main idea – the PIC 16F87XA, The 16F873A block diagram and CPU, 16F873A memory and memory maps, 16F873A interrupts, 16F873A oscillator, reset and power supply, 16F873A parallel ports.
RTOS: Basic design using RTOS, Micro/OS-II and Vx works, windows CE, OSEK, real-time Linux functions
Case study: digital camera hardware and software architecture, embedded systems in automobile, embedded system for a smart card, mobile phone software for key inputs.

Text Books:
1. Embedded Systems Architecture Programming and Design by Raj Kamal, II edition, Tata MC Graw-Hill.
2. Designing Embedded Systems with PIC Microcontrollers: principles and applications by Tim Wilmshurst, Elsevier.

Reference Text Books:
1. Embedded Systems Design by Steve Heath, II edition, Newnes publications
2. Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers by Tammy Noergaard, Elsevier.

Simulation Books:
1. An embedded software primer by David E. Simon, Pearson Education, 1995.
2. Microcontrollers Architecture Programming Interfacing and System Design by Raj Kamal, Pearson Educa

NANO ELECTRONICS

Course Code: 13EC591 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Introduction: Recent past, the present and its challenges, Future, Overview of basic Nano electronics.
Nano electronics & Nanocomputer architectures: Introduction to Nanocomputers, Nanocomputer Architecture, Quantum DOT cellular Automata (QCA), QCA circuits, Single electron circuits, molecular circuits, Logic switches – Interface engineering – Properties (Self-organization, Size-dependent) – Limitations.
Nanoelectronic Architectures: Nanofabrication Nano patterning of Metallic/Semiconducting nanostructures (e-beam/X-ray, Optical lithography, STM/AFM-SEM &Soft-lithography) – Nano phase materials – Self-assembled Inorganic/Organic layers.
Spintronics: Introduction, Overview, History & Background, Generation of Spin Polarization Theories of spin Injection, spin relaxation and spin dephasing, Spintronic devices and applications, spin filters, spin diodes, spin transistors.
Memory Devices And Sensors: Memory devices and sensors – Nano ferroelectrics – Ferroelectric random access memory –Fe-RAM circuit design –ferroelectric thin film properties and integration – calorimetric -sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors –electronic noses – identification of hazardous solvents and gases – semiconductor sensor array

Text Books:
1. Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices: Karl Goser, JanDienstuhl and others.
2. Nano Electronics and Information Technology: Rainer Waser

Reference Text Books:
1. Concepts in Spintronics – Sadamichi Maekawa
2. Spin Electronics – David Awschalom

IMAGE AND VIDEO PROCESSING

Course Code: 13EC520 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

Image Processing Techniques: 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 Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation

Image Compression Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations

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.

Text Books:

1. Gonzaleze and Woods ,"Digital Image Processing ", 3rd edition , Pearson
2. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication",1st edition , PHI

Reference Text Book:

1. M. Tekalp ,"Digital video Processing", Prentice Hall International

Simulation Text Books:

1. Relf, Christopher G.,"Image acquisition and processing with LabVIEW", CRC press
2. Aner ozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", John Wiley & Sons
3. Chris Solomon, Toby Breckon ,"Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons

MEMORY DESIGN AND TESTING

Course Code: 13EC560 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Random Access Memory Technologies-Static Random Access Memories (SRAMs): SRAM Cell Structures-MOS SRAM Architecture-MOS SRAM Cell and Peripheral Circuit Operation-Bipolar, SRAM Technologies-Silicon On Insulator (SOl) Technology-Advanced SRAM Architectures and Technologies- Application Specific SRAMs. Dynamic Random Access Memories (DRAMs): DRAM Technology Development-CMOS DRAMs-DRAMs Cell Theory and Advanced Cell Structures- BiCMOS DRAMs-Soft Error Failures in DRAMs-Advanced DRAM Designs and Architecture-Application Specific DRAMs.

Non-Volatile Memories-Masked Read-Only Memories (ROMs)-High Density ROMs-Programmable Read-Only Memories (PROMs)- Bipolar PROMs-CMOS PROMs-Erasable (UV) - Programmable Road-Only Memories (EPROMs)-Floating- Gate EPROM Cell-One-Time Programmable (OTP) Eproms-Electrically Erasable PROMs (EEPROMs)- EEPROM Technology And Architecture-Nonvolatile SRAM-Flash Memories (EPROMs or EEPROM)-Advanced Flash Memory Architecture.

Memory Fault Modeling, Testing, And Memory Design For Testability And Fault Tolerance-RAM Fault Modeling, Electrical Testing, Pseudo Random Testing-Megabit DRAM Testing-Nonvolatile Memory Modeling and Testing-IDDQ Fault Modeling and Testing-Application Specific Memory Testing.

Semiconductor Memory Reliability And Radiation Effects-General Reliability Issues-RAM Failure Modes and Mechanism-Nonvolatile 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 Dosimeter-Water Level Radiation Testing and Test Structures.

Advanced Memory Technologies And High-Density Memory Packaging Technologies-Ferroelectric Random Access Memories (FRAMs)-Gallium Arsenide (GaAs) FRAMs-Analog Memories-Magneto resistive Random Access Memories (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.

Text Book:

1. Ashok K.Sharma, " Semiconductor Memories Technology, Testing and Reliability ", Prentice-Hall of India Private Limited, New Delhi, 1997.

Reference Books:

1. Luecke Mize Care, “Semiconductor Memory design & application”, Mc-Graw Hill.
2. Belty Prince, “ Semiconductor Memory Design Handbook”.
3. Memory Technology design and testing 1999 IEEE International Workshop on: IEEE Computer Society Sponsor (S).

RECONFIGURABLE COMPUTING

Course Code: 13EC565 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction Goals and motivations - History, state of the art, future trends - Basic concepts and related fields of study - Performance, power, and other metrics - Algorithm analysis and speedup projections - RC Architectures - Device characteristics - Fine-grained architectures - Coarse-grained architectures.

Fpga Design FPGA Physical Design Tools -Technology mapping - Placement & routing - Register transfer (RT)/Logic Synthesis - Controller/Data path synthesis - Logic minimization

Parallel Processing RC Application Design - Parallelism - Systolic arrays -Pipelining - Optimizations - Bottlenecks - High-level Design - High-level synthesis - High-level languages - Design tools.

Architectures Hybrid architectures- Communication - HW/SW partitioning - Soft-core microprocessors- System architectures -System design strategies - System services - Small-scale architectures - HPC architectures - HPEC architectures - System synthesis - Architectural design space explorations.

Case Study Case Studies- Signal and image processing - Bioinformatics - Security - Special Topics - Partial Reconfiguration - Numerical Analysis -Performance Analysis/Prediction - Fault Tolerance

Text Book:

1. Paul S. Graham and Maya Gokhale "Reconfigurable Computing Accelerating Computation with Field-Programmable Gate Arrays" springer .

BICMOS TECHNOLOGY & APPLICATIONS

Course Code: 13EC573 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Device Modeling: Modeling of the MOS Transistor, Modeling of the Bipolar Transistor.
Device Design Considerations: Design Considerations for MOSFET's, Design Considerations for Bipolar Transistors, BiCMOS Device Synthesis.
BiCMOS Device Scaling: MOS Device Scaling, Bipolar Device Scaling.
BiCMOS Process Technology: BiCMOS Isolation Consideration, CMOS Well & Bipolar Collector tradeoffs, CMOS & BiCMOS Processes considerations, Interconnect Processes for submicron BiCMOS, Submicrometer BiCMOS Process for 5V Digital Applications, Analog BiCMOS Process Technology, Process Reliability.
Digital Design: Delay Analysis, Gate Design, Performance Comparisons.
Analog Design: BiCMOS Operational Amplifiers, BiCMOS Analog Subsystems**.**
BiCMOS Digital Circuit Applications: Adders, Multiplier, Random Access Memory, Programmable Logic Arrays, BiCMOS Logic Cells, BiCMOS Gate Arrays.

Text Books:
1. A L ALVAREZ, BICMOS Technology & Applications, Kluwer Academic Publishers.
2. Sherif H.K. Embabi, Abdellatif Bellaouar & Mohamed 1. Elmasry “Digital BiCMOS Integrated Circuit Design” Springer Science+ BusÎness Media, LLC.

Reference Book:
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. Klaas-Jan de Langen, Johan Huijsing, Compact Low-Voltage and High-Speed CMOS, BiCMOS and Bipolar Operational Amplifiers, Springer Science

SEMICONDUCTOR DEVICE MODELING

Course Code: 13EC592 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Basic Device Physics: Electrons and holes in silicon, p-n junction, MOS capacitor, Highfield effects.
MOSFET Devices: Long-channel MOSFETs, Short-channel MOSFETs. CMOS Device Design: MOSFET Scaling, Threshold voltage, MOSFET channel length.
CMOS Performance Factors: Basic CMOS circuit elements, Parasitic elements, Sensitivity of CMOS delay to device parameters, Performance factors of advanced CMOS devices.
Bipolar Device: n-p-n Transistors, Ideal current-voltage characteristics, Characteristics of a typical n-p-n transistor, Bipolar device models for circuit and time-dependent analyses, Breakdown voltages.
Bipolar Device Design: Design of the emitter design, Design of the base region, Design of the collector design, Modern bipolar transistor structures.

Text Book:

1. Yuan Taur, Tak.H.Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press

Reference Book:

1. Donald Neamen, Semiconductors Physics and Devices, Tata Mc Graw Hill, 2003
2. Tyagi, Introduction to Semiconductor Materials and Devices, Wiley Publications, 2002.
3. Semiconductor Devices, Basic Principles Jasprit Singh, Wiley Publications, 2001
4. S.M. Sze (Ed), Physics of Semiconductor Devices, 2nd Edition, Wiley Publications, 1998
5. Analysis and Design of Analog Integrated Circuits 4/e, Paul R. Gray, Paul J. Hurst,
6. Robert G Meyer, 2001, Wiley Publications
7. Physics of Semiconductor Devices 3/e S. M. Sze, Wiley Publications, 2007.

LOW POWER VLSI CIRCUITS

Course Code: 13EC555 **L-T-P:3-0-2**
Prerequisite: **Credits: 4**

Syllabus

Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches.

Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Transistor sizing& gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.

Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.

Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.

Low Power Circuit's: Transistor and gate sizing, network restructuring and Reorganization. Special Flip Flops & Latches design, high capacitance nodes, low power digital cells library.

Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.

Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components.

Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network.

Special Techniques: Power Reduction in Clock networks, CMOS Floating Node, Low Power Bus Delay balancing, and Low Power Techniques for SRAM.

Text Books:

1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002
2. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic

Reference Text Books:

1. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley, 2000
2. Yeo, "CMOS/BiCMOS ULSI Low Voltage Low Power" Pearson Education

VLSI SYSTEM DESIGN

Course Code: 13EC556 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus
Design Methodology: Structured design techniques; Programmable logic; Gate array and sea of gates design; cell based design; full custom design; Design flow; Design Economics.
Data path Subsystems: Adders; One/zero Detectors; Comparators; Counters; Shifters; Multipliers; Power and Speed Trade-off.
Memory and Array Subsystems: SRAM, DRAM, ROM, Serial access memories; CAM, PLAs; Array yield, reliability; Power dissipation in Memories.
Special-purpose Subsystems: Packaging; power distribution; I/O pads;
Interconnect: Interconnect parameters; Electrical wire models, capacitive parasitics; Resistive parasitics; Inductive parasitic; Crosstalk; Advanced Interconnect Techniques.
Timing Issues: Timing classification; Synchronous design; Self-timed circuit design;
Clock Synthesis and Synchronization: Synchronizers; Arbiters; Clock Synthesis; PLLs; Clock generation; Clock distribution; Synchronous Vs Asynchronous Design.

Text Books:
1. Neil H. E. Weste, David. Harris and Ayan Banerjee,"CMOS VLSI Design" - Pearson Education, Third Edition, 2004.
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits" Pearson Education, Second Edition.

Reference Text Books:
1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits" TMH, Third Edition, 2003
2. Wayne Wolf, "Modern VLSI Design ", 2nd Edition, Prentice Hall,1998.

Simulation Books:
1. Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005.

ADVANCED ANALOG IC DESIGN

Course Code: 13EC570 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus
Small Signal & large signal Models of MOS & BJT transistor. Analog MOS Process
Passive & Active Current Mirrors: Basic current mirrors, Cascade current mirror, Active loads, voltage and current Reference **Text Books:**;
Frequency response of integrated circuits: Single Stage (CS,CG,CD) amplifiers, Cascade Stage; frequency response(miller effect) of CG, CS, CD, Operation of Basic Differential Pair, differential pair with MOS loads, Frequency response of Cascade & Differential Pair;
Operational Amplifiers with single ended outputs: Applications of operational amplifiers, basic two stage MOS operational amplifiers, Deviations from ideality in real operational amplifiers, Basic two-stage MOS operational amplifier, MOS Folded –cascode operational amplifiers
Feedback: Ideal feedback equation, gain sensitivity, feedback configurations, practical configuration and effect of loading
Nonlinear Analog circuits & other applications: Precision rectification, phased locked loops, Sampling Switches, switched capacitor integrator, oscillators, ADC, DAC.

Text Books:

1. Gray & Meyer, Analysis & Design of Analog Integrated Circuits, 4th edition, Wiley, 2001.
2. Behzad Razavi, "Design Of Analog CMOS Integrated Circuits", Tata Mcgraw Hill,2005.

Reference Books:

1. Jacob Baker, "CMOS Mixed Signal Circuit Design", John Wiley.
2. Gray, Wooley, Brodersen, " Analog MOS Integrated Circuits ", IEEE Press, 1989.
3. Kenneth R. Laker, Willy M.C. Sansen, William M.C.Sansen, "Design of Analog Integrated Circuits and Systems ", McGraw Hill.

TESTING OF VLSI CIRCUITS

Course Code: 13EC571 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Basics of Testing And Fault Modeling Introduction to Testing - Faults in digital circuits - Modeling of faults - Logical Fault Models - Fault detection - Fault location - Fault dominance - Logic Simulation - Types of simulation - Delay models - Gate level Event-driven simulation.

Test Generation For Combinational and Sequential Circuits Test generation for combinational logic circuits - Testable combinational logic circuit design - Test generation for sequential circuits - design of testable sequential circuits.

Design For Testability Design for Testability - Ad-hoc design - Generic scan based design - Classical scan based design – System level DFT approaches.

Self Test and Test Algorithms Built-In Self Test - Test pattern generation for BIST - Circular BIST - BIST Architectures - Testable Memory Design - Test algorithms - Test generation for Embedded RAMs.

Fault Diagnosis Logic Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self-checking design - System Level Diagnosis.

Text Books:

1. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House.
2. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers.

Reference Books:

1. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002.
2. A.L. Crouch, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International.

CMOS MIXED SIGNAL CIRCUITS

Course Code: 13EC562 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Data Converter Modelling and SNR: Sampling and Aliasing: A modeling Approach, SPICE models for DACs and ADCs, Quantization noise, Viewing the quantization noise spectrum using simulations, quantization noise voltage spectral density, Data converter SNR: an overview, Improving SNR using averaging, Decimating filters for ADC, Interpolating filters for DACs, Using feedback to improve SNR.
Submicron CMOS Circuit Design: Submicron CMOS overview and models, Digital circuit design, Analog circuit design.
Implementing Data Converters: R-2R topologies for DACs, Op-Amps in data converters, Implementing ADCs.
Noise-Shaping Data Converters: Noise-shaping fundamentals, Second-order noise-shaping, noise-shaping topologies.
Integrator-Based CMOS Filters: Integrator building blocks, filtering topologies, Filters using Noise-shaping.

Text Book:
1. R. Jacob Baker, "CMOS: Mixed-Signal Circuit Design", Wiley-Student Edition, IEEE Press,

Reference Books:
1. Behzad Razavi, "Principles of Data Conversion System Design,"John Wiley & Sons.
2. P. Allen and D. Holberg, "CMOS Analog Circuit design," Oxford Press.
3. E. Bogatin, "Signal and Power –Simplified," 2nd edition, Prentice Hall.

PROCESS AND DEVICE CHARACTERIZATION & MEASUREMENTS

Course Code: 13EC563 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction and Preliminary Concepts: Macro-Meso, Micro and Nanostructure of Materials, Fundamentals of crystallography and Crystal structures Optical Microscopy: Geometry of Optics, Resolution, and Construction of a Microscope, Image Contrast, and Phase Contrast.

Electron Microscopy: SEM: Electron Optics - Interaction of Electrons and Matter - Elastic and Inelastic Scattering, Backscattered Electrons, Secondary Electrons, Scanning Electron Microscopy – Image Formation, EPMA, Magnification, and Depth of Field, Distortion, Detectors, Contrast, and Resolution. TEM: Electron diffraction, different electron Diffraction techniques.

Semiconductor Material Impurity Characterization: Spectroscopic Ellipsometry (SE), X-ray Reflectivity (XRR), X-ray Fluorescence (XRF), X-ray Diffraction (XRD), Secondary Ion Mass Spectrometry (SIMS), Auger Electron Spectrometry (AES), Rutherford Backscattering Spectrometry (RBS), EDAX, FTIR.

Electrical Characterization: Four-probe technique, Hall Effect, sheet resistance C-V measurements, DLTS, Carrier lifetime, impurity profiling, I-V measurements.Process and Spice Model Parameter Extraction

Text /Reference Text Books:

1. W.R. Reunyan, "Semiconductor Measurements and Instrumentation", Mc-Graw Hill
2. Micro structural Characterization of Materials - David Brandon and Wayne Kaplan, John Wiley and Sons, New York, NY.
3. Schroder, "Semiconductor Material and Device Characterization"
4. Philips F. Kare and Greydon B. Lauabee, "Characterization of semiconductor Materials", Mc-Graw Hill.
5. K.V. Ravi, "Imperfections and Impurities in Semiconductor Silicon", John Wiley and Sons.

ADVANCED VLSI DESIGN

Course Code: 13EC564 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Review of MOS Circuits: MOS and CMOS static plots, switches, comparison between CMOS and BI - CMOS.
MESFETS: MESFET and MODFET operations, quantitative description of MESFETS.
MIS Structures and MOSFETS: MIS systems in equilibrium, under bias, small signal operation of MESFETS and MOSFETS.
Short Channel Effects and Challenges to CMOS: Short channel effects, scaling theory, processing challenges to further CMOS miniaturization
Beyond CMOS: Evolutionary advances beyond CMOS, carbon Nano tubes, conventional vs. tactile computing, computing, molecular and biological computing Mole electronics-molecular Diode and diode- diode logic ,Defect tolerant computing.
Super Buffers, Bi-CMOS and Steering Logic: Introduction, RC delay lines, super buffers-An NMOS super buffer, tri state super buffer and pad drivers, CMOS super buffers, Dynamic ratio less inverters, large capacitive loads, pass logic, designing of transistor logic, General functional blocks - NMOS and CMOS functional blocks.
Special Circuit Layouts and Technology Mapping: Introduction, Talley circuits, NAND-NAND, NORNOR, and AOI Logic, NMOS, CMOS Multiplexers, Barrel shifter, Wire routing and module lay out.
System Design: CMOS design methods, structured design methods, Strategies encompassing hierarchy, regularity, modularity & locality, CMOS Chip design Options, programmable logic, Programmable inter connect, programmable structure, Gate arrays standard cell approach, Full custom Design.

Text Books:

1. Kevin F Brennan **"**Introduction to Semi-Conductor Device**"**, Cambridge publications
2. Eugene D Fabricius **"**Introduction to VLSI Design**"**, McGraw-Hill publications

Reference Books:

1. D.A Pucknell **"**Basic VLSI Design", PHI Publication
2. Wayne Wolf, **"**Modern VLSI Design**"** Pearson Education, Second Edition

VLSI FOR WIRELESS COMMUNICATION

Course Code: 13EC574 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Communication Concepts: Wireless Channel Description, Path Loss, Multipath Fading, Channel Model and Envelope Fading, Frequency Selective and Fast Fading
Receiver Architectures: Receiver Front End: Filter Design, Rest of Receiver Front End, Derivation of NF, IIP3 of Receiver Front End
Low Noise Amplifier: Wideband LNA Design, Narrow Band LNA: Impedance Matching, Core Amplifier
Active Mixer: Balancing, Qualitative Description of the Gilbert Mixer, Distortion, Low Frequency Case: Analysis of Gilbert Mixer, Distortion, High-Frequency Case, Noise
Passive Mixer: Switching Mixer, Distortion in Unbalanced Switching Mixer, Conversion Gain in Unbalanced Switching Mixer, Noise in Unbalanced Switching Mixer, practical Unbalanced Switching Mixer, Sampling Mixer, Conversion Gain in Single-Ended Sampling Mixer
Analog-to-Digital Converters: Demodulators, A/D converters Used in a Receiver, Low-Pass Sigma-Delta Modulators, Implementation of Low-Pass Sigma-Delta Modulators, Bandpass Sigma-Delta Modulators, Implementation of Bandpass Sigma-Delta Modulators

Text Book:

1. Bosco Leung, "VLSI for Wireless Communication, Second Edition, Springer

Reference Text Books:

1. Emad N Farag, M.I Elmasry, “Mixed Signal VLSI Wireless Design Circuits and Systems”, KluwerPublication.
2. David Tsee, Pramod Viswanath,” Fundamentals of Wireless Communication”, Cambridge Univ Press.

NANO SENSORS AND ITS APPLICATIONS

Course Code: 13EC593 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Sensor Characteristics And Physical Effects: Active and Passive sensors – Static characteristic - Accuracy, offset and linearity – Dynamic characteristics - First and second order sensors – Physical effects involved in signal transduction- Photoelectric effect – Photo dielectric effect – Photoluminescence effect – Electroluminescence effect – Hal effect – Thermoelectric effect – Peizoresistive effect – Piezoelectric effect – Pyroelectric effect – Magneto-mechanical effect (magnetostriction) – Magneto resistive effect.

Nano Based Inorganic Sensors: Density of states (DOS) – DOS of 3D, 2D, 1D and 0D materials – one dimensional gas sensors:- gas sensing with nanostructured thin films – absorption on surfaces – metal oxide modifications by additives – surface modifications – nano optical sensors – nano mechanical sensors – plasmon resonance sensors with nano particles – AMR, Giant and colossal magneto resistors – magnetic tunneling junctions.

Organic / Biosensors: Structure of Protein – role of protein in nanotechnology – using protein in nanodevices – antibodies in sensing – antibody in nano particle conjugates – enzymes in sensing – enzyme nanoparticle hybrid sensors – Motor proteins in sensing – transmembrane sensors – Nanosensors based on Nucleotides and DNA – Structure of DNA – DNA decoders and microarrays – DNA protein conjugate based sensors – Bioelectronic sensors – DNA sequencing with nanopores – sensors based on molecules with dendritic architectures – biomagnetic sensors.

Nano Sensors: Temperature Sensors, Smoke Sensors, Sensors for aerospace and defense: Accelerometer, Pressure Sensor, Night Vision System, Nano tweezers, nano-cutting tools, Integration of sensor with actuators and electronic circuitry Biosensors. **Applications:** Cantilever array sensors - Cantilever sensors for diagnosis of diabetes mellitus - Cantilever sensors for cancer diagnosis - Nanotube based sensors - Nanotube based sensors for DNA detection - Nanotube based sensors for capnography - Nanowire based sensors - Nanowire based electrical detection of single viruses - Nanowire based electrical detection of biomolecules.

Detectors and Applications: Bio receptors –Bio detectors - Nano array based detector - Nano Particle based detector - Ultra-sensitive detection of pathogenic biomarkers - Ultra-sensitive detection of single bacteria.

Reference Text Books:

1. Kourosh Kalantar – Zadeh, Benjamin Fry, “Nanotechnology- Enabled Sensors”, Springer,
2. H.Rosemary Taylor, “Data acquisition for sensor systems”, Chapman & Hall, 1997.
3. Jerome Schultz, Milan Mrksich, Sangeeta N. Bhatia, David J. Brady, Antonio J. Ricco, David R. Walt, Charles L. Wilkins, “Biosensing: International Research and Development”, Springer,
4. Ramon Pallas-Areny, John G. Webster, “Sensors and signal conditioning” John Wiley & Sons, 2001.
5. Vijay.K.Varadan, Linfeng Chen, Sivathanupillai, “Nanotechnology Engineering in Nano and Biomedicine”, John Wiley & Sons, 2010.

ADVANCED DIGITAL IC DESIGN

Course Code: 13EC558 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Implementation Strategies for Digital ICs: Introduction, From Custom to Semicustom and Structured Array Design Approaches, Custom Circuit Design, Cell-Based Design Methodology, Standard Cell, Compiled Cells, Macrocells, Megacells and Intellectual Property, Semi-Custom Design Flow, Array-Based Implementation Approaches, Pre-diffused (or Mask-Programmable) Arrays, Prewired Arrays, Perspective—The Implementation Platform of the Future.

Coping with Interconnect: Introduction, Capacitive Parasitics, Capacitance and Reliability—Cross Talk, Capacitance and Performance in CMOS, Resistive Parasitics, Resistance and Reliability—Ohmic Voltage Drop, Electromigration, Resistance and Performance—RC Delay.

Timing Issues in Digital Circuits: Introduction, Timing Classification of Digital Systems,Synchronous Interconnect, Mesochronous interconnect, Plesiochronous Interconnect, Asynchronous Interconnect, Synchronous Design — An In-depth Perspective, Synchronous Timing Basics, Sources of Skew and Jitter, Clock-Distribution Techniques, Synchronizers and Arbiters, Synchronizers— Concept and Implementation, Arbiters, Clock Synthesis and Synchronization Using a Phase-Locked Loop, Basic Concept, Building Blocks of a PLL.

Designing Arithmetic Building Blocks: Introduction, The Adder, The Binary Adder: Definitions, The Full Datapaths in Digital Processor Architectures, Adder: Circuit Design Considerations, The Binary Adder: Logic Design Considerations, The Multiplier, The Multiplier: Definitions, Partial- Product Generation, Partial Product Accumulation, Final Addition, Multiplier Summary, The Shifter, Barrel Shifter, Logarithmic Shifter.

Designing Memory and Array Structures: Introduction, Memory Classification, Memory Architectures and Building Blocks, The Memory Core, Read-Only Memories, Nonvolatile Read-Write Memories, Read-Write Memories (RAM), Contents-Addressable or Associative Memory (CAM), Memory Peripheral Circuitry, The Address Decoders, Sense Amplifiers, Voltage Reference **Text Books:**, Drivers/Buffers, Timing and Control.

Text Books:

1. Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, “Essentials of VLSI Circuits and Systems” – PHI, EEE, 2005 Edition.
2. Neil H. E. Weste and David. Harris Ayan Banerjee,, “CMOS VLSI Design” - Pearson Education.

Reference Text Books:

1. Sung-Mo Kang, Yusuf Leblebici,”CMOS Digital Integrated Circuits” TMH 2003
2. Jan M. Rabaey, “Digital Integrated Circuits” Pearson Education, 2003
3. Wayne Wolf, “Modern VLSI Design ", 2nd Edition, Prentice Hall,1998.

Simulation Books:

1. Etienne Sicard, Sonia Delmas Bendhia, “Basics of CMOS Cell Design”, TMH, EEE, 2005.

OPTIMIZATION TECHNIQUES AND APPLICATIONS IN VLSI DESIGN

Course Code: 13EC561 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Statistical Modelling: Modelling sources of variations, Monte Carlo techniques, Process variation modelling- Pelgroms model, principal component based modelling, Quad tree based modelling, Performance modelling-Response surface methodology, delay modelling, interconnect delay models 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 Convex Optimization Convex sets, convex functions, geometric programming, trade-off and sensitivity analysis, Generalized geometric programming, geometric programming applied to digital circuit gate sizing, Floor planning, wire sizing, Approximation and fitting- Monomial fitting, Max-monomial fitting, Polynomial fitting. Genetic Algorithm Introduction, GA Technology-Steady State Algorithm-Fitness Scaling-Inversion GA for VLSI Design, Layout and Test automation- partitioning-automatic placement, routing technology, Mapping for FPGA- Automatic test generation- Partitioning algorithm Taxonomy-Multiday Partitioning Hybrid genetic-encoding-local improvement-WDFR-Comparison of Cas-Standard cell placement-GASP algorithm-unified algorithm. Ga Routing Procedures And Power Estimation Global routing-FPGA technology mapping-circuit generation-test generation in a GA frame work-test generation procedures. Power estimation-application of GA-Standard cell placement-GA for ATG-problem encoding- fitness function-GA vs Conventional algorithm.

Reference Text Books:

1. Ashish Srivastava, Dennis Sylvester, David Blaauw "Statistical Analysis and Optimization for VLSI:Timing and Power" , Springer, 2005.
2. Pinaki Mazumder, E.Mrudnick, "Genetic Algorithm for VLSI Design,Layout and test Automation", Prentice Hall,1998.
3. Stephen Boyd, Lieven Vandenberghe "Convex Optimization", Cambridge University Press

CMOS RF CIRCUIT DESIGN

Course Code: 13EC566 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Introduction to RF Design and Wireless Technology: Design and Applications, Complexity and Choice of Technology. Basic concepts in RF design: Nonlinearly and Time Variance, Inter symbol interference, random processes and noise. Sensitivity and dynamic range, conversion of gains and distortion

RF Modulation: Analog and digital modulation of RF circuits, Comparison of various techniques for power efficiency, Coherent and non-coherent detection, Mobile RF communication and basics of Multiple Access techniques. Receiver and Transmitter architectures, Direct conversion and two-step transmitters

RF Testing: RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.

BJT and MOSFET behaviour at RF Frequencies: BJT and MOSFET behaviour at RF frequencies, modelling of the transistors and SPICE model, Noise performance and limitations of devices, integrated parasitic elements at high frequencies and their monolithic implementation

RF Circuits Design: Overview of RF Filter design, Active RF components & modelling, Matching and Biasing Networks. Basic blocks in RF systems and their VLSI implementation, Low noise Amplifier design in various technologies, Design of Mixers at GHz frequency range, various mixers- working and implementation. Oscillators- Basic topologies VCO and definition of phase noise, Noise power and trade off. Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers, Design issues in integrated RF filters.

Text Books:

1. B. Razavi, "RF Microelectronics" PHI 1998
2. R. Jacob Baker, H.W. Li, D.E. Boyce "CMOS Circuit Design, layout and Simulation", PHI

Reference Books:

1. Thomas H. Lee "Design of CMOS RF Integrated Circuits" Cambridge University press 1998.
2. Y.P. Tsividis, "Mixed Analog and Digital Devices and Technology", TMH 1996

ASIC DESIGN FLOW

Course Code: 13EC568 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Types of ASICs – Design flow – Economics of ASICs – ASIC cell libraries – CMOS logic cell data path logic cells – I/O cells – cell compilers.
ASIC Library design: Transistors as resistors – parasitic capacitance – logical effort programmable ASIC design software: Design system – logic synthesis – half gate ASIC.
Low level design entry: Schematic entry – low level design languages – PLA tools – EDIF – An overview of VHDL and verilog. Logic synthesis in verilog and & VHDL simulation.
CMOS System case studies: Dynamic warp processor: Introduction, the problem, the algorithm, a functional overview, detailed functional specification, structural floor plan, physical design, fabrication.
pixels-planes graphic engine: introduction, raster scan graphic fundamental, pixels-planes system overview, chip electrical design, chip organization and layout, clock distribution.
Hierarchical layout and design of single chip 32 bit CPU: Introduction ,design methodology, technology updatability and layout verification.
Floor planning & placement: Floor Planning Goals and Objectives**,** Measurement of Delay in floor planning, Floor planning tools ,I/O and Power planning, Clock planning ,Placement Algorithms**.**

Routing: Global routing, Detailed routing ,Special routing.

Text Books:
1. Application specific Integrated Circuits", J.S. Smith, Addison Wesley.
2. Principles of CMOS VLSI Design : A System Perspective, N. Westle & K. Eshraghian ,Addison – Wesley Pub.Co.1985.

Reference Text Books:
1. Basic VLSI Design :Systems and Circuits, Douglas A. Pucknell & Kamran Eshraghian, Prentice Hall of India Private Ltd. , New Delhi , 1989.
2. Introduction to VLSI System,C. Mead & L. Canway, Addison Wesley Pub
3. Introduction to NMOS & VLSI System Design, A. Mukharjee, Prentice Hall,
4. The Design & Analysis of VLSI Circuits, L. A. Glassey & D. W. Dobbepahl, Addison Wesley Pub Co. 1985.
5. Digital Integrated Circuits: A Design Perspective, Jan A. Rabey, Prentice Hall of India Pvt Ltd

NANO SENSORS AND ITS APPLICATIONS

Course Code: 13EC593 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Sensor Characteristics And Physical Effects: Active and Passive sensors – Static characteristic - Accuracy, offset and linearity – Dynamic characteristics - First and second order sensors – Physical effects involved in signal transduction- Photoelectric effect – Photo dielectric effect – Photoluminescence effect – Electroluminescence effect – Hal effect – Thermoelectric effect – Peizoresistive effect – Piezoelectric effect – Pyroelectric effect – Magneto-mechanical effect (magnetostriction) – Magneto resistive effect.

Nano Based Inorganic Sensors: Density of states (DOS) – DOS of 3D, 2D, 1D and 0D materials – one dimensional gas sensors:- gas sensing with nanostructured thin films – absorption on surfaces – metal oxide modifications by additives – surface modifications – nano optical sensors – nano mechanical sensors – plasmon resonance sensors with nano particles – AMR, Giant and colossal magneto resistors – magnetic tunneling junctions.

Organic / Biosensors: Structure of Protein – role of protein in nanotechnology – using protein in nanodevices – antibodies in sensing – antibody in nano particle conjugates – enzymes in sensing – enzyme nanoparticle hybrid sensors – Motor proteins in sensing – transmembrane sensors – Nanosensors based on Nucleotides and DNA – Structure of DNA – DNA decoders and microarrays – DNA protein conjugate based sensors – Bioelectronic sensors – DNA sequencing with nanopores – sensors based on molecules with dendritic architectures – biomagnetic sensors.

Nano Sensors: Temperature Sensors, Smoke Sensors, Sensors for aerospace and defense: Accelerometer, Pressure Sensor, Night Vision System, Nano tweezers, nano-cutting tools, Integration of sensor with actuators and electronic circuitry Biosensors.

Applications: Cantilever array sensors - Cantilever sensors for diagnosis of diabetes mellitus - Cantilever sensors for cancer diagnosis - Nanotube based sensors - Nanotube based sensors for DNA detection - Nanotube based sensors for capnography - Nanowire based sensors - Nanowire based electrical detection of single viruses - Nanowire based electrical detection of biomolecules.

Detectors and Applications: Bio receptors –Bio detectors - Nano array based detector - Nano Particle based detector - Ultra-sensitive detection of pathogenic biomarkers - Ultra-sensitive detection of single bacteria.

Reference Text Books:

1. Kourosh Kalantar – Zadeh, Benjamin Fry, "Nanotechnology- Enabled Sensors", Springer,
2. H.Rosemary Taylor, "Data acquisition for sensor systems", Chapman & Hall, 1997.
3. Jerome Schultz, Milan Mrksich, Sangeeta N. Bhatia, David J. Brady, Antonio J. Ricco, David R. Walt, Charles L. Wilkins, "Biosensing: International Research and Development", Springer,
4. Ramon Pallas-Areny, John G. Webster, "Sensors and signal conditioning" John Wiley & Sons, 2001.
5. Vijay.K.Varadan, Linfeng Chen, Sivathanupillai, "Nanotechnology Engineering in Nano and Biomedicine", John Wiley & Sons, 2010.

MEMS SYSTEM DESIGN

Course Code: 13EC593 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
MEMS and Microsystems, Microsystems and microelectronics, Microsystems and miniaturization, Working principle of micro system - Micro sensors, Micro actuators, MEMS with Micro actuators.
Materials For MEMS - Substrate and wafer, silicon as a substrate material, silicon compound, silicon Piezo-resistors, Gallium Arsenide, quartz, Piezoelectric crystals, polymers and packaging Materials.
Fabrication Process - Photolithography, Ion implantation, Oxidation, Chemical vapor deposition (CVD), Physical vapor deposition, Deposition by Epitaxy, Etching.
Manufacturing Process - Bulk Micromachining, Surface Micromachining, and LIGA Process. Micro system Design - Design consideration, process design, Mechanical design, Mechanical design using MEMS.
Mechanical packaging of Microsystems, Microsystems packaging, interfacing in Microsystems packaging, packaging technology, and selection of packaging materials, signal mapping and transduction.
Case study on strain sensors, Temperature sensors, Pressure sensors, Humidity sensors, Accelerometers, Gyroscopes , RF MEMS Switch, phase shifter, and smart sensors. Case study of MEMS pressure sensor Packaging.

Text Books:

1. Tai Ran Hsu,” MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.
2. Julian W Gardner, "Microsensors MEMS and smart devices", John Wiley and sons Ltd,2001.
3. Chang Liu, "Foundation of MEMS", Pearson International Edition,2006.

Reference Text Books:

1. Stephen Santuria,” Microsystems Design”, Kluwer publishers, 2000.
2. Nadim Maluf,” An introduction to Micro electro mechanical system design”, Artech House,
3. Mohamed Gad-el-Hak, editor,” The MEMS Handbook”, CRC press Baco Raton,2000.
4. Gabriel M Rebeiz, "RF MEMS - Theory Design and Technology", John Wiley and Sons, 2003.

SYSTEM ON CHIP DESIGN

Course Code: 13EC562 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
System Level Design: System level design-Tools & methodologies for system level design, System level space & modelling languages, SOC block based design & IP assembly, Performance evaluation methods for multiprocessor SOC design
Power Management And Synthesizing System level power management, Processor modelling & design tools, Embedded software modelling & design Using performance metrics to select microprocessor for IC design, Parallelizing High-Level Synthesize ,A code transformational approach to High Level Synthesize.
Micro-Architecture Design And Power Optimization Micro-architecture design, Cycle accurate system – level modelling, Performance evaluation, Micro architectural power estimation optimization, Design planning.
Software Design Verification logical verification, Design & Verification languages, Digital simulation, using transactional, level models in an SOC design, Assertion based verification.
Hardware Design Verification Hardware acceleration & emulation, Formal property verification, TEST, DFT, ATPG,Analog
& mixed signal test

Text Book:
1. Louis Scheffer Luciano Lavagno and Grant Martin, "EDA for IC System verification andTesting", CRC, 2006.

Reference Text Books:
1. Wayone Wolf," Modern VLSI Design: SOC Design"
2. Prakash Rashnikar, Peter Paterson, Lenna Singh" System-On-A-Chip Verification methodlogy & Techniques", Kluwer Academic Publishers.
3. Alberto Sangiovanni Vincentelli," Surviving the SOC Revolution: A Guide to Platformbased Design", Kluwer Academic Publishers.

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING
M-TECH COURSE STRUCTURE WITH SYLLABUS

M.TECH EMBEDDED SYSTEMS

S No	Course Code	SEMESTER: - 1	L	T	P	Cr
1	11-EM501	Microcontrollers for Embedded System Design.	**3**	**1**	**2**	**5**
2	12-EM502	Real Time Concepts for Embedded Systems	**3**	**1**	**0**	**4**
3	13-EM503	VLSI Technology & Design	**3**	**1**	**2**	**5**
4	12-EM504	Wireless Communications & Networks	**3**	**1**	**0**	**4**
5		Elective – 1 –GROUP-A	**3**	**0**	**0**	**3**
6		Elective – 2 –GROUP-B	**3**	**0**	**0**	**3**
7	12EM505	Seminar	**0**	**0**	**4**	**2**
		Total Credits				**26**
S No	**Course Code**	**SEMESTER: - 2**	**L**	**T**	**P**	**Cr**
1	11-EM601	Advanced Embedded Processor Architectures	**3**	**1**	**2**	**5**
2	13-EM602	Digital Signal Processors and Architectures	**3**	**1**	**0**	**4**
3	11-EM603	Hardware Software Co –Design	**3**	**1**	**0**	**4**
4	13-EM604	Linux System Concepts	**3**	**1**	**2**	**5**
5		Elective – 3 --GROUP-A	**3**	**0**	**0**	**3**
6		Elective -4 --GROUP-B	**3**	**0**	**0**	**3**
7	11TP501	Term Paper	**0**	**0**	**4**	**2**
		Total Credits				**26**

S.No.	Course Code		Credits
		SEMESTER-3	
1	14TM602	Internship	18
		SEMESTER -4	
2	EMCT01	Thesis	18
Total Credits			**88**

Course Code	GROUP-A
13-EM-E30	CPLD & FPGA Architectures and Applications
11-EM-E31	Network Security & Cryptography
11-EM-E32	Advanced Digital signal processing
11-EM-E33	Ad-hoc & Wireless Sensor Networks
11-EM-E34	Robotics
11-EM-E35	System Modeling and Simulation
	GROUP-B
11-EM-E40	Embedded Linux
12-EM-E41	System On Chip Architecture
11-EM-E42	Advanced Computer Networks
11-EM-E43	Image and Video Processing
12-EM-E44	Real Time Operating Systems
12-EM-E45	Object Oriented Analysis and Design

MICRO CONTROLLERS FOR EMBEDDED SYSTEM DESIGN

Course Code: 11-EM501 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus
UNIT – I: Introduction to Embedded Systems
Overview of Embedded Systems, Processor Embedded into a system, Embedded Hardware **UNIT**s and Devices in system, Embedded Software, Complex System Design, Design Process in Embedded System, Formalization of System Design, Classification of Embedded Systems.

UNIT – II: Microcontrollers and Processor Architecture & Interfacing
8051 Architecture. Real world interfacing, Introduction to advanced architectures, processor & memory organization, Instruction-level parallelism, and performance metrics.

UNIT – III: PIC Microcontroller Hardware
Introduction, Architectural overview, Memory organization, interrupts and reset, I/O ports, Timers

UNIT – IV: Device Drivers & Interrupt service Mechanism
Programmed-I/O Busy-wait approach without ISM,ISR concept, Interrupt sources, Interrupt service mechanism, Multiple Interrupts, context and the periods for context switching, Interrupt latency and deadline, Classification of processors ISM from context-saving angle, Direct Memory Access, Device driver programming

UNIT – V: Devices &Communication Buses for Devices Network
IO Types and examples, Serial communication Devices, Parallel Device ports, Networked Embedded systems, Serial Bus communication protocols

Text Books:
1. Embedded Systems - Architecture Programming and Design – Raj Kamal, 2nd ed., 2008, TMH.
2. Embedded C Programming and the Microchip PIC-Richard Barnett, O" Cull, Cox, 2009, Cengage Learning.

Reference Books:
1. Embedded Microcomputer Systems, Real Time Interfacing – Jonathan W. Valvano – Brookes Cole, 1999, Thomas Learning

REAL TIME CONCEPTS FOR EMBEDDED SYSTEMS

Course Code: 12EM502 **L-T-P:3-1-0**
Prerequisite: **Credits: 4 Syllabus**

UNIT I

Introduction: Examples of Embedded Systems, Definition of Embedded Systems, Architecture of Embedded Systems, Real- Time Embedded Systems , Design Issues and Current Trends for Embedded Systems

Hard versus soft Real- Time Systems: Jobs and Processes, Release Times, Deadlines and Timing Constraints, Hard and Soft Timing Constraints, Hard Real Time Systems, Soft Real Time Systems

UNIT II

A Reference Model of Real – Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency, Functional Parameters- preemptivity of jobs, criticality of jobs, Resource Parameters of Jobs and Parameters of Resources, Scheduling Hierarchy- Scheduler and Schedules, Feasibility, Optimality and Performance Measures.

Classification of Real Time Scheduling Approaches: Clock- Driven Approach, Weighted Round- Robin Approach, Priority- Driven Approach, Dynamic versus Static Systems, Effective Release Times and Deadlines, optimality of the EDF and LST algorithms, Non optimality of the EDF and LST algorithms, Challenges in validating timing constraints in priority –driven systems Off-line versus On-line Scheduling

UNIT III:

Clock-Driven Scheduling : Notations and Assumptions, Static, Timer -Driven Scheduler, General Structure of Cyclic Schedules, Cyclic Executives, Improving the Average Response Time of Aperiodic Jobs, Scheduling Sporadic Jobs-Acceptance test ,EDF Scheduling of accepted jobs and implementation, Pros and Cons of Clock Driven Scheduling,

UNIT IV:

Priority-Driven Scheduling of Periodic Tasks: Static Assumption, Fixed Priority v/s Dynamic Priority Algorithms, schedulability test for the EDF algorithm, a schedulability test for fixed priority tasks with short response times-time demand analysis, schedulability test for fixed priority tasks with arbitrary response times: busy intervals, general schedulability test, sufficient schedulability conditions for RM & DM algorithms: schedulable utilization of the RM algorithm for tasks with Di=pi, schedulable utilization of fixed priority tasks with arbitrary relative deadlines

Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems: Assumptions and Approaches, Deferrable Servers- Operations of Deferrable Servers, Constant utilization server Scheduling of sporadic jobs-a simple acceptance test in deadline driven systems, a simple acceptance test in fixed- priority driven systems

UNIT V:

Resources and Resource Access control: Assumptions on Resources and Their Usage, Effects of Resource Contention and Resource Access Control, Non-preemptive Critical Sections, Basic

Priority Inheritance Protocol, Basic Priority Ceiling Protocol- Definition, computation of blocking time, controlling accesses to Multiple **UNIT** Resources

Real-Time Operating Systems: Overview- Threads and Tasks, The Kernel, Time Services and Scheduling Mechanisms- Time Services, Scheduling Mechanisms, Other Basic Operating System Functions- Communication and Synchronization, Event Notification and Software Interrupt, Memory Management, I/O and Networking

Text Books:

1. Real Time Systems – By Jane W.S.Liu -Low Price Edition , Pearson Education Asia
2. Real-Time Concepts for Embedded Systems - Qing Li with Caroline Yao published by CMP Books

VLSI TECHNOLOGY & DESIGN

Course Code: 13EM503 L-T-P:3-1-2
Prerequisite: **Credits: 5**

Syllabus

UNIT – I
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 Vt, Gm, Gds and ωo, Pass Transistor, MOS, CMOS & Bi CMOS Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits.

UNIT – II
Layout Design and Tools: Transistor structures, Wires and Bias, Scalable Design rules, Layout Design and Tools.
Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.

UNIT – III
Combinational Circuit Design: Delay Estimation, Logical Effort and Transistor Sizing , Power Dissipation, Circuit Families,Circuit Pitfalls,Low-power Logic Design,Comparison of Circuit Families,Silicon-on-Insulator Circuit Design

UNIT –IV
Sequential Circuit Design: Introduction,Sequencing Static Circuits,Circuit Design of Latches and Flip-flops:Conventional CMOS Latches and Flip-Flops,Pulsed Latches, Resettable Latches and Flip-Flops,Enabled Latches and Flip-flops. Static Sequencing Element Methodology:Choice of Elements,Low-power Sequential Design.Synchronizers: A simple synchronizer, arbiter.

UNIT – V
Floor Planning and System Design: Floor planning methods, Global interconnect, Floor Plan design, off-chip connections, Register Transfer Design, Pipelining

Text Books:
1. Essentials of VLSI Circuits and Systems, K. Eshraghian. D, A.Pucknell, 2005, PHI.
2. Modern VLSI Design - Wayne Wolf, fourth edition, Pearson Education.
3. CMOS VLSI Design A Circuits and systems perspective Third Edition Neil H.E.Weste

Reference Text Books:
1. Introduction to VLSI systems – A Logic, Circuit and System Perspective- Ming Bo, Liu, CRC Press, 1st Edition 2011.
2. Principals of CMOS VLSI Design – N.H.E Weste, K.Eshraghian, 2nd ed., Adisson Wesley.

WIRELESS COMMUNICATIONS & NETWORKS

Course Code: 12EM504 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus
UNIT I
Introduction to Mobile and Wireless Landscape: Definition of Mobile and Wireless, Components of Wireless Environment, Challenges, Applications, Overview of Wireless Networks, Categories of Wireless Networks, open Research topics.
Wireless LAN: Infra redVs radio transmission, Infrastructure and Ad-hoc Network,
IEEE 802.11: System architecture, Protocol architecture. **Bluetooth:** User scenarios, Architecture.

UNIT II
Global System for Mobile Communications (GSM): Introduction, Mobile services, System architecture, Radio interface, Localization and calling, Handover, Security.
(Wireless) Medium Access Control: Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.

UNIT III
Mobile Network Layer:
Mobile IP: Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations, Dynamic Host Configuration Protocol (DHCP).
Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms.

UNIT IV
Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

UNIT V
Broadcast Systems: Overview, Cyclical repetition of data, Digital audio broadcasting: Multimedia object transfer protocol, Digital video broadcasting: DVB data broadcasting, DVB for high-speed internet access, Convergence of broadcasting and mobile communications.

Text Book:
1. Jochen Schiller, “Mobile Communications”, Pearson Education, Second Edition, 2009.

Reference Books:
1. MartynMallick, “Mobile and Wireless Design Essentials”, Wiley, 2008.
2. Asoke K Talukder, et al, “Mobile Computing”, Tata McGraw Hill, 2008.
3. Mobile Computing, Raj Kamal,Oxford University Press.
4. William Stallings, “ Wireless Communications & Networks”, Person, Second Edition, 2007.
5. JimGeier, “Wireless Networks first-step”, Pearson, 2005.

ADVANCED EMBEDDED PROCESSOR ARCHITECTURE

Course Code: 11EM601 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus

UNIT I
ARM Processor as System-on-Chip: Acorn RISC Machine – Architecture inheritance – ARM programming model. 3 and 5 stage pipeline ARM organization – ARM instruction execution and implementation – ARM Co-processor interface

UNIT II
ARM Assembly Language Programming: ARM instruction types – data transfer, data processing and control flow instructions – ARM instruction set – Co-processor instructions, Thumb Instruction Set.

UNIT III
Architectural Support for System Development: Advanced Microcontroller bus architecture – ARM memory interface – ARM reference peripheral specification – Hardware system prototyping tools – ARMulator – Debug architecture.

UNIT IV
ARM Processor Cores: ARM7TDMI, ARM8, ARM9TDMI, ARM10TDMI, the AMULET Asynchronous ARM Processors- AMULET1

UNIT V
Embedded ARM Applications: The VLSI Ruby II Advanced Communication Processor, The VLSI ISDN Subscriber Processor, The OneC™ VWS22100 GSM chip, The Ericsson-VLSI, Bluetooth Baseband Controller, The ARM7500 and ARM7500FE.

Text Books:
1. ARM System on Chip Architecture – Steve Furber – 2nd ed., 2000, Addison Wesley Professional.
2. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st ed., 2004, Springer

Reference Text Books:
1. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM
2. System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.

DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES

Course Code: 13EM602 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

UNIT I
Introduction To Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. DiscreteFourier Transform (DFT) and Fast Fourier Transform (FFT), linear time-invariant systems, Digital filters, Decimation and interpolation
Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of errorin DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT II
Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation **UNIT**, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT III
Programmable Digital Signal Processors: Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

UNIT IV
Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices- ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP2100, ADSP-2181 high performance Processor.
Introduction to Blackfin Processor – The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing **UNIT**s and Register files, Address Arithmetic **UNIT**, Control **UNIT**, Bus Architecture and Memory, Basic Peripherals.

UNIT V
Interfacing Memory And I/O Peripherals To Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

Text Books:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing – K Padmanabhan, R. Vijayarajeswaran, Ananthi.S, New Age International, 2006/2009.

3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007.

Reference Text Books:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architecture & Features- Lapsley et al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Enguneering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI.
5. The Scientist and Engineering's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997.
6. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005.

HARDWARE SOFTWARE CO –DESIGN

Course Code: 11EM603 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

UNIT –I
Co- Design Issues
Co- Design Models, Architectures, Languages, A Generic Co-design Methodology.
Co- Synthesis Algorithms:
Hardware software synthesis algorithms: hardware – software partitioning distributed system co-synthesis.

UNIT –II
Prototyping and Emulation:
Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping
Target Architectures:
Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

UNIT – III
Compilation Techniques and Tools for Embedded Processor Architectures:
Modern embedded architectures, embedded software development needs, compilation technologies practical consideration in a compiler development environment.

UNIT – IV
Design Specification and Verification:
Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification

UNIT – V
Languages for System – Level Specification and Design-I
System – level specification, design representation for system level synthesis, system level specification languages.
Languages for System – Level Specification and Design-II
Heterogeneous specifications and multi-language co-simulation the cosyma system and lycos system

Text Books:
1. Hardware / software co- design Principles and Practice – Jorgen Staunstrup, Wayne Wolf – 2009, Springer.

2. Hardware / software co- design Principles and Practice, 2002, kluwer academic publishers

LINUX SYSTEM CONCEPTS

Course Code: 13EM604 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus

UNIT1
GNU Development tools: Compilation tools and its functionalities, Debugging applications, Using Make, Creating Libraries.

UNIT – II
Operating Systems Concepts: Structure of Linux Operating System, Process Management, Memory Management, File System Management, I/O Management, Networking Subsystem.

UNIT – III
Introduction Linux Kernel: Linux installation, partitioning, Compilation of open sources, Configuration & Compilation of kernel sources, Kernel modules, Implementing System Calls.

UNIT – IV
Linux Kernel Concepts: The proc file system, Unified Device Model and systems, Memory Management and Allocation, User and Kernel Space communication, Interrupt Handling. KernelDebugging.

UNIT – V
Linux Device drivers: Skeleton of device drivers, Character Driver, Block Drivers, Building driver into the kernel
Networking in Linux: Sockets, a sample example

Text Books:

1. Programming Embedded Systems, 2nd Edition With C and GNU Development Tools by Michael Barr, Anthony Massa.
2. Michael Beck (1998), “ Linux Kernel Internals”, Addison Wealey
3. Doug Abbott. (2003), “Linux for Embedded and Real time Applications”, Newnes publishers.

Reference Books:

1. Understanding the Linux Kernel, Third Edition Daniel P. Bovet , Marco Cesati, 3rd edition, Orally Publications
2. Linux Device Drivers, 3rd edition, Linux Device Drivers, 3rd Edition Jonathan Corbet, Alessandro Rubini , Greg Kroah-Hartman, Orally Publications
3. Advanced Programming in UNIX Environment– Richard Stevens, Addison-Wesley, 1992.
4. Linux Kernel Development, Robert Love, 2nd Edition, 2006, Pearson Education.

CPLD AND FPGA ARCHITECTURE AND APPLICATIONS

Course Code: 13EME30 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT - I
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 Implementation of a Parallel Adder with Accumulation.

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

UNIT – III
SRAM Programmable FPGAs:
Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 And XC4000 Architectures.

UNIT – IV
Anti-Fuse Programmed FPGAs:
Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

UNIT – V
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.

Text Books:

1. Field Programmable Gate Array Technology by Stephen M. Trimberger, Springer International Edition.
2. Digital Systems Design by Charles H. Roth Jr, Lizy Kurian John, Cengage Learning.

Reference Books:

1. Field Programmable Gate Arrays by John V. Oldfield, Richard C. Dorf, Wiley India.
2. Digital Design Using Field Programmable Gate Arrays by Pak K. Chan/Samiha Mourad, Pearson Low Price Edition.
3. Digital Systems Design with FPGAs and CPLDs by Ian Grout, Elsevier, Newnes.

4. FPGA based System Design by Wayne Wolf, Prentice Hall Modern Semiconductor Design Series.

NETWORK SECURITY & CRYPTOGRAPHY

Course Code: 11EME31 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I
Introduction: Attacks, Services and Mechanisms, Security attacks, Security services, A Model for Internetworksecurity. Classical Techniques: Conventional Encryption model, Steganography, Classical EncryptionTechniques.

UNIT II
Modern Techniques: Simplified DES, Block Cipher Principles, Data Encryption standard, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of operations.
Algorithms: Triple DES, International Data Encryption algorithm, Blowfish, RC5, CAST-128, RC2, Characteristics of Advanced Symmetric block cifers.
Conventional Encryption: Placement of Encryption function, Traffic confidentiality, Key distribution, Random Number Generation.
Public Key Cryptography: Principles, RSA Algorithm, Key Management, Diffie-Hellman Key exchange, Elliptic Curve Cryptography.

UNIT III
Number theory: Prime and Relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Testing for primality, Euclid's Algorithm, the Chinese remainder theorem, Discrete logarithms.
Message authentication and Hash functions: Authentication requirements and functions, Message Authentication, Hash functions, Security of Hash Functions and MACs

UNIT IV
Hash and Mac Algorithms: MD File, Message digest Algorithm, Secure Hash Algorithm, RIPEMD-160, and HMAC. **Digital signatures and Authentication protocols**: Digital signatures, Authentication Protocols, Digital signature standards. **Authentication Applications**: Kerberos, X.509 directory Authentication service. Electronic Mail Security: Pretty Good Privacy, S/MIME.

UNIT-V
IP Security: Overview, Architecture, Authentication, Encapsulating Security Payload, Combining security Associations, Key Management
Web Security
Web Security requirements, Secure sockets layer and Transport layer security, Secure Electronic Transaction. **Intruders, Viruses and Worms:**Intruders, Viruses and Related threats. **Fire Walls** Fire wall Design Principles, Trusted systems.

Text Book:
1. Cryptography and Network Security: Principles and Practice - William Stallings, 2000, PE.

Reference Text Books:

1. Principles of Network and Systems Administration, Mark Burgess,JohnWiel

ADVANCED DIGITAL SIGNAL PROCESSING

Course Code: 11-EM-E32 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I
Review of DFT, FFT, IIR Filters, and FIR Filters, **Multirate Signal Processing:** Introduction, Decimation by a factor D, Interpolation by a factor I, and Sampling
rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design & Implementation for sampling rate conversion, Applications of Multirate Signal Processing

UNIT II
Non-Parametric methods of Power Spectral Estimation: Estimation of spectra from finite duration observation of signals, Non-parametric Methods: Bartlett, Welch & Blackman &Tukey methods, Comparison of all Non-Parametric methods

UNIT III
Parametric Methods of Power Spectrum Estimation: Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models - Yule-Waker& Burg Methods, MA & ARMA models for power spectrum estimation.

UNIT –IV
Linear Prediction : Forward and Backward Linear Prediction – Forward Linear Prediction, Backward Linear Prediction, Optimum reflection coefficients for the Lattice Forward and Backward Predictors. Solution of the Normal Equations: Levinson Durbin Algorithm, Schur Algorithm. Properties of Linear Prediction Filters

UNIT V
Finite Word Length Effects: Analysis of finite word length effects in Fixed-point DSP systems – Fixed, Floating Point Arithmetic – ADC quantization noise & signal quality – Finite word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.

Text Books:

1. Digital Signal Processing: Principles, Algorithms & Applications - J.G.Proakis&
2. D.G.Manolokis, 4th ed., PHI.
3. Discrete Time signal processing - Alan V Oppenheim & Ronald W Schaffer, PHI.
4. DSP – A Pratical Approach – Emmanuel C.Ifeacher, Barrie. W. Jervis, 2 ed., PearsonEducation.

Reference Text Books:

1. Modern spectral Estimation : Theory & Application – S. M .Kay, 1988, PHI.
2. Multirate Systems and Filter Banks – P.P.Vaidyanathan – Pearson Education
3. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C.Gnanapriya, 2000,TMH

AD-HOC WIRELESS & SENSOR NETWORKS

Course Code: 11EME33 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I
Introduction to Ad Hoc Networks: Characteristics of MANETs, Applications of MANETs and challenges of MANETs - **Routing in MANETs:** Criteria for classification, Taxonomy of MANET routing algorithms, Topology based routing algorithms, Position based routing algorithms, Other routing algorithms.

UNIT II
Data Transmission: Broadcast storm problem, Broadcasting, Multicasting and Geocasting - **TCP over Ad Hoc:** TCP protocol overview, TCP and MANETs, Solutions for TCP over Ad hoc

UNIT III
Basics of Wireless Sensors and Applications: Applications, Classification of sensor networks, Architecture of sensor network, Physical layer, MAC layer, Link layer.

UNIT IV
Data Retrieval in Sensor Networks: Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs, Sensor Networks and mobile robots - **Security:** Security in Ad Hoc networks, Key management, Secure routing, Cooperation in MANETs, Intrusion Detection systems.

UNIT V
Sensor Network Platforms and Tools: Sensor Network Hardware, Berkeley motes, Sensor Network Programming Challenges, Node-Level Software Platforms - **Operating System:**TinyOS - **Imperative Language:** nesC, Dataflow style language: TinyGALS, Node-Level Simulators, ns-2 and its sensor network extension, TOSSIM

Text Books:

1. Ad Hoc and Sensor Networks – Theory and Applications, Carlos Corderio Dharma P.Aggarwal, World Scientific Publications, March 2006, ISBN – 981-256-681-3

2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science, ISBN – 978-1-55860-914-3 (Morgan Kauffman)

ROBOTICS

Course Code: 11EME344 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT – I
Introduction & Basic Definitions: Introduction, Control Programs for Robots, Industry Applications of Robots, Pick and Place, Gantry and Armtype Robots in typical set-ups like Automobile Industry
Coordinate Systems: Cartesian, Cylindrical, Polar, and Revolute systems: Robot Positioning: Robot Arms; Axes, their ranges, offset and In-line Wrist: Roll, Pitch and Yaw, their meaning in Robotics

UNIT II
Mechanical Aspects: Kinematics, Inverse Kinematics, Motion planning and Mobile Mechanisms

UNIT III
Sensors and Applications: Range and Use of Sensors, Micro switches, Resistance Transducers, Piezo-electric, Infrared and Lasers. Applications of Sensors : Reed Switches, Ultrasonic, Barcode Readers and RFID

UNIT IV
Robot Systems: Hydraulic and Electrical Systems including pumps, valves, solenoids, cylinders, stepper motors, Encoders andAC Motors

UNIT-V
Programming of Robots: Programming of Robots such as Lego Robots, Programming environment, Example Applications, Safetyconsiderations

Text Books:
1. Introduction to Robotics – P.J.Mckerrow, ISBN : 0201182408
2. Introduction to Robotics – S.Nikv, 2001, Prentice Hall,
3. Mechatronics and Robotics: Design & Applications – A.Mutanbara, 1999,CRC Press.

Reference Text Books:
1. Robotics – K.S.Fu, R.C.Gonzalez and C.S.G.Lee, 2008, TMH.

SYSTEM MODELING AND SIMULATION

Course Code: 11EME35 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT – I
Basic Simulation Modeling, Systems, Models and Simulation, Nature of Systems, event Driven Models, Simulation of Single Server Queuing System, event Driven Models, Characterizing Systems, Simulation Diagrams.

UNIT – II
Stochastic generators: Uniformly Distributed Random Numbers, Statistical Properties of U[0,1] generators, Generation of Non-Uniform and Arbitrary Random Variates, Random processes, Characterizing and Generating Random
Processes, White Noise. Modeling Time Driven Systems: Modeling Input Signals, Discrete and Distributed Delays, System Integration, Linear Systems.
Exogenous Signals and Events: Disturbance Signals, State Machines, Petri Nets and their Analysis, System Encapsulation.

UNIT – III
Markov Process: Probabilistic Models, Discrete Time Markov Processes, Random Walks, Poisson Processes, ExponentialDistribution, Simulating a Poisson Process, Continuous Time Markov ProcessEvent Driven Models: Simulation Diagrams, Queuing Theory, M/M/I Queues, Simulating Queuing Systems,Finite Capacity Queues, Multiple Servers, M/M/C Queues.

UNIT – IV
System Optimization: System Identification, Searches, Alpha / Beta trackers, Multidimensional Optimization, Modeling and Simulation Methodology.

UNIT – V
Simulation Software and Building Simulation Models:
Comparison of Simulation Packages with Programming Languages, Classification of Simulation Software, Desirable software features, General Purpose Simulation Packages-Arena, extend; Guide lines for determining the level of Model detail, Techniques for increasing Model Viability and credibility.

Text Books:
1. System Modeling and Simulation: An Introduction – Frank L. Severance, 2001,John Wiley&Sons.
2. Simulation Modeling and Analysis - Averill M.Law, W.David Kelton, , 3 ed., 2003, TMH.

Reference Text Books:
1. Systems Simulation-Geoffery Gordan, PHI.

EMBEDDED LINUX

Course Code: 11EME40 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT – I
Introduction: History of Embedded Linux, Embedded Linux versus Desktop Linux, Embedded Linux Distributions, Architecture of Embedded Linux, Linux Kernel Architecture, Linux Start-Up Sequence, GNU Cross-p\Platform Tool chain.

UNIT – II
Board Support Package: Inserting BSP in Kernel Build Procedure, Boot Loader Interface, Memory Map, Interrupt Management, PCI Subsystem, Timers, UART, and Power Management.
Embedded Storage: Flash Map, MTD—Memory Technology Device, MTD Architecture, Flash-Mapping Drivers, MTD Block and Character devices, Embedded File systems, Optimizing Storage Space.

UNIT – III
Embedded Drivers: Linux Serial Driver, Ethernet Driver, I2C subsystem on Linux, USB Gadgets, Watchdog Timer, and Kernel Modules.

UNIT IV
Porting Applications: Architectural Comparison, Application Porting Road Map, Programming with Pthreads, Operating System Porting Layer (OSPL), Kernel API Driver.

UNIT-V
Real-Time Linux: Linux and Real-Time, Real-Time Programming in Linux, Hard Real-Time Linux.

Text Books:

1. Embedded Linux System Design and Development, P.Raghavan, Amol Lad, SriramNeelakandan, 2006, Auerbach Publications

Reference Books:

1. Embedded Linux – Hardware, Software and Interfacing

SYSTEM ON – CHIP ARCHITECTURE

Course Code: 12EME41 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I
Introduction ,Design Methodology for Logic cores : SoC Design flow, General guide lines for design reuse, design process for soft, firm and hard cores, system integration.

UNIT II
Design Methodology for Memory Cores and Analog cores: Design methodology for embedded memories, specifications of analog circuits Design Validation: core level validation, core interface verification SoC design validation.

UNIT III
On-chip communication Architectures: A quick overlook, Basic concepts of bus based communication Architectures: Terminology, characteristics of Bus based communication architectures, data transfer modes, Bus topology types.

UNIT IV
On chip Communication Architecture Standard: standard on chip bus based communication architectures; socket based on chip interface standards.

UNIT-V
Verification and security Issues in On chip communication Architectures: verification of on chip communication protocols, compliance verification for IP block integration, basic concepts for SoC security, security support in standard bus protocols Networks on chip: network topology, switching strategies, routing algorithms, flow control, clocking schemes, NOC architectures.

Text Books:

1. System On a Chip Design and Test? by Rochit Rajsuman, Library of Congress Cataloging-in-Publication Data,2000.
2. On chip communication Architectures? by Sudeep Pasricha and Nikil Dutt , Morgan Kaufmann Publishers,2008

ADVANCED COMPUTER NETWORKS

Course Code: 11EME42 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT -I

Congestion and Quality of Service (QoS): Data traffic, Congestion, Congestion Control, Open loop and Closed Loop Congestion Control in TCP andFrame Relay, Quality of Service, Flow Characterization, Flow Classes, Need For QoS, Resource Allocation,Best Effort Service Features, Techniques to Improve QoS.

Queue Management: Passive, Active (RED), and Fair (BRED, Choke) Queue Management Schemes, Scheduling, Traffic Shaping, Resource Reservation and Admission Control Scheduling, Integrated and Differential Services.

UNIT II

Wireless Local Area Networks: Introduction, Wireless LAN Topologies, Wireless LAN Requirements, the Physical Layer, the Medium Access Control (MAC) Layer, Latest Developments.

Wireless Personal Area Networks (WPANs): Introduction to PAN Technology and Applications, Commercial Alternatives- Bluetooth, Home RF.

Wireless Wide Area Networks and MANS: The Cellular Concept, Cellular Architecture, The First-Generation Cellular Systems, The Second- Generation Cellular Systems, The Third-Generation Cellular Systems, Wireless in Local Loop, Wireless ATM, IEEE 802.16 Standard.

UNIT III

Cellular Systems and Infrastructure- Based Wireless Networks: Cellular Systems Fundamentals, Channel Reuse, SIR and User Capacity, Interference Reduction Techniques, Dynamic Resource Allocation, Fundamental Rate Limits.

Virtual Private Network (VPN): Types of VPN, VPN General Architecture, Disadvantages, VPN Security Issues, VPN Standards.

UNIT IV

ATM Protocol Reference Model: Introduction, Transmission Convergence (TC) Sub-layer, Physical Medium Dependent (PMD) Sub-layer, Physical Layer Standards for ATM.

ATM Layer: ATM Cell Header Structure at UNI, ATM Cell Header Structure at NNI, ATM Layer Functions.

ATM Adaptation Layer: Service Classes and ATM Adaptation Layer, ATM Adaptation Layer 1 (AAL1), ATM Adaptation Layer 2 (AAL2), ATM Adaptation Layer 3/4 (AAL3/4), ATM Adaptation Layer 5 (AAL5).

ATM Traffic and Service Parameterization: ATM Traffic Parameters, ATM Service Parameters, Factors Affecting QoS Parameters, ATM Service Categories, QoS and QoS Classes.

UNIT-V

Interconnection Networks: Introduction, Banyan Networks- Properties, Crossbar Switch, Three Stage Class Networks, Rearrangeable Networks, Folding Algorithm, Benes Networks, Looping Algorithm, Bit- Allocation Algorithm.

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

Text Books:

1. Wireless Communications - Andrea Goldsmith, 2005, Cambridge University Press.
2. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj,2004, PHI.
3. Data Communication and Networking - B. A.Forouzan, 2nd updating, 2004,TMH

Reference Text Books:

1. Introduction to Broadband Communication Systems- Sadiku, Mathew N.O., Akujuobi Cajetan.M, PHI
2. Wireless Networks- P. Nicopolitidis, A. S. Pomportsis, G. I. Papadimitriou, M. S. Obaidat,2003, JohnWiley& Sons
3. High Performance TCP / IP Networking – Mahaboob Hassan, Jain Raj, PHI.
4. Telecommunication System Engineering – Roger L. Freeman, 4/ed., Wiley-Interscience, John Wiley & Sons, 2004.

IMAGE AND VIDEO PROCESSING

Course Code: 13EC574 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I
Fundamentals of Image Processing and Image Transforms: Basic steps of Image Processing System Sampling and Quantization of an image – Basic relationship betweenpixelsImage Transforms: 2 D- Discrete Fourier Transform, Discrete Cosine Transform (DCT), Wavelet Transforms:Continuous Wavelet Transform, Discrete Wavelet Transforms.

UNIT II
Image Processing Techniques:
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.
Image Segmentation: Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region Based segmentation.

UNIT III
Image Compression: Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compressionmodels: Lossy& Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, Bit plane
coding, Transform coding, Predictive coding, Wavelet coding, JPEG Standards.

UNIT IV
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 2-D
Motion Estimation: Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, and Mesh basedMotion 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.

Text Books:
1. Digital Image Processing – Gonzaleze and Woods, 3rd ed., Pearson.
2. Video processing and communication – Yao Wang, JoemOstermann and Ya–quin Zhang. 1st Ed., PH Int.

Reference Text Books:
1. Digital Video Processing – M. Tekalp, Prentice Hall International

REAL TIME OPERATING SYSTEMS

Course Code: 12EME44 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I
Review of Operating Systems: Basic Principles, Operating System structures, System Calls, Files, Processes, Design and Implementation of processes, Communication between processes, Introduction to Distributed operating system, Distributed scheduling.

UNIT II
Overview of RTOS: RTOS Task and Task state, Process Synchronisation- Message queues, Mail boxes, pipes, Critical section, Semaphores, Classical synchronisation problem, Deadlocks

UNIT III
REAL TIME MODELS AND LANGUAGES: Event Based – Process Based and Graph based Models, Real Time Languages, RTOS Tasks, RT scheduling, Interrupt processing, Synchronization, Control Blocks, Memory Requirements.

UNIT IV
REAL TIME KERNEL: Principles, Design issues, Polled Loop Systems, RTOS Porting to a Target, Comparison and study of various RTOS like QNX, VX works, PSOS, C Executive- Case studies.

UNIT V
RTOS APPLICATION DOMAINS: RTOS for Image Processing, Embedded RTOS for voice over IP, RTOS for fault Tolerant Applications, RTOS for Control Systems.

REFERENCE TEXT BOOKS:

1. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill, 2006.
2. Herma K., “Real Time Systems – Design for distributed Embedded Applications”, Kluwer Academic, 1997.
3. Charles Crowley, “Operating Systems-A Design Oriented approach” McGraw Hill 1997.
4. Krishna.C.M, Kang, Shin.G, “Real Time Systems”, McGraw Hill, 1997.
5. Raymond J.A.Bhur, Donald L.Bailey, “An Introduction to Real Time Systems”, PHI 1999.
6. Mukesh Sighal and Shi.N.G “Advanced Concepts in Operating System”, McGraw Hill 2000.

OBJECT ORIENTED ANALYSIS & DESIGN

Course Code: 12EME45 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I
Methodology, Modeling: Object-oriented Methodologies; Rumbaugh et al.'s Object Modeling Technique; The Booch Methodology; The Jacobson et al. Methodologies; Patterns; Frameworks; The Unified Approach.

UNIT II
Unified Modeling Language: Introduction; Static and Dynamic Models; Modeling; Introduction to the Unified Modeling Language; UML Diagrams; UML Class Diagram; Use-Case Diagram; UML Dynamic Modeling; Model Management: Packages and Model Organization; UML Extensibility; UML Meta-Model.

UNIT III
Object-Oriented Analysis: Use-Case Driven: Object-Oriented Analysis Process: Identifying use cases: Introduction; Why Analysis is a Difficult Activity; Business Object Analysis: Understanding the Business Layer; Use-Case Driven Object-Oriented Analysis: The Unified Approach; Business Process Modeling; Use-Case Model; Developing Effective Documentation; Case-Study: Analyzing the Via Net Bank ATM-The Use-Case Driven Process. **Classification:** Introduction; classifications Theory; Approaches for Identifying Classes; Noun Phrase Approach; Common Class Patterns Approach; Use-Case Driven Approach: Identifying Classes and Their Behaviors through Sequence/Collaboration Modeling; Classes, Responsibilities, and Collaborators.

UNIT IV
Identifying Object Relationships, Attributes, And Methods: Introduction; Associations; Super-Sub Class Relationships; A-Part-of Relationships-Aggregation; Case Study: Relationship Analysis for the Via Net Bank ATM System; Class Responsibility: Identifying Attributes and Methods; Class Responsibility: Defining Attributes by Analyzing Use Cases and Other UML Diagrams; Defining Attributes for Via Net Bank Objects; Object Responsibility: Methods and Messages; Defining Methods for Via Net Bank Objects. **The Object-Oriented Design Process And Design Axioms:** Introduction; The Object-Oriented Design Process; Object-Oriented Design Axioms; Corollaries.

UNIT V
Designing Classes: Introduction; The Object-Oriented Design Philosophy; UML Object Constraint Language; Designing Classes: The Process; Class Visibility: Designing Well-Defined Public, Private, and Protected Protocols; Designing Classes: Refining Attributes; Refining Attributes for the Via Net Bank Objects; Designing Methods and Protocols; Designing Methods for the Via Net Bank Objects; Packages and Managing Classes. **View Layer:** Designing Interface Objects: Introduction; User Interface Design as a Creative Process; Designing View Layer Classes; Macro-Level Process: Identifying View Classes by Analyzing Use Cases; Micro-Level Process.

Text Books:

1. Object Oriented Systems Development by Ali Bahrami Tata McGraw Hill International Editions, Computer Science Series.

Reference Books:

1. Unified Modeling Language Reference Manual, James Rumbaugh, Jacobson, Booch, PHI.
2. The Unified Software Development Process, Ivar Jacobson, Grady Booch, James Rumbaugh , Pearson Education.

M.TECH WIRELESS COMMUNICATION & SENSOR NETWORKS

S No	Course	SEMESTER: - 1	L	T	P	Cr
1	13EM511	Computational Methods and Error Analysis	**3**	**1**	**0**	**4**
2	13EM512	Wireless Communications & Networks	**3**	**1**	**2**	**5**
3	13EM513	Sensors and Sensing Principles	**3**	**1**	**0**	**4**
4	13EM514	Data Acquisition and Hardware Networks	**3**	**1**	**2**	**5**
5		Elective – 1	**3**	**0**	**0**	**3**
6		Elective – 2	**3**	**0**	**0**	**3**
7	13EM610	Seminar	**0**	**0**	**4**	**2**
		Total Credits				**26**
S No	**Course**	**SEMESTER: - 2**	**L**	**T**	**P**	**Cr**
1	13EM515	MEMS & NEMS	**3**	**1**	**0**	**4**
2	13EM516	Communications Protocols and Standards	**3**	**1**	**2**	**5**
3	13EM517	Wireless Sensor Networks	**3**	**1**	**2**	**5**
4	13EM518	Design and Analysis of Algorithms	**3**	**1**	**0**	**4**
5		Elective – 3	**3**	**0**	**0**	**3**
6		Elective -4	**3**	**0**	**0**	**3**
7		Term Paper	**0**	**0**	**4**	**2**
		Total Credits				**26**

S.No.	Course Code		Credits
		SEMESTER-3	
1	14TM602	Internship	18
		SEMESTER -4	
2	EMCT01	Thesis	18
		TOTAL	**36**
Total Credits			**88**

Course Code	ELECTIVE-1
13EM531	Ad hoc and Vehicular Networks
13EM532	Cryptography Wireless Security
13EM533	Advanced Data Communications
13EM534	Probability and Stochastic Process
	ELECTIVE-2
13EM535	Database management systems
13EM536	Software Engineering & Usability Engineering
13EM537	RF System Design for Wireless Communications
13EM538	Optical Networks
	ELECTIVE-3
13EM539	Advanced Digital Communications
13EM540	Sensor web services –case studies
13EM541	Advanced Wireless Networks
13EM542	CDMA and OFDM for Wireless Communications

	ELECTIVE-4
13EM543	Advanced Techniques for Wireless Reception
13EM544	Fuzzy logic and Neural Networks
13EM545	Reliability Engineering
13EM546	Advanced Microcontroller and its Applications

COMPUTATIONAL METHODS AND ERROR ANALYSIS

Course Code: 13EM511 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus
UNIT – I
Error Analysis: Errors in numerical calculations, solution of algebraic and transcendental equations: Bisection method, iteration method, newton Raphson method, Secant method, Mullermethod. Interpolation: Newton's forward and newton's backward interpolation formulas, cubic spline interpolation; Lagrange's interpolation and newton's divided difference interpolation for unequal intervals.

UNIT – II
Curve Fitting: Fitting of straight line, parabola, power curve, exponential curve using method of least squares and method of weighted least squares; Method of least squares for continuous functions; Grams – Schmidt process.

UNIT – III
Numerical differentiation and Numerical Integration: Errors in numerical differentiation, Newton's forward and backward formulas; cubic spline method, maxima and minima of tabulated functions.Numerical integration: Simpson's formulae, Weddle's rule, Boole's rule, cubic splines, Romberg integration.

UNIT – IV
Matrices and Linear system of equations: Formation of system of linear equations, Gauss elimination methods, Gauss-Jacobi iterative method, Gauss-Seidal iterative method, Power method to find Eigenvalues. Numerical solution of ordinary differential equations: Euler's method, modified Euler's method, 4^{th} order Runge-Kutta method, and Runge-kutta method for simultaneous first order ordinary differential equations.

UNIT – V
Finite difference method: Solution of BVP by finite differences, classification of Partial differential equations, solution of PDE by finite differences: Laplace and Poisson equation by Gauss – seidal method.

Text Books:
1. Introductory methods to Numerical analysis by S.S. Sastry, 4^{th} edn., PHI.
2. Numerical methods for scientific and engineering computations by M.K. Jain, S.R.K. Iyengar, and R.K. Jain, 4^{th} edn., New Age publishers.

Reference Books:
1. Higher engineering mathematics by B.S. Grewal, 40rd edn, Khanna publishers.
2. Advanced Engineering Mathematics by Erwin Kreyszig, 8^{th} Edn, Wiley publishers. dory.

WIRELESS COMMUNICATIONS & NETWORKS

Course Code: 13EM512 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus

UNIT I
Introduction to Mobile and Wireless Landscape: Definition of Mobile and Wireless, Components of Wireless Environment, Challenges, Applications, Overview of Wireless Networks, Categories of Wireless Networks, open Research topics.
Wireless LAN:Infra-redVs radio transmission, Infrastructure and Ad-hoc Network,
IEEE 802.11: System architecture, Protocol architecture. **Bluetooth:** User scenarios, Architecture.

UNIT II
Global System for Mobile Communications(GSM): Introduction, Mobile services, System architecture, Radio interface, Localization and calling, Handover, Security.
(Wireless) Medium Access Control : Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.

UNIT III
Mobile Network Layer:
Mobile IP: Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations, Dynamic Host Configuration Protocol (DHCP)
Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms.

UNIT IV
Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

UNIT V
Broadcast Systems: Overview, Cyclical repetition of data, Digital audio broadcasting: Multimedia object transfer protocol, Digital video broadcasting: DVB data broadcasting, DVB for high-speed internet access, Convergence of broadcasting and mobile communications.

Text Book:

1. Jochen Schiller, "Mobile Communications", Pearson Education, Second Edition, 2009.

Reference Books:

1.MartynMallick, "Mobile and Wireless Design Essentials", Wiley, 2008.
2.Asoke K Talukder, et al, "Mobile Computing", Tata McGraw Hill, 2008.
3.Mobile Computing, Raj Kamal,Oxford University Press.
4.William Stallings, " Wireless Communications & Networks", Person, Second Edition, 2007.
5.JimGeier, "Wireless Networks first-step", Pearson, 2005.

ADVANCED DATA COMMUNICATIONS

Course Code: 13EM533 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I

CONGESTION AND QUALITY OF SERVICE (QoS): Data traffic, congestion, Congection control, Open loop and Closed Loop Congestion control I TCP and Frame Relay, Quality of Service, Flow Characterization, Flow Classes, Need For Qos, Resource Allocastion, Best Effort Service Features, Techniques to Improve QoS.

QUEUE MANAGEMENT: Queue management schemes, Scheduling, traffic Shapin, Resource Reservation and Admission Control Scheduling, Integratedand differential Service.

UNIT II

SIMPLE INTERNETWORKING (IP): What is an Internet, Service Model, Global Addresses, Datagram Forwarding in IP, Address Translation (ARP), Hostconfiguration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels.

ROUTING: Network as Graph, Distance Vector (RIP), Link State (OSPF), Metrics, Routing for Mobile Hosts.

GLOBAL INTERNET: Sub netting, Classless Routing (CIDR), Inter domain Routing (BGP), Routing Aress, IP Version 6 (IPv6).

MULTICAST: Link state Multicast, Distance Vector Multicast, Protocal Independent Multicast (PIM).

MULTIPROTOCAL LABEL SWITCHING (MPLS): Destination based Forwarding, Explicit Routing, Virtual Private Networks and Tunnels.

UNIT III

SIMPLE DE MULTIPLEXER (UDP), RELIABLE BYTE STREAM (TCP): End to End Issues, Segment Fromat, Connection Estiblishment and Termination, Sliding |Window Revisited, Triggering Transmision, Adaptive Retransmission, Recodr boundaries, TCP Extensions, Alternative Design Choices.

REMOTE PROCEDURE CALL: Bilk Transfer (BLAST), Request/Reply(CHAN), Dispatchers (SELECT), Performance.

VIRTUAL PRIVATE NETWORKS (VPN): Types of VPN,VPN General Architectures, Disadvantages, VPN Security Issues, VPN Standards.

UNIT IV

ATM PROTOCOL REFERENC MODEL: Introduction, Transmission Convergence (TC), Sub layer, Physical Medium Dependent (PMD) sub layer Standards for ATM.

LAYERS: ATM Cell Header Structure at UNI, ATM Cell Header Structure at NNI, ATM Layer Functions.

ATM ADAPTER LAYER: Service Clases and ATM Adaptation Layer, ATM Adaptation Layer1 (AAL1), ATM Adaptation Layer 2 (AAL2), ATM Adaptation Layer ¾ (AAL3/4), ATM Adaptation Layer 5 (AAL5).

UNIT V

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

Text Books:

1. Computer networks: ASystem Approach By Larry L.Peterson, Bruce S. Davie.
2. Data Communication and Networking – B. A. Forouzan, 2^{nd} updating,2204 TMH.
3. ATM Networks Concepts and Protocals By Sumit Kasera.

Reference Books:

1. Computer Networks by Andrew S. Tanenbaum.

DATA ACQUISITION AND HARDWARE NETWORKS

Course Code: 13EM514 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus

UNIT I
POWER SUPPLIE AND FILTERS: Amplifiers – Instrumentation of amplifiers-isolation-chopper and low drift amplifer-Lock-in amplifiers electrometer and trans-impedance amplifiers-modulation-filters-constant voltage and constant current regulators, DC-DC concverter, smps. D/A converters, Comparator, PLL.

UNIT II
SENSOR SIGNAL CONDITIONING CIRCUITS: Signal conditioning for resistive sensors, Reactive variation sensors and Self generating sensors Error budget analysis.

UNIT III
BASIC SIGNAL CONSERVATIONA AND COMMUNICATION: RS232 interface standard, RS485 interface standard. Distributed and standalone data loggers, IEEE488 standard. Methods of frequency-to-codeconversion-standard, indirect and combined countin method, two wire transmission-four, six wire sensing.

UNIT IV
DATA ACQUISITION METHODS FOR MULTI CHANNEL SENSOR SYSTEMS: Data Acquisition method with time-division channeling, data acquisition with space-divison channeling, and main errors of multi-channel data-acquisition systems, data transmission and error protection.

UNIT V
SERIAL COMMUNICATION AND NETWORK: Serial data communication – transmission modes, SPI,IC, CAN Example of Implementation on a 8051 based microcontroller.
Interfacing: Memory interfacing, Linear variable Differential Transformer(LVDT), speed measurement(RPM meter), Digital Thermometer

Text Books:

1. Jacob Fraden, " Hand Book of Modern Sensors: physics, Designs and Applications" ,3rd ed., Springer, 2003.
2. Jon S. Wilson, "Sensor Technology Hand Book", Eleservier Inc., 2005.

Reference Books:

1. Pallas Areny R, Webster. J. G. "Sensor Signal Conditioning", 2nd ed. John Wiley and Sons, 2001.
2. Tsylor H Rosemary, "Data Acquisition for Sensor systems" , Kluwer Academic Publishers Group, 1997.
3. Microcontroller(Theory & application) – A.V. Deshmuk, WTMH 2005.

4. Embedded Systems Architecture, programming and Design 2nd ed.Rajkamal McGraw – Hill.

DATA BASE MANAGEMENT SYSTEM

Course Code: 13EM535 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I
BASIC CONCEPTS: Database and Need for DBMS, Characteristics of DBMS, Database Users, 3-tire architecture of DBMS (its advantages over 2-tier), Data Models, Views of data schemes and instances, Data Independence.

UNIT II
DATABASE DESIGN USING ER MODELS: Entites, Reletionships, Repesentation of entites, attributes, relationship attributes, relationship, Generalization, aggregation, Relatiional algebra, Structure of relation Database and different types of keys, Codd's rules, ER to Relational model.

UNIT III
RELATIONAL MODEL: Relational model concepts, Relational model constraints, DatadefinationinSQL,Views and Queries in SQL Specifying constraints and Indexes in SQL., Functional Dependencies, Normalization, Normal forms baed on primary keys (1 NF, 2 NF, 3 NF, BCNF, 4 NF, 5 NF), Loss less joins and dependency preserving Decomposition.

UNIT IV
TRANSACTION AND CONCURRENCY CONTROL: Concept of transaction, ACID properties, Serializibility, States of transaction, concurrency control, Locking techniques, time stamp based protocols, Granularity of data items, Deadlocks.

UNIT V
STORAGE AND FILE STRUCTURE: Overview of Physical storage media,Tertiary storage, Storage acces, File organization, Organization of records in files, RAID, Database security issues, Failure classifications, Recovery & atomicity , Log base recovery, Recovery with concurrent transactions.

Text Books:
1. Database system concepts Korth.
2. Introduction to database Management Systems C.J.Date.

Reference Books:
1. Database Management Systems Bipin Desai.
2. Database Management Systems Ramakrishnan & Gehrke.

RF SYSTEM DESIGN FOR WIRELESS COMUNICATION

Course Code: 13EC537 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I

FUNDAMENTALS OF SYSTEM DESIGN: Linear System, Fourier Series and Transformation, Frequency Response of LTI Systems, Brand Pass to Low Pass equivalent Mapping nad Hilbert Transform.

NON LINEAR SYSTEM REPRESENTATIN AND ANALYSIS APPROACHES: Representation for memory Less Nonlinear systems. Multiple Input Effects in Nonlinear Syatem, Memory less Brand Pass Nonlinearities and Their Low Pass Equivalents.

UNIT II

RADIO ARCHITECTURE AND DESIGN CONSIDERATION

SUPER HETERODYNE ARCHITECTURE: Confuguration of Super Radio, Frequency Planning, Design consideration of Superheterodyne Transciver.

DIRECT CONSERVATION (ZERO IF) ARCHITECTURE: Cofiguration of Direct Conversion Radio.

LOW IF ARCHITECTURE: Configuration of Low IF Radio, Approach to Achieve High Image Rejection, Some Design Considerations.

UNIT III

RECEIVER SYSTEM ANALYSIS AND DESIGN

INTRODUCTION SENSITIVITY AND NOISE FIGURE OF RECEIVER: Sensitivity Calculation, Cascaded Noise Figure.

ADJACENT/ALTERNATE CHANNEL SELECTIVITY AND BLOCKING CHARACTERISTICS: Desired Signal Level and Allowed Degradation, Formual of Adjaced Alternative Channel Selectivity and BlockingCharacterists, Two Tone Blocking and AM Suppression Characteristics.

RECEIVER DYNAMIC RANGE AND AGC SYSTEM: Dynamic Range of a Receiver.

SYSTEM DESIGN AND PERFORMANCE EVALUATION: Receiver system Design Basics, Basic Requirements of Key Devices in Receiver System.

UNIT IV

TRANSMITTER SYSTEM ANALYSIS AND DESIGN: Introduction Transmission Power and Spectrum.

ADJACENT AND ALTERNATE CHANNEL POWER: Low pass Equivalent Behavioral Model Approach, Multitone Techniques.

UNIT V

NOISE AND RANDOM PROCESS: Noise Power and Spectral Representation, Noise and Random Process Through Linear System, Narrow Band Noise Representation, Noise Figure and Noise Temperature.

NOISE EMISSION CALCULATION: Formulas for Noise Emission Calculation, Some Important Notes in Noise Estimation Calculation, noise Expressed in Voltage, Examples of Noise Emission Calculations.

Text Books:

1. Gu, Qizheng, "RF System Design of Transceivers for Wireless Communications," 1st ed.Corr. 2nd printing, 2005,XIV,479p. 125 illus.,Hardcover, Springer, ISBN: 978-0-387-24161.

Reference Books:

1. D.K. Misra, "Radio Frequence and Microwave Communication Circuits, Analysis and Design", John wiley & Sons., inc, 2004, kundli.
2. Pozar, D.M. "Microwave Engineering," Adison Wesley, 3rd Edition, 1990.

SENSORS AND SENSING PRINCIPLES

Course Code: 13EM513 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

UNIT I
SENSOR FUNDAMENTALS: Basic sensor technology – sensor characteristics – statics dynamic – principles of sensing – capacitance – magnetic and electromagnetic induction resistance piezoelectric effect Pyroelectric effect Hall effect See eck and Pettier effect heat transfer light.

UNIT II
PHYSICAL SENSORS: Position, Displacemetns and level Sensor, Velocity and Acceleratin sensors Force, Strain, Tactile and pressure sensors.

UNIT III
CHMICAL SENSOR: Classification of chemical sensing, Mechanism, Potentiometric sensors, Conduct metric sensors, Amperometric Sensors, Enhanced Catalytic gas sensor.

UNIT IV
OPTICASL SENSORS: Optical Radiation Electromagnatic Spectrum, Snell's Law and Total internal reflection, Diffraction principles, Optical Detectors and Sources Photo dides and transistors, Photo darling ton pairs, Photoconductive sensors, CCD sensors, Fiber optic sensors. Solid state light sources LED, Diode lasers, Semiconductor laser.

UNIT V
BIO SENSORS: Origin and Transmission of bioelectrical Signals, The Electromyogtram (EMG) & the Electrocardiogram (ECG) The Electroencephalogram (EEG) & Blood pressure measurements, Catalytic biosensors, mono enzyme lectrodes, bi enzyme electrodes. Cell based biosensors, biochips and biosensor arrays, problem and limitations.

Text Books:

1. Biosensor principles and applications, Edited by Loic J. Blum, Pierre R. Coulet Agarwal, Govind P , " Fiber Optic Communication Systems", 2nd edition, Wiley, New York,1997.
2. Principles of Biochemistry Albert L.Lehninger, David Lee Nelson, Michael M. 2005, 4th Edition.
3. Sensor and Transducers D. Patranbis Prentice – Hall of India Pvt.Ltd(Aug 15, 2004).
4. Jacob Fraden, " Hand Book of Modern Sensors: physics, Designs and Applications" ,3rd ed., Springer, 2003.

CDMA AND OFDM FOR WIRELESS COMMUNICATIONS

Course Code: 13EM542 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I
Principles of Code Division Multiple Access
Spread spectrum technique – Direct sequence and frequency hopping spread spectrum communication system – PN codes and Walsh codes – Rake receiver – Capacity – Effects of loading, sectorization and voice activity – Power control – Hand off – Link structure – Forward link – Pilot, synchronization, paging and traffic channels – Reverse Link – access and traffic channel.

UNITII
Call Processing and Traffic
Call processing states – Initialization, idle, access and traffic states – Forward link and Reverse link analysis - Calculation of Ec/I0 and Eb/N0 – Traffic intensity – Grade of Service – Erlang- B and C models.

UNIT III
OFDM Basics
OFDM principles – system model – Generation of sub carrier using IFFT, guard time and cyclic extensions – windowing - Choice of OFDM parameters - OFDM signal processing.

UNIT IV
Coding, Modulation and Channel Estimation
FEC coding – Interleaving – QAM – Coded modulation – Synchronization – Synchronization using cyclic extension and special training symbols – Coherent detection – One and two dimensional channel estimation – Special training symbols – Decision directed channel estimation – Differential detection in the time and frequency domain.

UNIT V
OFDMA and MC-CDMA
Frequency hopping in OFDMA - OFDMA system description – Channel coding, modulation, time and frequency synchronization, Combination of OFDM and CDMA - MC-CDMA, MT-CDMA and MC-DS CDMA systems - Difference between OFDMA and MC-CDMA

Text Books:

1. Samuel C Yang, “CDMA RF System Engineering”, Artech House, 1998.
2. Richard Van Nee and Ramjee Prasad, “OFDM for wireless Multimedia Communication”, Artech House, 2000.

Reference Books:

1. Lajas Hanzo, “OFDM and MC-CDMA for Broadband Multiuser Communications,” 2003
2. Khaled Fazal and Stephen Kaiser, “Multicarrier and Spread Spectrum Systems,” 2008

COMMUNICATION PROTOCOLS AND STANDARDS

Course Code: 13EM516 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus

UNITI
Networks in process automation
Networks in process automation: Information flow requirements, Hierarchical communication model, Data Communication basics, OSI reference model, Industry Network, Network Topologies.

UNITII
Communication Protocols:
Communication Protocols: Communication Basics, Basics, Network Classification, Device Networks, Control Networks, Enterprise Networking, Network selection. Proprietary and open networks: Network Architectures, Building blocks

UNITIII
Wired Communication:
Wired: Wired Communication: Industry open protocols (RS-232C, RS- 422, RS-485), CAN bus, I2C, SPI, Ethernet,USB ,OFC, Modbus, Modbus Plus, Data Highway Plus, Advantages and Limitations of Open networks.

UNIT IV
Fieldbus Trends
Fieldbus: Fieldbus Trends, Hardware selection, Fieldbus design, Installation, Documentation, Fieldbus advantages and limitations, Automotive Most bus, Hot standby router protocol(HSRP) and Hot 255 modem, Dial up modem, Physical media -Cabling types and noise level conditions, leased line modems.

UNIT-V
WPAN
Wireless: WPAN, Wi-Fi, Bluetooth, Zig-Bee, Z-wave, GPRS, GSM. Infrared communication: Routers, Hubs, Bridges, Ethernet switches, Different type of converters - Serial to Ethernet, Ethernet to OFC, Serial to OFC, RS232 to RS485
Outcomes: After completion of these course students should able to, Build sensor networks and Communicate through various media

Text Books:
1. TCIP/IP protocol suite , Behrouz A. Forouzen, III Edition
2. Data communications, computer networks, open systems, Prakash C. Guptha, V Edition

DESIGN & ANALYSIS OF ALGORITHMS

Course Code: 13EM518 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

UNIT I
Introduction: Algorithm, Pseudo code for expressing algorithms, performance Analysis- Space complexity, Time complexity, Asymptotic Notation-Big oh notation. Omega notation, Theta notation and little oh notation.

UNIT II
Divide and conquer: General method, applications-Binary search, Quick sort, Merge sort, Strassen's Matrix Multiplication.
Greedy method: General method, applications-Job sequencing with dead lines, 0/1 knapsack problem, Minimum cost spanning trees, Single source shortest path problem.

UNIT III
Dynamic Programming: General method, applications-Matrix chain multiplication, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Traveling sales person problem, Reliability design.

UNIT IV
Search Trees- Balanced search trees-AVL trees, representation, Operations-insertion,deletion and searching, B-Trees-B-Tree of order m, Operations- insertion, deletion and searching.
Backtracking General method -Applications-n-queen problem, sum of subsetsproblem, graph coloring, Hamiltonian cycles.

UNIT-V
and Branch and Bound: General method, **Applications** - Traveling sales person problem, 0/1 knapsack problem-LC Branch and Bound solution, FIFO Branch and Bound solution.
NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP – Hard and NP- Complete classes

Text Books:
1. Computer Algorithms/C++, E.Horowitz, S.Sahani and S.Rajasekharan, Galgotia Publishers pvt. Limited.
2. Data Structures and Algorithm Analysis in C++, 2nd Edition, Mark Allen Weiss, Pearson Education.

Reference Books:
1. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson Education.
2. Introduction to the Design and Analysis of Algorithms, A.Levitin, Pearson Education.
3. Data structures, Algorithms and Applications in C++, S.Sahni, University press (India) pvt ltd, 2nd edition, Orient Longman pvt.ltd.
4. 4 Object Oriented Programming Using C++, 2nd Edition, I.Pohl, Pearson Education.

MEMS AND NEMS

Course Code: 13EM515 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

UNIT I
Overview of MEMS and Micro Systems: Introduction, miniaturization, Reliability, Advantages of MEMS, working principles of chemical sensors, optical, pressure and thermal sensors, micro actuation: actuation using thermal forces, actuation using piezo electric crystals, actuation using electrostatic forces; micro accelerometers, micro fluidics, MEMS switches, phase shifters, varactors, tunable oscillators

UNIT II
Basics of MEMS technology: Molecular theory of matter and intermolecular forces, doping of semi conductors, the diffusion process, scaling laws in miniaturization, Engineering mechanics: static bending of thin plates, mechanical vibrations, thermo mechanics, fluid flow in nano scale.

UNIT III
Micro system Design: Introduction, design considerations, process design, mechanical design, micro system packaging, essential packaging technologies, 3D packaging, assembly, selection of materials, Finite Element Analysis (FEA).

UNIT IV
Fabrication methods: Lithography:Introduction,wafers, masks, spinning resist and soft baking, exposure and post exposure treatment, resolution, mathematical expression of resist profiles, image reversal, interface effects, radiation and resist profiles, ion implantation, diffusion, oxidation, RIE , Chemical Vapour Deposition (CVD), Physical Vapour Deposition (PVD), deposition by epitaxy, comparison of bulk and surface micromachining, comparison of wet and dry etching, LIGA process. System level packaging, single and multichip packaging.

UNIT V
Case Study: MEMS capacitive switch, MEMS capacitive accelerometer, MEMS pressure sensor, quartz rate gyroscope, cantilever based micro cantilevers for mass measurement.

Text Books:

1. Microsystem Design by *Stephen D.Senturia*, Springer International Edition,2010
2. RF MEMS Theory, Design and Technology by *Gabriel M.Rebeiz,* Wiley India Pvt Ltd.
3. MEMS and Microsystems: Design and Manufacture by *Tai-Ran Hsu,* Tata McGraw Hill,2002
4. The MEMS Handbook, *Mohamed Gad-el-Hak,* CRC Press, 2002.
5. Foundations of MEMS by *Chang Liu,* Second Edition, Pearson Publication

RELIABILITY ENGINEERING

Course Code: 13EM545 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT- 1
Concept of reliability: What is Reliability, Mathematics of reliability:- Variation, Probability concept, Rules of probability, Continuous variation, Continuous distribution functions, Variationin engineering, Discrete variation, Statistical confidence, Statistical hypothesis testing, Nonparametricinferential methods, Goodness of fit Series of events, Computer software forstatistics, Practical conclusions.

UNIT -II
Electronic System Reliability: Reliability of electronic Components, Component Types & Failure Mechanisms, Summary of Device Failure Modes, Circuit & System Aspects, Electronic System reliability prediction, Reliability in electronic system design, Parameter variation and tolerance, Design for production test and maintenance.

UNIT -III
Design for higher redundancy: Computer aided engineering, Environment, Design analysis methods, Quality function deployment, Load strength analysis, Failure mode effect andcriticality analysis, Reliability prediction, Hazard and operability study, Parts material and process review.
Quality: Managing production quality, Quality audit, Quality management approach.

UNIT -IV
Maintainability: Maintenance time distribution, Preventive maintenance strategy, Maintenanceschedule, Technology aspect, Calibration, Maintainability prediction, Design for maintainability,

UNIT -V
Reliability Management: Corporate policy for reliability, integrated reliability programs, Reliability and cost, Standards for quality reliability and safety, contracting for reliability achievement, managing lower level supply, Customer management of reliability, Organizationfor reliability,

Text Books:

1. Practical Reliability Engineering -Patrick D. T. O' Connor, IV Edition
2. Electronic Safety Systems - Josef Borcsok

Reference Books:

1. Reliability Engineering- E.Balagurusamy Tata McGraw-Hill
2. Reliability Engineering Theory and practice-A.Birolini, IV Edition
3. Reliability Engineering-L.S.Srinath, IV Edition

WIRELESS SENSOR NETWORKS

Course Code: 13EM517 **L-T-P:3-1-2**
Prerequisite: **Credits: 5**

Syllabus

UNIT I
Introduction to Ad Hoc Networks: Characteristics of MANETs, Applications of MANETs and challenges of MANETs - Routing in MANETs: Criteria for classification, Taxonomy of MANET routing algorithms, Topology based routing algorithms, Position based routing algorithms, Other routing algorithms.

UNIT II
Data Transmission: Broadcast storm problem, Broadcasting, Multicasting and Geocaching - TCP over Ad Hoc: TCP protocol overview, TCP and MANETs, Solutions for TCP over Adhoc

UNIT III
Basics of Wireless Sensors and Applications: Applications, Classification of sensor networks, Architecture of sensor network, Physical layer, MAC layer, Link layer.

UNIT IV
Data Retrieval in Sensor Networks: Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs, Sensor Networks and mobile robots - Security: Security in Ad Hoc networks, Key management, Secure routing, Cooperation in MANETs, Intrusion Detection systems.

UNIT V
Sensor Network Platforms and Tools: Sensor Network Hardware, Berkeley motes, Sensor Network Programming Challenges, Node-Level Software Platforms - Operating System: TinyOS - Imperative Language: nesC, Dataflow style language: TinyGALS, Node-Level Simulators, ns-2 and its sensor network extension, TOSSIM

Text Books:
1. Ad Hoc and Sensor Networks – Theory and Applications, Carlos Corderio Dharma P.Aggarwal, World Scientific Publications, March 2006, ISBN – 981-256-681-3
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science, ISBN – 978-1-55860-914-3 (Morgan Kauffma

WIRELESS COMMUNICATIONS & NETWORKS

Course Code: 12EM504 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus
UNIT I
Introduction to Mobile and Wireless Landscape: Definition of Mobile and Wireless, Components of Wireless Environment, Challenges, Applications, Overview of Wireless Networks, Categories of Wireless Networks, open Research topics.
Wireless LAN :Infra redVs radio transmission, Infrastructure and Ad-hoc Network,
IEEE 802.11: System architecture, Protocol architecture. **Bluetooth:** User scenarios, Architecture.

UNIT II
Global System for Mobile Communications(GSM): Introduction, Mobile services, System architecture, Radio interface, Localization and calling, Handover, Security.
(Wireless) Medium Access Control : Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.

UNIT III
Mobile Network Layer:
Mobile IP: Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations, Dynamic Host Configuration Protocol (DHCP).
Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms.

UNIT IV
Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

UNIT V
Broadcast Systems: Overview, Cyclical repetition of data, Digital audio broadcasting: Multimedia object transfer protocol, Digital video broadcasting: DVB data broadcasting, DVB for high-speed internet access, Convergence of broadcasting and mobile communications.

Text Book:

1. Jochen Schiller, “Mobile Communications”, Pearson Education, Second Edition, 2009.

Reference Books:

1. MartynMallick, “Mobile and Wireless Design Essentials”, Wiley, 2008.
2. Asoke K Talukder, et al, “Mobile Computing”, Tata McGraw Hill, 2008.
3. Mobile Computing, Raj Kamal,Oxford University Press.
4. William Stallings, “ Wireless Communications & Networks”, Person, Second Edition, 2007.
5. JimGeier, “Wireless Networks first-step”, Pearson, 2005.

DEPARTMENT OF ELECTRONICS AND ELECTRICAL ENGINEERING
M-TECH COURSE STRUCTURE WITH SYLLABUS

M.TECH (PED)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING				
S.No	**Course Code**	**Course Title**	**L-T-P**	**Credits**
SEMESTER -1				
1	11-EE511	POWER ELECTRONIC CIRCUITS – I	3-1-2	5
2	11-EE512	ELECTRICAL MACHINE MODELING AND ANALYSIS	3-1-0	4
3	11-EE503	OPTIMIZATION TECHNIQUES	3-1-0	4
4	11-EE504	MODERN CONTROL THEORY	3-1-0	4
5		ELECTIVE-1	3-0-0	3
6		ELECTIVE-2	3-0-0	3
7	11-EE509	SEMINAR	0-0-4	2
		TOTAL Credits		25
SEMESTER -2				
1	11-EE513	POWER ELECTRONICS CIRCUITS II	3-1-2	5
2	11-EE506	MICRO CONTROLLERS AND EMBEDDED SYSTEMS	3-1-0	4
3	11-EE514	POWER ELECTRONIC CONTROL OF DRIVES	3-1-0	4
4	11-EE515	INTELLIGENT CONTROL OF ELECTRICAL DRIVES	3-1-0	4
5		ELECTIVE-3	3-0-0	3
6		ELECTIVE-4	3-0-0	3
7	11-EE509	TERM PAPER	0-0-4	2
		TOTAL Credits		25
SEMESTER -3&4				
1	KLUC505	THESIS		36

ODD SEMESTER ELECTIVES				
1	11-EE541	INSTRUMENTATION & CONTROL	3-0-0	3
2	11-EE532	VLSI	3-0-0	3
3	11-EE533	DIGITAL SIGNAL PROCESSING	3-0-0	3
4	11-EE540	SPECIAL MACHINES	3-0-0	3
5	11-EE534	NON CONVENTIONAL ENERGY RESOURCES	3-0-0	3

EVEN SEMESTER ELECTIVES				
1	11-EE535	FACTS	3-0-0	3
2	11-EE544	ELECTRICAL VEHICLES	3-0-0	3
3	11-EE536	STATE ESTIMATION & ADAPTIVE CONTROL	3-0-0	3
4	11-EE542	EMBEDDED CONTROL OF ELECTRIC DRIVES	3-0-0	3
5	11-EE543	AL TECHNIOQUES IN POWER ELECTRONICS & DRIVES	3-0-0	3

POWER ELECTRONICS CIRCUITS – I

Course Code : 11 EE511 **L-T-P: 3-1-2**
Prerequisite: **Credits: 5**

Syllabus

UNIT I
POWER ELECTRONICS DEVICES:
power electronic devices – SCR, Theory of operation of SCR, Two transistor model of SCR, Characteristics and ratings, SCR turn on and turn off methods, Firing circuits, DIAC, TRIAC, IGBT, MOSFET and their characteristics , MTO,ETO , IGCTs , MOS-controlled thyristors(MCTs) – Static Induction Thyristors (SITHs) – Power integrated circuits (PICs) – symbol, structure and equivalent circuit – comparison of their features.

UNIT II
NATURAL COMMUTATED CONVERTERS:
AC to DC Converter- single phase controlled rectifier bridge type - with R load- RL load- with and without FWD- analysis & wave forms- three phase controlled rectifier bridge type with R, RL loads with & without FEWD- analysis & waveforms – performance factors of natural commutated converters - advantages- applications - power factor improvements.

UNIT III
AC VOLTAGE CONTROLLERS:
Single phase Ac voltage controllers- with R & RL loads- Analysis & waveforms- three phase AC voltage controllers- analysis& wave forms – AC synchronous tap changers - Matrix converters, cyclo converters

UNIT IV
PWM INVERTERS (single phase)
Bridge type- Single Phase Inverters. MC Murray- Bedford inverter- and their analysis & waveforms – Bridge type three phase Inverters with different modes. CSI-some applications- comparison of VSI & CSI. Simple problems. PWM and their methods, Advanced modulation techniques for improved performance, stepped, harmonic injection and delta modulation, Advantages, application

UNIT V
D.C - D.C. Converters.
Analysis of step-down and step-up dc to dc converters with resistive and Resistive-inductive loads – Switched mode regulators – Analysis of Buck Regulators - Boost regulators – buck and boost regulators – Cuk regulators – Condition for continuous inductor current and capacitor voltage – comparison of regulators –Multiouput boost converters – advantages – applications – Numerical problems.

Text Books:
1. Power Electronics – Mohammed H. Rashid – Pearson Education –Third Edition – First Indian reprint 2004.

2. Power Electronics – Ned Mohan, Tore M. Undeland and William P. Robbins – John Wiley AND Sons – Second Edition

Reference Books:

1. Power Electronics by W.Launder
2. Industrial Electronics & Robotics by Shaler & C.Menamee

ELECTRICAL MACHINE MODELING AND ANALYSIS

Course Code : 11 EE512 **L-T-P: 3-1-0**
Prerequisite: **Credits : 4**

Syllabus

UNIT I
Basic concepts of Modeling
Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine - voltage, current and Torque equations.

DC Machine Modeling

Mathematical model of separately excited D.C motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor-Mathematical model of D.C Series motor, Shunt motor-Linearization Techniques for small perturbations

UNIT II
Reference frame theory
Real time model of a two phase induction machine- Transformation to obtain constant matrices-three phase to two phase transformation-Power equivalence-
Dynamic modeling of three phase Induction Machine
Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly used Induction machine models- Stator reference frame model-Rotor reference frame model-Synchronously rotating reference frame model-Equations in flux linkages-per **UNIT** model

UNIT III
Small Signal Modeling of Three Phase Induction Machine
Small signal equations of Induction machine-derivation-DQ flux linkage model derivation-control principle of Induction machine.
Symmetrical and Unsymmetrical 2 phase Induction Machine
Analysis of symmetrical 2 phase induction machine-voltage and torque equations for unsymmetrical 2 phase induction machine-voltage and torque equations in stationary reference frame variables for unsymmetrical 2 phase induction machine-analysis of steady state operation of unsymmetrical 2 phase induction machine- single phase induction motor - Cross field theory of single-phase induction machine.

UNIT IV
Modeling of Synchronous Machine
Synchronous machine inductances –voltage equations in the rotor's dq0 reference frame-electromagnetic torque-current in terms of flux linkages-simulation of three phase synchronous machine- modeling of PM Synchronous motor.

UNIT V
Dynamic Analysis of Synchronous Machine

Dynamic performance of synchronous machine, three-phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria

Text Books:

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis& control", Pearson Publications, 1st edition, 2002.
2. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", IEEE Press, Second Edition.

Reference Books:

1. P.S.Bimbra, "Generalized Theory of Electrical Machines" Khanna publications, 5th edition-1995
2. Dynamic simulation of Electric machinery using Matlab / Simulink –Chee Mun Ong- Prentice Hall.

OPTIMIZATION TECHNIQUES (PED & PS)

Course Code :11EE503 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus

UNIT I
Linear Programming
Standard form of linear programming problem; Simplex method two phase simplex method; revised simplex method. Duality in Linear programming. Some simple numerical problems.

UNIT II
Non-Linear Programming
Fibonacci method, Golden section method, Powell's method, Newton's method, Kuhn-Tucker conditions. Some simple numerical problems.

UNIT III
Transportation Problem
Definition of transportation problem, transportation algorithm, North-West corner method, Vogel approximation method, Least cost method, Hungarian method for assignment. Some simple numerical problems.

UNIT IV
Project planning through Networks
Arrow diagram representation; Rules for constructing an arrow diagram. PERT and CPM, critical path calculations, Earliest start and latest completion times; Determination of floats. Some simple numerical problems.

UNIT V
Dynamic Programming
Multistage decision processes; Types of multistage decision problems, concept of sub-optimization and the principle of sub-optimality computational procedure in dynamic programming. Some simple numerical problems.

Text Books:

1. Engineering optimization theory and practice by S.S. Rao New Age International publications.
2. Operations Research, An introduction by Hamdy A. Taha. PHI learning private Ltd. New Delhi.

Reference Books:

1. Operations Research by S.D. Sharma, Kedarnath & Ramnath Publishers, Delhi.
2. Introduction to operations research Hiller and Liberman.

MODERN CONTROL THEORY (PED & PS)

Course Code : 11 EE504 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus
UNITI

DIGITAL CONTROL SYSTMES
Introduction, Signal Reconstruction, Difference Equation, Z Transfor Function, Response of Linear Discrete Systems, Z Transform Analysis of Discrete data Control Systems, Z and S Domain Relationship, Stability of Discrete systems.

UNIT II
STATE VARIABLE ANALYSIS OF DIGITAL CONTROL SYSTEMS
Introduction, State Descriptions of Digital Processors, State Description of sampled continuous time plants, Solution of State difference equations, Controllability and Observability

UNITIII
NONLINEAR SYSTEMS
Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions

UNITIV
STABILITY ANALYSIS
Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method– Direct method of Lyapunov – Generation of Lyapunov functions – Variable gradient and Krasoviskii's methods – estimation of transients using Lyapunov functions.

UNITV
OPTIMAL CONTROL
Introduction to optimal control - Formulation of optimal control problems – calculus of variations – fundamental concepts, functionals, variation of functionals – fundamental theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator

Text Books:

1. M.Gopal – Digital Control and state variable methods, Tata Mcgraw'Hill, 2ndedition
2. M.Gopal - Modern Control System Theory - New Age International (P.Ltd,) 2nd eddition,1984

Reference Books:

1. Stafani etal , "Design of Feedback control Systems" – Oxford Press, 4th eddition.
2. Ogata K, "Modern Control Engineering," Prentice Hall, 4th eddition.

3. Nagarath IJ and M. Gopal, “ Control Systems Engineering”- New Age International Publishers, 5th eddition.

POWER ELECTRONICS CIRICUITS – II

Course Code : 11 EE513 **L-T-P: 3-1-2**
Prerequisite: **Credits: 5**
Syllabus
UNIT I
Resonant pulse inverters – series resonant inverters – series resonant inverters with unidirectional switches – series resonant inverters with bidirectional Switches – analysis of half bridge resonant inverter – evaluation of currents and Voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – numerical problems.

UNIT II
Frequency response of series resonant inverters – for series loaded inverter – for parallel loaded inverter – For series and parallel loaded inverters – parallel resonant inverters – Voltage control of resonant inverters – class E resonant inverter – class E resonant rectifier – evaluation of values of C's and L's for class E inverter and Class E rectifier – numerical problems.

UNIT III
Multilevel concept – Types of multilevel inverters – Diode clamped multilevel inverter – Improved diode clamped inverter – Flying capacitors multilevel inverter – Cascaded multilevel inverter – Hexagram inverter - Principle & Operations –Switching device currents – DC link capacitor voltage balancing – Features of multilevel inverters – Comparison of multilevel inverters - Applications – numerical problems.

UNIT IV
Resonant converters – zero current switching resonant converters – L type ZCS resonant converter – M type ZCS resonant converter – zero voltage Switching resonant converters – comparison between ZCS and ZVS resonant Converters – Two quadrant ZVS resonant converters – resonant dc-link Inverters – evaluation of L and C for a zero current switching inverter – Numerical problems.

UNIT V
Power supplies **-** DC power supplies – classification - switched mode dc power supplies – flyback Converter – forward converter – push-pull converter – half bridge converter – Full bridge converter – Resonant d c power supplies – bidirectional power Supplies – Applications - AC power supplies – classification – switched mode ac power supplies – power line disturbances – power conditioners – uninterruptible Power supplies – Renewable uninterruptible Power supplies – applications

Text Books:

1. Mohammed H. Rashid , "Power Electronics", Pearson Education, 3rd Edition.
2. Bimal K. Bose, "Modern Power Electronics", PHI publications.

Reference Books:

1. C.V.Lander, "Power Electronics", Mc Graw Hills, International Edition.
2. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics", John Wiley and Sons, 2nd Edition.
3. G.K. Roy, "Non Conventional Energy Sources" Khanna Publicatoins, 1st Edition – 2004.

MICRO CONTROLLERS & EMBEDDED SYSTEMS

Course Code :11EE506 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus
UNITI
MICRO CONTROLLERS:
Introduction to Micro controllers - Micro controller families - Features of 8051 Micro controller - 8051 Architecture - Block diagram of 8051 Micro controller - Register organization - Addressing modes - Instruction set - Distinction between CISC and RISC - Assembler directives – Architecture of 16 bit micro controller.

UNIT II
INTRODUCTION TO EMBEDDED SYSTEMS:
An Embedded System - Embedded System Classification – Components of an Embedded System Hardware - Overview of Processors in the System - Other hardware **UNIT**s - Software embedded into the system - Exemplary Embedded Systems - Embedded System on a Chip (SOC) and the use of VLSI design circuit – Structural **UNIT**s in Processor

UNIT III
DEVICE NETWORK AND EMBEDDED PROGRAMMING:
Input/output devices – Device I/O types and Examples – Synchronous, Iso-synchronous and Asynchronous communication from Serial Devices – Timer and Counting devices - Programming in Assembly language (ALP) versus High Level Language - C program elements - Macros and functions - Multiple function calls in a cyclic order in the main Function - C Program compiler and Cross compiler

UNIT IV
REAL TIME OPERATING SYSTEMS:
Operating System services – Goals of an operating system – Process management – Memory management - Device management - File System Organization and Implementation - I/O Subsystem – IEEE Standard POSIX functions for Standardization of RTOS and inter-task communication functions – Inter-Process Communication and Synchronization - OS Security Issues – Mobile OS

UNIT V
Hardware Software Co-design in an Embedded System:
Embedded System Project management – Embedded System design and Co-Design issues in System development Process – Design cycle in the development phase for an Embedded System – Uses of a Target System or its Emulator and In-Circuit Emulator – Use of software tools for development of an Embedded System – Use of Scopes and logic analyzers for system hardware tests.

Text Books:

1. Mazidi & Mc Kinley, " The 8051 Micro controller and Embedded Systems using Assembly and c", 2^{nd} edition.
2. Rajkamal, "Embedded Systems Architecture, Programming and Design", TATA McGraw-Hill Publications

Reference Books:

1. Dr.K.V.K.K.Prasad, "Embedded/Real-time Operating System", Dreamtech Press.

POWER ELECTRONIC CONTROL OF DRIVES

Course Code : 11 EE514 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus
UNITI
Control of induction motor, Review of steady-state operation of Induction motor, Equivalent circuit analysis, torque-speed characteristics. Voltage Source Inverter Fed Induction motor drives &Current Source Inverter Fed Induction motor drives. control of induction by Slip power recovery schemes.

UNITII
Vector control of Induction Motor : Principles of vector control, Direct vector control, derivation of indirect vector control, implementation – block diagram; estimation of flux, flux weakening operation.

UNITIII
Control of Synchronous motor drives : Synchronous motor and its characteristics- Control strategies-Constant torque angle control- power factor control, constant flux control, flux weakening operation, Load commutated inverter fed synchronous motor drive, motoring and regeneration, phasor diagrams. PMSM and BLDC control of Drives, control of Variable Reluctance Motor Drive

UNITIV
Speed control of dc Motors-Different types of speed control techniques by using single phase& three phase ac systems Closed loop control of phase controlled DC motor Drives. Open loop Transfer function of DC Motor drive- Closed loop Transfer function of DC Motor drive –Phase-Locked loop control.

UNIT V
Closed loop control of chopper fed DC motor Drives, Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current controller

Text Books:
1. Modern Power Electronics and AC Drives –B. K. Bose-Pearson Publications-
2. Electric Motor Drives- R.Krishanan- Prentice Hall, Indian Edition.

Reference Text Books:
1. Power Electronics and Motor Control – Shepherd, Hulley, Liang – II Edition, Cambridge University Press
2. Power Electronic Circuits, Devices and Applications – M. H. Rashid – PHI.
3. Fundamentals of Electrical Drives by GK Dubey, Narosa Publishers.

INTELLIGENT CONTROL OF ELECTRIC DRIVES

Course Code : 11 EE515 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus

UNIT I

Introduction and motivation. Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network.

UNIT II

Data Pre-Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Networks: Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller Case studies: Identification and control of linear and nonlinear dynamic systems using MATLAB-Neural Network toolbox.

UNIT III

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm.

Concept on some other than GA search techniques like tabu search and ant-colony search techniques for solving optimization problems.

UNIT IV

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to Fuzzy logic modeling and control of a system. Fuzzification, inference and defuzzification. Fuzzy knowledge and rule bases.

Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox.

UNIT V

Fuzzy logic & Neural network applications to Drives

Fuzzy logic applications**:** Design of Fuzzy PI controller for speed control of DC motor- Flux programming efficiency improvement of three phase induction motor-Induction motor speed control-Slip gain tuning of indirect vector control of induction motor-stator resistance estimation.

Neural network applications**:-**PWM Controller-Selected harmonic elimination PWM-Space vector PWM-Vector controlled drive-feedback signal estimation-speed estimation and flux estimation of induction motor

Text Books:

1. Neural Networks: A comprehensive Foundation – Simon Haykins, Pearson Edition, 2003.
2. Fuzzy logic with Fuzzy Applications – T.J.Ross – Mc Graw Hill Inc, 1997.

3. Genetic Algorithms- David E Goldberg.

Reference Books:

1. Principles of Neurocomputing for science and Engineering,- Fredric M.Ham and Ivica Kostanic, McGraw Hill, 2001.
2. Neural Network Fundamentals with Graphs, Algorithms and Applications, N.K. Bose and P.Liang, Mc-Graw Hill, Inc. 1996.
3. Fuzzy logic Intelligence, Control, and Information- John Yen and Reza Langari, Pearson Education, Indian Edition, 2003.

SPECIAL MACHINES (ELECTIVE)

Course Code : 11 EE540 **L-T-P :3-0-0**
Prerequisite: **Credits : 3**

Syllabus
UNITI:
Induction generators: self excitation requirements, steady state analysis, voltage regulation, different methods of voltage control, application to mini and micro hydel systems.
Doubly fed induction machines: control via static converter, power flow, voltage/frequency control (generation mode), application to grid connected wind and mini/micro hydel systems.

UNITII
Brushless DC Machines: construction operation, performance, control and applications.
Micro Machines: principles of operation of various types. Sensors for control, e.g. Position sensor, etc. Recent developments in the area.

UNITIII
Linear Machines: Linear Induction Machines and Linear Synchronous Machines.
Construction, operation, performance, control and applications. PMDC and PM Synchronous Machine, control and applications. Recent developments in electrical machines

UNITIV
Stepper Motors: Various types, principle of operation, operating characteristics, application. Servo Motors. Servo amplifier and control. Special types of permanent magnet motors for servo application. Various types of specialized actuators. Switched Reluctance Motor: Construction, operating performance, control and applications.

UNITV: Synchronous And Special Machines
Construction of synchronous machines-types - Induced emf - Voltage regulation; emf and mmf methods - Brushless alternators - Reluctance motor - Hysteresis motor - Stepper motor.

Text Books:
1. P.C Sen, 'Principles of Electrical Machines and Power Electronics', Wisley Edition, Second edition, 1997.
2. Gopal K Dubey, 'Fundamentals of Electrical Drives' Narosa Publications, Second edition, 2008.
3. J Gnanvadivel, N.Rathina prabha et.el, 'ELECTRICAL MACHINES', Anuradha publications.

Reference Books:
1. Bimal K. Bose, 'Modern Power Electronics And AC Drives', Low Price Edition, First edition.
2. R.K Rajput, 'Electrical Machines', Laxmi Publications Pvt Ltd, Fifth Edition.

INSTRUMENTATION AND CONTROL(ELECTIVE)

Course Code :11 EE541 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
UNITI
Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics –sources of error, Classification and elimination of error.open and closed systems Servomechanisms–Examples with block diagrams–Temperature, speed & position control systems.

UNIT II
Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures,measurement of temperature -Classification – Ranges – Various Principles of measurement – Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers – Temperature Indicators.

UNITIII
MEASUREMENT OF PRESSURE : **UNIT**s – classification – different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

UNITIV
MEASUREMENT OF LEVEL : Direct method – Indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – Bubler level indicators,flow measurement : Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

UNITV
MEASUREMENT OF SPEED : Mechanical Tachometers – Electrical tachometers – Stroboscope, Noncontact type of tachometer Measurement of Acceleration and Vibration Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle.

Text Books:
1. D.S Kumar “Mechanical Measurement Control” 3rd edition, Metropolitan Publishers, 2004.
2. Mechanical Measurements / BeckWith, Marangoni, Linehard, PHI / PE

Reference Text Books:
1. Measurement systems: Application and design, Doeblin Earnest. O. Adaptation by Manik and Dhanesh/ TMH
2.

VLSI DESIGN (ELECTIVE)

Course Code : 11 EE 532 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
UNITI
Introduction to CMOS circuits: MOS transistors, MOS switches, CMOS logic: Inverter, combinational logic, NAND, NOR gates, compound gates, Multiplexers. Memory: Latches and registers. Circuit and system representations: Behavioral, structural and physical representations

UNITII
MOS transistor theory: NMOS, PMOS enhanment mode transistors, Threshold voltage, body effect, MOS device design equations: basic DC equations, second order effects, sub threshold region, channel-length modulation, mobility variation, impact ionization-hot electrons

UNITIII
MOS models, small signal AC characteristics, CMOS inverter DC characteristics, static load MOS inverters, bipolar devices, CMOS processing technology: An overview of silicon semiconductor technology:

UNITIV
basic CMOS technology, CMOS process enhancement, layout design rules, Latch up, technology related CAD issues . CMOS circuit and logic design: CMOS logic gate design: fan in, fan-out, typical CMOS NAND and NOR Delays, transistor sizing.

UNITV
Basic physical design of simple logic gates. CMOS logic structures. Clocking strategies: single phase memory structures, PLL techniques, single phase logic structures, two phase clocking, memory structures, And logic structures, I/O Structures: out put pads, input pads.

Text Book:

1. Weste, Eshragian, Principles of CMOS VLSI design, Addison Wesley, 2001.

Reference Books:

1. Douglas A Pucknell and Kamaran Eshragian, Basic VLSI design, 3rd edition, 2001.
2. J.S.Smith, Application Specific Integrated Circuits, Addison Wesley, 2004

DIGITAL SIGNAL PROCESSING (ELECTIVE)

Course Code : 11 EE533 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I: Digital Filter Structures:
Introduction- Structure for realization of Discrete systems, Structures for FIR systems, Cascaded and Lattice filter, Structures for IIR Filters- Cascaded and Lattice filters, State space analysis of structures- Solution to state equations.

UNIT II: Implementation of DTS:
Representation of Numbers- fixed binary, floating, Error in rounding, Trunk - Quantization of Filter coefficients, quantization coefficients in FIR, Round off effects in Filters-Limit cycle oscillations, Scaling to prevent overflow.

UNIT III: Digital filter design:
General considerations- Design of FIR filter using windows- Design of IIR digital filters-Using Bilinear transformations of IIR filters- FIR filter Design-based on Least Square Method - Design of FIR digital filters with least Square –Inverse(Wiener Filter)- design of IIR digital filters in Frequency domain.

UNIT IV: Analysis of finite Word length effects:
The Quantization process and errors- Reduction of Product round-off errors using feedback – Quantization of fixed point and floating point Numbers- Analysis of coefficient Quantization effects – Dynamic range scaling- overflow oscillations.

UNIT V: Power Spectrum Estimation:
Estimation of spectra from Finite Duration Observations signals – Non-parametric methods for power spectrum estimation-Walsh methods-Blackman & Tukey method. – Parametric method for power spectrum Estimation - Minimum variance spectral estimation.

Text Books:

1. Digital Signal Processing principles, Algorithms and Applications – John G. Proakis -PHI –3rd edition-2002.
2. Discrete Time Signal Processing – Alan V. Oppenheim, Ronald W. Shafer -PHI-1996 1st edition-9th reprint.

Reference Books:

1. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2nd reprint-2001
2. Digital Filter Analysis and Design - Auntonian -TMH

NON CONVENTIONAL ENERGY RESOURCES(ELECTIVE)

Course Code : 11 EE534 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I : SOLAR RADIATION

Extraterrestrial solar radiation, terrestrial solar radiation, solar thermal conversion, solar ponds, solar heating/cooling technique, solar distillation, photovoltaic energy conversion, solar cells – 4 models.

UNIT II:WIND ENERGY

Planetary and local winds, vertical axis and horizontal axis wind mills, principles of wind power, maximum power, actual power, wind turbine operation.

UNIT III: ENERGY FROM OCEANS

Ocean temperature differences, principles of OTEC plant operations, wave energy, devices for energy extraction, tides, simple single pool tidal system.

UNIT IV: GEOTHERMAL ENERGY

Origin and types, Bio fuels, classification, direct combustion for heat and electricity generator, anaerobic digestion for biogas, biogas digester, power generation.

UNIT V: MICRO- HYDEL ELECTRIC SYSTEMS:

Power potential –scheme layout-generation efficiency and turbine part flow-geothermal energy extraction.

Text Books:

1. Godfrey Boyle "Renewable Energy", Oxford Publications, Second edition.
2. G. D. Rai, "Non-Conventional Energy Sources", Khanna Publishers, First edition.

Reference Books:

1. Roger H.Charlier, Charles W. " Ocean Energy- Tide and Tidal Power"ISBN: Library of Congress Control Number: 2008929624_c Springer-Verlag Brerlin Heidelberg 2009.
2. John Twidell & Toney Weir: E&F.N. Spon, "Renewable Energy Sources", Taylor & Francis New York, 2nd edition.
3. John F.Walker & N.Jenkins, "Wind Energy Technology", John Willey and Sons Chichester, U.K – 1997.

FLEXIBLE AC TRANSMISSION SYSTEMS (ELECTIVE)

Course Code :11 EE535 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT – 1 FACTS Concept and General System Considerations

Introduction to Facts devices, Power Flow in AC system, Dynamic stability Considerations and the importance of the controllable parameters, Definitions on FACTS, Basic types of FACTS Controllers, Basic concept of voltage source converters, Single phase, there phase full wave bridge converters operation, Transformer connections for 12 pulse, 24 and 48 pulse operation.

UNIT II CONVERTERS

Three level voltage source converter, pulse width modulation converter, Design of pwm converter to reduce the harmonics, basic concept of current source Converters, Comparison of current source converters with voltage source converters.

UNIT III Static shunt Compensators

SVC and STATCOM Operation & characteristics and Control of TSC,TSR, STATCOM, Comparison between SVC and STATCOM – STATCOM for transient and dynamic stability enhancement.

UNIT – IV Static Series Compensation

GCSC, TSSC, TCSC and SSSC Operation and Control External system Control for series Compensator SSR and its damping – Static Voltage and Phase angle Regulators - TCVR and TCPAR –Operation and Control.

UNIT –V UPFC and IPFC

The unified power flow Controller – Operation –Comparison with other FACTS devices – control of P and Q – dynamic performance – special Purpose FACTS controllers – Interline Power flow Controller – Operation and Control.

Text Books:

1. N.G Hingorani & L.Gyugyi " Understanding FACTS: Concepts and Technol;ogy of Flexible ACTransmission System" , IEEE Press,2000
2. K.R.Padiyar "FACTS Controller in power Transmission and Distribution" New Age Int Publisher,2007

Reference Books:

1. Ned Mohan e.al "Power Electronics" John wiley & Sons T.J.E Millor, "Reactive power control in electric Systems" John wiley & sons

ELECTRIC VEHICLES (ELECTIVE)

Course Code :11 EE544 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
UNIT I
Introduction to Alternate Propulsion Systems: History and working principle of hybrid vehicles, configurationsof hybrid vehicles, case studies of hybrid vehicles, fuel oil reserves and depletion, the need for alternate propulsion devices, introduction to electric vehicle, introduction to hybrid vehicle.

UNIT II
Motors and Drives: Electromagnetic force, torque production from electromagnets, workingprinciple of DC motor, variants of DC motors, torque-speed characteristics of DC motors, speed control of DC motors, merits and limitations of DC motors, Introduction to AC motors, Induction, permanent magnet and switched reluctance motors: working principle, torque-speed characteristics and control.

UNIT III
Battery Technology: Energy density of various energy sources and storage devices, basics ofbattery, working principle, construction, of lead-acid, nickel cadmium, nickel metal hydride and lithium ion batteries, high voltage battery, various configurations of battery, maintenance free and low maintenance battery, recombination battery, AGM and valve regulated battery, battery capacity, current and voltage characteristics during charging and discharging, battery modeling, Peukart Capacity and discharging, battery failure modes, good practices of battery maintenance.

UNIT IV
Energy Storage Devices for Hybrid Vehicles: Super capacitor, ultra capacitor, fly wheeltechnology, Vehicle dynamics, tractive effort, aerodynamicresistance, maximum tractive effort limited by ground adhesion, acceleration performance, gradeability, maximum speed of a vehicle,Working principle of fuel cell, various types of fuel cells and details,performance and efficiency of fuel cells, fuel cell voltage pattern, fuel cell vehicles, supply and storage of hydrogen.

UNIT-V
Design of Plug-in Electric Vehicle (EV): Requirement of drive train of EV, various configurationsof drive train in EV, transmissions systems, motor sizing for EV, tractive effort and transmission requirement, general EV configuration, Energy consumption pattern in EV, driving pattern in EV, control of EV,Case studies of series and parallel hybrid vehicle design practices.

Text Books:
1. Jefferson, C.M., Barnard and R.H., *Hybrid Vehicle Propulsion*, WIT Press, Boston, 2002
2. Husain and Iqbal, *Electric and Hybrid Vehicles : Design Fundamentals*, CRC Press, London, 2003

Reference Books:

1. International Journal of Electric and Hybrid Vehicle, Inderscience Publications.
2. International Journal of Alternate Propulsion, Inderscience Publications.
3. Erjavec, Jack, Arias and Jeff Hybrid, *Electric and Fuel-Cell Vehicles*, Thomson, Australia, 2007

EMBEDDED CONTROL OF ELECTRIC DRIVES (ELECTIVE)

Course Code :11 EE542 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I: MC68HC11 MICROCONTROLLER

Architecture memory organization – Addressing modes – Instruction set – Programming techniques – simple programs

UNIT II: PERIPHERALS OF MC68HC11

I/O ports – handshaking techniques – reset and interrupts – serial communication interface – serial peripheral interface – programmable timer – analog / digital interfacing – cache memory

UNIT III: PIC 16C7X MICROCONTROLLER

Architecture – memory organization – addressing modes – instruction set – programming techniques – simple operation.

UNIT IV: PERIPHERAL OF PIC 16C7X MICROCONTROLLER

Timers – interrupts – I/O ports – I^2C bus for peripheral chip access – A/D converter – VART

UNIT V: SYSTEM DESIGN USING MICROCONTROLLERS

Interfacing LCD display – Keypad interfacing – AC load control – PID control of DC motor – stepper motor control – brush less DC motor control.

Text Books:

1. B. Peatman , 'Design with PIC Microcontrollers,' Pearson Education, Asia 2004
2. Michael Khevi, 'The M68HC11 Microcontroller Applications in control, Instrumentation and communication', Prentice Hall, New Jersey, 1997.

Reference Book:

1. John B. Peatman, 'Design with Microcontrollers', Mc-Graw Hill

STATE ESTIMATION AND ADAPTIVE CONTROL (ELECTIVE)

Course Code :11 EE536 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I: Elements of Probability Theory

Introduction, Random variables, Probability functions, Expected value, Characteristic function, Independence, Correlation Gaussian distribution, Elements of theory of stochastic processes.

UNIT II: Least Squares Estimation

Least squares and Regression models, Estimation of parameters, Simulation of Recursive estimation, Wiener filtering, General filter optimization.

UNIT III: Optimal Prediction And Filtering For Discrete Systems

Optimal prediction for discrete linear systems, optimal estimation for discrete systems, Kalman filter for discrete linear systems.

UNIT IV: Model Reference Adaptive Schemes

Introduction, MIT Rule, Determination of the adaptation gain, Lyapunov theory, Design of MRAS using Lyapunov theory, Applications of adaptive control.

UNIT V: Robust And Self Oscillating Systems

Robust high gain feedback control, Self oscillating adaptive systems, Variable structure systems, practical issues and implementation.

TextBooks:

1. Stochastic optimal linear estimation and control by J.S. Meditch, McGraw Hill book company
2. Adaptive control by Karl J. Astrom and Bjorn Witten Mark second edition, Pearson Education; 2006

AI TECHNIQUES IN POWER ELECTRONICS & DRIVES (ELECTIVE)

Course Code :11 EE543 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I: ARTIFICIAL NEURAL NETWORK

Fundamentals of artificial neural networks – Basic concepts of neural networks - Biological Prototype - Artificial neuron – Basic models of artificial neural networks – connections – learning - Activation functions - Important terminologies of ANN - Neural Network Architecture - Single layer artificial neuron networks - Multilayer artificial neuron networks – Recurrent networks.

UNIT II: SUPERVISED LEARNING NETWORK

Perceptron Network – Perceptron learning rule - Architecture- Perceptron training algorithms – Adaline – Architecture – Madaline - Architecture – Training Algorithms - Architecture of Back Propagation Network- Back Propagation Learning – Back Propagation Algorithms.

UNIT III: FUZZY LOGIC

Introduction – Fuzzy sets - basic Fuzzy set operations – Properties of Fuzzy sets - Membership function - features of membership function - Fuzzy Inference Systems - Methods of FIS – defuzzification methods – centroid method – weighted average method

UNIT IV: GENETIC ALGORITHMS

Introduction- Characteristics of Genetic algorithms- Basic operators and Terminologies in GAs - search space – Effects of Genetic operators - Traditional Algorithm Vs Genetic Algorithm -Simple GA - General Genetic Algorithm

UNIT-V: APPLICATIONS OF POWER ELECTRONICS & DRIVES

Neural network based Control: Neural network based Control of DC Motor Drive, Neural network based Control of Induction Motor, Neural network based Control of Stepper Motor - Fuzzy Logic Control: Fuzzy Logic Control of DC Motor Drive, Fuzzy Logic Control of Induction Motor, Fuzzy Logic Control of Stepper Motor

Text Books:

1. S.N.Sivanandam & S.N.Deepa, “Principles of Soft Computing”, Wiley India (P) Ltd., 1st Indian Edition 2008
2. Alok Jain, ‘Power Electronics & its Applications”, Penram international Publishing, Second Edition

Reference Book:

1. J.S.R. Jang, C.T. Sun and E. Mizutani “Neuro Fuzzy and Soft Computing”, Pearson Education.

M.TECH (PS)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING				
S.No	**Course Code**	**Course Title**	**L-T-P**	**Credits**
SEMESTER -1				
1	11-EE501	POWER SYSTEM ANALYSIS AND DYNAMICS	3-1-2	5
2	11-EE502	EHVAC AND HVDC TRANSMISSION	3-1-0	4
3	11-EE503	OPTIMIZATION TECHNIQUES	3-1-0	4
4	11-EE504	MODERN CONTROL THEORY	3-1-0	4
5		ELECTIVE-1	3-0-0	3
6		ELECTIVE-2	3-0-0	3
7	11-EE509	SEMINAR	0-0-4	2
		TOTAL Credits		25
SEMESTER -2				
1	11-EE505	REAL TIME CONTROL OF POWER SYSTEMS	3-1-2	5
2	11-EE506	MICRO CONTROLLERS AND EMBEDDED SYSTEMS	3-1-0	4
3	11-EE507	POWER SYSTEMS PROTECTION	3-1-0	4
4	11-EE508	POWER QUALITY	3-1-0	4
5		ELECTIVE-3	3-0-0	3
6		ELECTIVE-4	3-0-0	3
7	11-EE509	TERM PAPER	0-0-4	2
		TOTAL Credits		25
SEMESTER -3&4				
1	KLUC505	THESIS		36

ODD SEMESTER ELECTIVES				
1	11-EE530	REACTIVE POWER COMPENSATION & MANAGEMENT	3-0-0	3
2	11-EE532	VLSI	3-0-0	3
3	11-EE531	DISTRIBUTION SYSTEM PLANNING & AUTOMATION	3-0-0	3
4	11-EE534	NON CONVENTIONAL ENERGY RESOURCES	3-0-0	3
5	11-EE533	DIGITAL SIGNAL PROCESSING	3-0-0	3

EVEN SEMESTER ELECTIVES				
1	11-EE536	STATE ESTIMATION & ADAPTIVE CONTROL	3-0-0	3
2	11-EE535	FACTS	3-0-0	3
3	11-EE539	AL TECHNIQUES IN POWER SYSTEMS	3-0-0	3
4	11-EE537	POWER SYSTEM RESTRUCTURING & DEREGULATION	3-0-0	3
5	11-EE538	ENERGY CONSERVATION & AUDIT	3-0-0	3

POWER SYSTEM ANALYSIS AND DYNAMICS

Course Code : 11 EE501 **L-T-P: 3-1-2**
Prerequisite: **Credits: 5**

Syllabus

UNIT I: POWER SYSTEM STABILITY

Basic definitions, statement of the problem, elementary model, Swing equations, power angle equations, Natural frequencies of oscillations, and single-machine-infinite bus system-Equal area criterion-classical model of a multi machines systems.

UNIT II: RESPONSE TO SMALL DISTURBANCES

The unregulated synchronous machine, Modes of oscillations of an unregulated multi machine system, regenerated synchronous machine, Distribution of power impacts.

UNIT III: SYNCHRONOUS MACHINE

Reactance and Time constants of a synchronous machine- Basic notions and relation to short circuit oscillogram. Circuit equations of Synchronous machine and parks Transformations, Vector diagrams in steady state and transient state, Power angle curves of a salient pole machine, a procedure for multi machines systems, effect of saturation, effect of damper windings as stability, damper action explained by theory of induction - motor.

UNIT IV: EXCITATION SYSTEMS

Typical Excitations configurations and excitation, (Automatic) Voltage regulators, Exciter Build-up, excitation system response and computer representations of excitations systems (types 1, 2, 3 and 4).

UNIT-V: EFFECTOF EXCITATION ON STABILITY

Effect on (a) Power limits, (b) Transient stability, (c) Dynamic stability, approximate excitation system representation, supplementary stabilizing signals.

Text Books:

1. P.M.Anderson and A.A.Foud, “Power System Control and Stability”, The IOWA state university press: AMES, IOWA, USA-GALGOTIA Publications (Indian English Language Edn.1981).
2. Edward Wilson Kim bark, “Power System Stability: Synchronous Machines”, Volume 3 Dover publications Inc., New York(1961)

Reference Books:

1. M. Powella & P. G. Murthy, “Transient Stability of Power Systems - Theory & Practice”, John Wiley Publications.(1994).
2. Charles & Concordia, “Mathematical Modeling of Synchronous Machines” John Willy & Sons, New York, 1951.

EHVAC & HVDC TRANSMISSION

Course Code : 11 EE502 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus
UNIT I: Introduction:
Need of EHV transmission, Limitations, Comparison of EHV-AC & HVDC transmission, Interconnected Network and Role of Interconnecting Transmission Lines.

UNIT II: EHV-AC Transmission:
Parameters of EHV line, over-voltages due to switching, Ferro resonance, line insulator and clearance, corona, long distance transmission with series & shunt compensations, principle of half wave transmission, flexible ac transmission.

UNIT III: HV DC Transmission
Types of dc links, terminal equipments & their operations, HVDC system control, reactive power control, harmonics, multiterminal dc (MTDC) system, ac/dc system analysis, protection of terminal equipments.

UNIT IV: Insulation Requirement of EHV-AC and HVDC
Classification, Insulation design aspect, Difference between Insulation Coordination-EHV-AC and HVDC, Insulation Coordination, Surge arrester protection in HVDC and EHV-AC Substation, Clearance for HVDC and EHV-AC.

UNIT-V: Towers for (EHV-AC and HVDC)
Types and configuration of self supporting and flexible towers, Foundation of towers, mechanical design of towers Tower design based on switching surges and lightning strokes.

Text Books:
1. K. R. Padiyar, HVDC Power Transmission System, Wiley Eastern Limited.
2. EHV-AC, HVDC Transmission and Distribution Engineering, S. Rao, Khanna Publications.

Reference Books:
1. Rakesh Das Begmudre, Extra High Voltage AC Transmission Engineering, Wiley Eastern Limited
2. E.W.Kimbark, EHV-AC and HVDC Transmission Engineering &Practice, Khanna Publishers.

OPTIMIZATION TECHNIQUES (PED & PS)

Course Code:11 EE503 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus

UNIT I: Linear Programming

Standard form of linear programming problem; Simplex method two phase simplex method; revised simplex method. Duality in Linear programming. Some simple numerical problems.

UNIT II: Non-Linear Programming

Fibonacci method, Golden section method, Powell's method, Newton's method, Kuhn-Tucker conditions. Some simple numerical problems.

UNIT III: Transportation Problem

Definition of transportation problem, transportation algorithm, North-West corner method, Vogel approximation method, Least cost method, Hungarian method for assignment. Some simple numerical problems.

UNIT IV: Project planning through Networks

Arrow diagram representation; Rules for constructing an arrow diagram. PERT and CPM, critical path calculations, Earliest start and latest completion times; Determination of floats. Some simple numerical problems.

UNIT V: Dynamic Programming

Multistage decision processes; Types of multistage decision problems, concept of sub-optimization and the principle of sub-optimality computational procedure in dynamic programming. Some simple numerical problems.

Text Books:

1. Engineering optimization theory and practice by S.S. Rao New Age International publications.
2. Operations Research, An introduction by Hamdy A. Taha. PHI learning private Ltd. New Delhi.

Reference Books:

1. Operations Research by S.D. Sharma, Kedarnath & Ramnath Publishers, Delhi.
2. Introduction to operations research Hiller and Liberman.

MODERN CONTROL THEORY(PED & PS)

Course Code : 11 EE504 **L-T-P: 3-1-0**
Prerequisite: **Credits: 4**

Syllabus

UNIT–I:DIGITALCONTROLSYSTMES

Introduction, Signal Reconstruction, Difference Equation, Z Transfor Function, Response of Linear Discrete Systems, Z Transform Analysis of Discrete data Control Systems, Z and S Domain Relation ship, Stability of Discrete systems.

UNIT- II: STATE VARIABLE ANALYSIS OF DIGITAL CONTROL SYSTEMS

Introduction, State Descriptions of Digital Processors, State Description of sampled continuous time plants, Solution of State difference equations, Controllability and Observability

UNIT III: NONLINEAR SYSTEMS

Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions

UNIT IV: STABILITY ANALYSIS

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method– Direct method of Lyapunov – Generation of Lyapunov functions – Variable gradient and Krasoviskii's methods – estimation of transients using Lyapunov functions.

UNIT- V: OPTIMAL CONTROL

Introduction to optimal control - Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator

Text Books:

1. M.Gopal – Digital Control and state variable methods, Tata Mcgraw'Hill, 2nd eddition
2. M.Gopal - Modern Control System Theory - New Age International (P.Ltd,) 2nd eddition,1984

Reference Books:

1. Stafani etal , "Design of Feedback control Systems" – Oxford Press, 4th eddition.
2. Ogata K, "Modern Control Engineering," Prentice Hall, 4th eddition.
3. Nagarath IJ and M. Gopal, " Control Systems Engineering"- New Age International Publishers, 5th eddition.

REAL TIME CONTROL OF POWER SYSTEM

Course Code :11 EE505 **L-T-P: 3-1-2**
Prerequisite: **Credits: 5**

Syllabus

UNIT – I

UnitCommitment Problem:Introductions to UCP, thermal & Hydral constraints in **UNIT** commitment-Economic Dispatch: Economic importance -characteristics of thermal, nuclear and hydro-generator **UNIT**s - Economic dispatch problem –Thermal system dispatch with network losses – line loss formula –The Lambda iteration method – first order gradient method – base point and participation factors – Economic dispatch Vs **UNIT** commitment.

UNIT – II

Load frequency control-I: Definition of control area – single area control – Block diagram representation – steady state analysis – dynamic response – proportional plus integral control of single area block diagrams – AGC multi area system –static and dynamic response – tie line bias control – Inter connected systems- Automatic voltage control

UNIT – III

Load Frequency Control-II: Load frequency control of 2-area system -uncontrolled case and controlled case- tie-time bias control.

UNIT – IV

Computer control of power systems: Energy control centre – various levels – SCADA system – computer configuration functions – monitoring – data acquisition and controls – EMS system – expert system applications for power system operation. Communication protocol IEC61850
Security control: Security analysis and monitoring – system operating states by security control functions – generator and line outages by linear sensitivity factors.

UNIT – V

State estimation: Power system state estimation – Weighted least square state estimation – state estimation of AC network. Treatment of bad data – network observability and pseudo measurements.

Text Books:

1. Allen J. Wood and Bruce F. Wollenberg "Power Generation, Operation & Control" 2nd edition, John Wiley and Sons.
2. I.J. Nagarath & D. P. Kothari , "Modern power system analysis" 3rd Edition, TMH

Reference Books:

1. I.Elgard , "Electric Energy Systems Theory – An Introduction" TMH.
2. Abhijit Chakrabarti & S**UNIT**a Halder " Power System Analysis operation and Control " 1st edition, PHI
3. Mahalanabis A.K., Kothari D.P. and Ahson S.I., "Computer aided power system analysis and control", TMH

4. J.J.Grainger, W.D.Stevenson JR, Power system analysis, Tata McGraw Hill N.D. 2007.
5. Springer Verlag,"Energy Management Systems" Berlin Hidelberg NewYork.

POWER SYSTEM PROTECTION

Course Code :11 EE507 **L-T-P: 4-0-0**
Prerquisite: **Credits: 4**

Syllabus
UNIT I
Need for protection systems: Nature and causes of faults, types of faults, effects of faults, fault statistics, evolution of protective relays, zones of protection, primary & back up protection, essential qualities of protection, classification of protective relays and schemes, CT, PT, summation transformer, phase-sequence current segregating network.

UNIT II
Protection of Power System Equipment - Generator, Transformer, Generator- Transformer **UNIT**s, Transmission Systems, Bus-bars, Motors.

UNIT III
Pilot wire and Carrier Current Schemes; Use of optical fibers for protection schemes. System grounding –ground faults and protection; Load shedding and frequency relaying; Out of step relaying; Re-closing and synchronizing

UNIT IV
Static Relays: Advantages of static relays, working principles of static impedance, static reactance using phase comparator, static distance, static over current, static differential relay using amplitude comparator, use of sampling comparator.

UNIT-V
Microprocessor based protection relays – Working principles of μP based over current, impedance, reactance directional, reactance (distance) & mho relays – digital relaying algorithms, various transform techniques employed like discrete Fourier, Walsh-Hadamard, Haar, microprocessor implementation of digital distance relaying algorithms – protection of lines against lightning & traveling waves.

Text Books:

1. T.S. Madhava Rao, "Power System Protection: Static Relays With Microprocessor Applications", Tata McGraw-Hill, 2nd edition.
2. Badri Ram & DN Viswakarma, "Power System Protection & Switch Gear", McGraw Hill

Reference Books:

1. A.R. Van C. Washington, "Protective Relays Their Theory & Practice", Vol.I & II, John Wiley & Sons.
2. Singh L.P ,Digital Protection, Protective Relaying from Electromechanical to Microprocessor, John Wiley & Sons, 1994
3. D. Robertson, "Power System Protection – Reference Manual", Oriel Press, London, 1982.
4. C.R. Mason, "The art and science of protective relaying", John Wiley &sons.
5. S. Sunil Rao, "Switch Gear & Protection", Khanna Publisher's, Delhi.

POWER QUALITY

Course Code :11 EE508 **L-T-P: 4-0-0**
Prerequisite: **Credits: 4**

Syllabus

UNIT I: Introduction

Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage, Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring

UNIT II: Long Interruptions

Interruptions – Definition – Difference between failure, outage, Interruptions – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – Short interruptions

UNIT III: Short Interruptions

Definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems. Multiple events, single phase tripping – voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.

UNIT IV: Voltage sag – characterization – Single phase

Voltage sag – definition, causes of voltage sag, voltage sag magnitude, monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, voltage sag duration - Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT V: Mitigation of Interruptions and Voltage Sags

Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment imm**UNIT**y, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.

Text Books:

1. Math H J Bollen, “Understanding Power Quality Problems: voltage sags and interruptions”, Wiley-IEEE Press, 1999.
2. Roger C Dugan, Surya Santoso, Mark F. McGranaghan, H. Wayne Beaty, “Electrical power systems quality”, Second edition, 2002.

Reference Book:

1. Angelo Baggini,“Hand book of power quality”,wiley publications, 2008.

REACTIVE POWER COMPENSATION AND MANAGEMENT (ELECTIVE-1)

Course Code :11 EE530 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

LOAD COMPENSATION: 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- example.: Steady – state reactive power compensation in transmission system: Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples. **TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS:** Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation –compensation using synchronous condensers –**:** Reactive power coordination: 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. **DEMAND SIDE MANAGEMENT:** Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels**:** Distribution side Reactive power Management: System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks . **USER SIDE REACTIVE POWER MANAGEMENT:** KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations. **REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARC FURNACES:** Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace

Text Books:

1. T.J.E.Miller, “Reactive power control in Electric power systems”, John Wiley and sons, 1982.
2. D. M. Tagare, “Reactive power Management”, Tata McGraw Hill, 2004.

Reference Books:

1. Hong Chen, “Practices of reactive power management and compensation”, PJM Interconnection, Norristown, PA;
2. T E Miller, “Reactive Power Control in Power Systems”, John Wiley, 1982.

DISTRIBUTION SYSTEM PLANNING & AUTOMATION(ELECTIVE)

Course Code :11 EE531 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I: Distribution system planning and load characteristics:
Planning and forecasting techniques, present and future role of computer, load characteristics, load forecasting, methods of forecasting, regression analysis, correlation analysis and time series analysis, load management, tariff, diversified demand method, and metering of energy.

UNIT II: Distribution transformers:
Types, Regulation and Efficiency, use of monograms for obtaining efficiency, distribution factors, KW-KVA-Method of determining regulation.
Design of sub transmission lines and distribution substation: Introduction, sub transmission systems, distribution substation, substation bus schemes, description and comparison of switching schemes, substation location and rating, application of network flow techniques in rural distribution networks to determine optimum location of substation.

UNIT III: Design considerations on primary systems:
Introduction, types of feeders, voltage levels, radial type feeders, feeders with uniformly distributed load and non-uniformly distributed loads.
Design considerations of secondary systems: Introduction, secondary voltage levels, secondary banking existing systems improvement.

UNIT IV: Capacitors in distribution systems and distribution system protection:
Effects of series and shunt capacitors, justification of capacitors, procedure to determine optimum capacitor size and location, basic definition and types of over current protection device, objective of distribution system protection, coordination of protective devices.

UNIT-V: Distribution system automation:
Reforms in power sector, methods of improvement, reconfiguration, reinforcement, automation, communication systems, sensors, automation systems architecture, software and open architecture, RTU and data communication, SCADA requirement and application functions, GIS/GPS based mapping of distribution network, communication protocol for distribution systems, integrated substation, metering systems, revenue improvement, issuing multiyear tariff and availability based tariff, Grounding system: earth and safety, nature and size of earth electrodes, design of earthing schemes.

Text Book:

1. Electrical Power Distribution Engineering by Turan Gonen, McGraw Hill.

Reference Book:

1. Electrical Power Distribution by A. S. Pabla, TMH, 5^{th} Ed., 2004.

NON CONVENTIONAL ENERGY RESOURCES (PED & PS)

Course Code :11 EE534 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

UNIT I : SOLAR RADIATION

Extraterrestrial solar radiation, terrestrial solar radiation, solar thermal conversion, solar ponds, solar heating/cooling technique, solar distillation, photovoltaic energy conversion, solar cells – 4 models.

UNIT II:WIND ENERGY

Planetary and local winds, vertical axis and horizontal axis wind mills, principles of wind power, maximum power, actual power, wind turbine operation.

UNIT III: ENERGY FROM OCEANS

Ocean temperature differences, principles of OTEC plant operations, wave energy, devices for energy extraction, tides, simple single pool tidal system.

UNIT IV: GEOTHERMAL ENERGY

Origin and types, Bio fuels, classification, direct combustion for heat and electricity generator, anaerobic digestion for biogas, biogas digester, power generation.

UNIT V: MICRO- HYDEL ELECTRIC SYSTEMS:

Power potential –scheme layout-generation efficiency and turbine part flow-geothermal energy extraction.

Text Books:

1. Godfrey Boyle "Renewable Energy", Oxford Publications, Second edition.
2. G. D. Rai, "Non-Conventional Energy Sources", Khanna Publishers, First edition.

Reference Books:

1. Roger H.Charlier, Charles W. " Ocean Energy- Tide and Tidal Power"ISBN: Library of Congress Control Number: 2008929624_c Springer-Verlag Brerlin Heidelberg 2009.
2. John Twidell & Toney Weir: E&F.N. Spon, "Renewable Energy Sources", Taylor & Francis New York, 2nd edition.
3. John F.Walker & N.Jenkins, "Wind Energy Technology", John Willey and Sons Chichester, U.K – 1997.

VLSI DESIGN(ELECTIVE)

Course Code :11 EE 532 **L-T-P: 0-0-3**
Prerequisite: **Credits: 3**

Syllabus
UNIT I
Introduction to CMOS circuits: MOS transistors, MOS switches, CMOS logic: Inverter, combinational logic, NAND, NOR gates, compound gates, Multiplexers. Memory: Latches and registers. Circuit and system representations: Behavioral, structural and physical representations

UNIT II
MOS transistor theory: NMOS, PMOS enhanment mode transistors, Threshold voltage, body effect, MOS device design equations: basic DC equations, second order effects, sub threshold region, channel-length modulation, mobility variation, impact ionization-hot electrons

UNIT III
MOS models, small signal AC characteristics, CMOS inverter DC characteristics, static load MOS inverters, bipolar devices, CMOS processing technology: An overview of silicon semiconductor technology:

UNIT IV
basic CMOS technology, CMOS process enhancement, layout design rules, Latch up, technology related CAD issues . CMOS circuit and logic design: CMOS logic gate design: fan in, fan-out, typical CMOS NAND and NOR Delays, transistor sizing.

UNIT-V
Basic physical design of simple logic gates. CMOS logic structures. Clocking strategies: single phase memory structures, PLL techniques, single phase logic structures, two phase clocking, memory structures, And logic structures, I/O Structures: out put pads, input pads.

Text Book:
1. Weste, Eshragian, Principles of CMOS VLSI design, Addison Wesley, 2001.

Reference Books:
1. Douglas A Pucknell and Kamaran Eshragian, Basic VLSI design, 3rd edition, 2001.
2. J.S.Smith, Application Specific Integrated Circuits, Addison Wesley, 2004

DIGITAL SIGNAL PROCESSING (ELECTIVE)

Course Code :11 EE533 **L-T-P: 0-0-3**
Prerequisite: **Credits: 3**

Syllabus

UNIT I: Digital Filter Structures:

Introduction- Structure for realization of Discrete systems, Structures for FIR systems, Cascaded and Lattice filter, Structures for IIR Filters- Cascaded and Lattice filters, State space analysis of structures- Solution to state equations.

UNIT II: Implementation of DTS:

Representation of Numbers- fixed binary, floating, Error in rounding, Trunk - Quantization of Filter coefficients, quantization coefficients in FIR, Round off effects in Filters-Limit cycle oscillations, Scaling to prevent overflow.

UNIT III: Digital filter design:

General considerations- Design of FIR filter using windows- Design of IIR digital filters-Using Bilinear transformations of IIR filters- FIR filter Design-based on Least Square Method - Design of FIR digital filters with least Square –Inverse(Wiener Filter)- design of IIR digital filters in Frequency domain.

UNIT IV: Analysis of finite Word length effects:

The Quantization process and errors- Reduction of Product round-off errors using feedback – Quantization of fixed point and floating point Numbers- Analysis of coefficient Quantization effects – Dynamic range scaling- overflow oscillations.

UNIT V: Power Spectrum Estimation:

Estimation of spectra from Finite Duration Observations signals – Non-parametric methods for power spectrum estimation-Walsh methods-Blackman & Tukey method. – Parametric method for power spectrum Estimation - Minimum variance spectral estimation.

Text Books:

1. Digital Signal Processing principles, Algorithms and Applications – John G. Proakis - PHI –3rd edition-2002.
2. Discrete Time Signal Processing – Alan V. Oppenheim, Ronald W. Shafer -PHI-1996 1st edition-9th reprint.

Reference Books:

1. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2nd reprint-2001
2. Digital Filter Analysis and Design - Auntonian -TMH

AI TECHNIQUES IN POWER SYSTEMS

Course Code :11 EE539 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
UNIT I

ARTIFICIAL NEURAL NETWORK: Fundamentals of artificial neural networks – Basic concepts of neural networks - Biological Prototype - Artificial neuron – Basic models of artificial neural networks - connections– learning - Activation functions - Important terminologies of ANN - Neural Network Architecture - Single layer artificial neuron networks - Multilayer artificial neuron networks – Recurrent networks.

UNIT II

SUPERVISED LEARNING NETWORK: Perceptron Network – Perceptron learning rule - Architecture- Perceptron training algorithms – Adaline – Architecture –Madaline - Architecture – Training Algorithms - Architecture of Back Propagation Network- Back Propagation Learning– Input layer computation– Hidden layer computation – Output layer computation– Back Propagation Algorithms.

UNIT III

FUZZY LOGIC: Introduction – Fuzzy sets- basic Fuzzy set operations – Properties of Fuzzy sets - Membership function- features of membership function - Fuzzy Inference Systems - Methods of FIS – defuzzification methods – centroid method – weighted average method.

UNIT IV

GENETIC ALGORITHMS: Introduction- Characteristics of Genetic algorithms- Basic operators and Terminologies in Gas - search space – Effects of Genetic operators - Traditional Algorithm Vs Genetic Algorithm -Simple GA - General Genetic Algorithm.

UNIT-V

APPLICATION TO ELECTRICAL SYSTEMS: ANN based Short Term Load Forecasting - load flow studies - Fuzzy Logic based **UNIT** Commitment and Genetic Algorithm based Economic Dispatch.

Text Books:

1. S.N.Sivanandam & S.N.Deepa, “Principles of Soft Computing”, Wiley India (P) Ltd., 1st Indian Edition 2008.
2. J.S.R. Jang, C.T. Sun, E. Mizutani “Neuro Fuzzy and Soft Computing”, Pearson education.

Reference Books:

1. D.E Goldberg," Genetic Algorithms", Addison – Wisley 1999.
2. Bast kosko, "Neural networks &Fuzzy systems", Prentice Hall.

STATE ESTIMATION & ADAPTIVE CONTROL(ELECTIVE-4)

(Common to Both PED & PS)

Course Code :11 EE536 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Elements of probability theory: definition of probability and random variable, probability functions, expected value, mean and covariance, independence and correlation, Gaussian distribution and its properties. **Stochastic processes and system models:** Elements of the theory of stochastic processes, mean value function and covariance kernel, independent and correlated stochastic processes, stationery and non sequence model, Gaussian white process. **Non parametric methods & parametric methods:** Nonparametric methods: Transient analysis-frequency analysis-Correlation analysis-Spectral analysis. Liner Regression: The Lease square estimate-best liner unbiased estimation under linear constraints-Prediction error methods: Description of Prediction error methods-Optimal Prediction –relationships between Prediction error methods and other identification methods theoretical analysis. **Adaptive control schemes** Introduction – users- Definitions-auto tuning-types of adaptive control-gain scheduling controller-model reference adaptive control schemes – self tuning controller. MRAC and STC: Approaches – The Gradient approach – Lyapunov functions – Passivity theory – pole placement method Minimum variance control – Predictive control. **Adaptive control and application:** Stability – Convergence – Robustness – Application of adaptive control, direct model reference adaptive control. Introduction: Basic approaches to adaptive control. Applications of adaptive control. Identification: Error formulations linear in the parameters. Direct adaptive control: Linear error equations with dynamics. Gradient and pseudo-gradient algorithms. Strictly positive real transfer functions. Kalman-Yacubovitch-Popov lemma. Passivity theory.

Text Books:

1. Dan Simon, “Optimal State Estimation”, Wiley Intersience, 2006.
2. S. Sastry and M. Bodson, Adaptive Control: Stability, Convergence, and Robustness, Prentice-Hall, 1989.

Reference Books:

1. K.J. Astrom and B. Wittenmark, Adaptive Control, Addison-Wesley, 2ndedition,1995.
2. I.D. Landau, R. Lozano, and M. M'Saad, Adaptive Control, Springer Verlag, London, 1998.
3. Meditch, “Stochastic Optimal Linear Estimation and Control” Mc-Graw Hill Company, 1969.
4. K.S. Narendra and A.M. Annaswamy, Stable Adaptive Systems, Prentice-Hall, 1989.
5. P.E. Wellstead & M.B. Zarrop, Self-Tuning Systems: Control and Signal Processing, J. Wiley & Sons, Chichester, England, 1991

FLEXIBLE AC TRANSMISSION SYSTEMS (Common for PS & PED)

Course Code :11 EE535 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus
UNIT I
FACTS and CONVERTER Concepts
Introduction to FACTS devices, Power Flow in AC system , Dynamic stability Consideration and the importance of the controllable parameter , Definition of FACTS , Basic types of FACTS Controllers, Basic concepts on voltage source converters, basic concepts of current source Converter, Comparison of current converters with voltage source converters, concepts on PWM technique and Three level voltage Source converter

UNITII
Static Shunt Compensators
SVC and STATCOM Operation & Characteristics and Control of TSC, TSR, STATCOM, comparison between SVC and STATCOM, STATCOM for transient and dynamic stability enhancement.

UNIT III
Static series Compensators
GCSC,TSSC,TCSC and SSSC Operation and Control External system control for series Compensator SSR and its damping, Static Voltage and Phase angle Regulator, TCVR and TCPAR Operation and Control.

UNITIV
UPFC and IPFC
The Unified Power Flow Controller Operation, Comparison with other FACTS devices, control of P and Q, Dynamic Performance, Special purpose of FACTS Controllers, Interline Power Flow Controller Operation and Control.

UNIT V
Custom Power devices
Introduction to custom power devices, Shunt active filter for power distribution system, Reactive power compensation by series connected compensator, Load Compensation & Distribution STATCOM, Application of STATCOM for reactive power compensation and voltage regulation, Concepts of DVR, UPQC.

Text Books:

1. N.G. Hingorani & L. Gyugyi " Understanding FACTS: Concepts and technology of Flexible AC Transmission System" , IEEE press, 2000
2. K.R. Padiyar, "FACTS Controllers In Power Transmission and Distribution" , New Age Int Publisher, 2007

Reference Books:

1. Ned Mohan et. al. “power Electronics” John Wiley & Sons
2. T.J.E. Miller, “ Reactive Power Control in Electric Systems”, John Wiley & Sons

ENERGY CONSERVATION & AUDIT

Course Code :11 EE537 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

BASIC PRINCIPLES OF ENERGY AUDIT: Energy audit- definitions, concept, types of audit, energy index, cost index, pie-charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit. **ENERGY**

MANAGEMENT:
Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting - Energy manger, Qualities and functions, language, Questionnaire - check list for top management. Demand side management. **ENERGY EFFICIENT MOTORS:** Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics - variable speed, variable duty cycle systems, RMS hp- voltage van at ion-voltage unbalance- over motoring- motor energy audit. **POWER FACTOR IMPROVEMENT, LIGHTING AND**

ENERGY INSTRUMENTS: Power factor - methods of improvement, location of capacitors, PF with non linear loads, effect of harmonics on PF , PF motor controllers - Good lighting system design and practice, lighting control, lighting energy audit - Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC's. **ECONOMIC ASPECTS AND ANALYSIS:** Economics Analysis - Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Energy efficient measures- calculation of simple payback method, net present worth method - Power factor correction, lighting - Applications of life cycle costing analysis, return on investment.

Text Books:

1. W.C.Turner, “Energy management hand book”, John wiley and sons Energy management and good lighting practice: fuel efficiency- book let 12-EEO
2. W.K. Murphy, G- Mckay Butier worth, “Energy management”, Heine mann publications, (20070.

Reference Books:

1. Paulo Callaghan, “Energy management”, 1st edition, Mc-graw Hill Book company, (1998)
2. Giovanni and Petrecca, “Industrial Energy Management: Principles and Applications”, The Kluwer international series-207 (1999)
3. Howard E.Jordan, “Energy-Efficient Electric Motors and their applications”, Plenum pub corp; 2nd ed. (1994)

POWER SYSTEM RESTRUCTURING, DEREGULATION & POWER MARKETS

Course Code :15 EE 538 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Key Issues in Electric Utilities 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. Open Access Same-time Information System (OASIS)Structure of OASIS - Posting of Information – Transfer capability on OASIS. **Available Transfer Capability (ATC)** 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. **Power System Operation in Competitive Environment** Introduction – Operational Planning Activities of ISO- The ISO in Pool Markets – The ISO in Bilateral Markets Operational Planning Activities of a GENCO. **Market Power:** Introduction - Different types of market Power – Mitigation of Market Power - Examples. **Transmission Congestion Management:**Introduction - 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.

Text Books:

1. Loi Lei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd., England, (2001).
2. Kankar Bhattacharya, "Operation of Restructured Power System", Math H.J. Boller and Jaap E.Daalder Kulwer Academic Publishers, (2001).

Reference Books:

1. Mohammad Shahidehpour and Muwaffaq alomoush, "Restructured Electrical Power Systems", Marcel Dekker, Inc., (2001).
2. P. Venkatesh,B V Manikandan,S Charles Raja and A Srinivasa Rao, "Electric Power System Analysis, Security & Deregulation", PHI, (2012).

DEPARTMENT OF MECHANICAL
M-TECH COURSE STRUCTURE WITH SYLLABUS

M.TECH (ME)

S.No	**Course Code**	**Course Title**	**L-T-P**	**Credits**
		SEMESTER -1		
1	13MT501	FUNDAMENTALS OF MECHATRONICS	3-0-0	3
2	13MT502	ADVANCED ENGINEERING MATHEMATICS	3-1-0	4
3	13MT503	SENSOR AND ACTUATORS	3-0-0	3
4	13MT504	MODELING AND SIMULATION OF MECHATRONICS SYSTEMS	3-1-0	4
5	13MT534	MEMS AND NEMS	3-0-0	3
6	13MT631	INDUSTRIAL AUTOMATION	3-0-0	3
7	13MT551	SEMINAR	0-0-4	2
8	13MTL550	MECHATRONICS LAB - I	0-0-4	2
		SEMESTER -2		
1	13MT601	ROBOTICS: ADVANCED CONCEPTS AND ANALYSIS	3-0-0	3
2	13MT602	CONTROL OF MECHATRONIC SYSTEMS	3-0-0	3
3	13MT603	MECHATRONICS PRODUCT DESIGN	3-1-0	4
4	13MT604	PRECISION ENGINEERING	3-1-0	4
5	13MT531	COMPUTATIONAL FLUID DYNAMICS	3-0-0	3
6	13MT636	FUZZY SETS AND ARTIFICIAL INTELLIGENCE	3-0-0	3
7	13MT651	TERM PAPER	0-0-4	2
8	13MTL650	MECHATRONICS LAB - II	0-0-4	2
		SEMESTER -3,4		
	MT	THESIS/PROJECT		36

FUNDAMENTALS OF MECHATRONICS

Course Code: 13MT501 **L-T-P: 3-0-0**
Prerequisite: **Credits: 3**

Module I: Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach.

Module II: Review of fundamentals of electronics. Data conversion devices, sensors, microsensors, transducers, signal processing devices, relays, contactors and timers. Microprocessors controllers and PLCs.

Module III: Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, transfer systems.

Module IV: Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems. Description

Module V: Description of PID controllers. CNC machines and part programming. Industrial Robotics.

Text Books:

1. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988.
2. G.W. Kurtz, J.K. Schueller, P.W. Claar . II, Machine design for mobile and industrial applications, SAE, 1994.
3. T.O. Boucher, Computer automation in manufacturing - an Introduction, Chappman and Hall, 1996.
4. R. Iserman, Mechatronic Systems: Fundamentals, Springer, 1st Edition, 2005
5. Musa Jouaneh, Fundamentals of Mechatronics, 1st Edition, Cengage Learning, 2012.

ADVANCED ENGINEERING MATHEMATICS

Course Code: 13MT502 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus
Linear Algebra: Matrix algebra; basis, dimension and fundamental subspaces; solvability of Ax = b by direct Methods; orthogonality and QR transformation; eigenvalues and eigenvectors, similarity transformation, singular value decomposition, Fourier series, Fourier Transformation, FFT.

Vector Algebra & Calculus: Basic vector algebra; curves; grad, div, curl; line, surface and volume integral, Green's theorem, Stokes's theorem, Gauss-divergence theorem.

Differential Equations: ODE: homogeneous and non-homogeneous equations, Wronskian, Laplace transform, series solutions, Frobenius method, Sturm-Liouville problems, Bessel and Legendre equations, integral transformations; PDE: separation of variables and solution by Fourier Series and Transformations, PDE with variable coefficient.

Numerical Technique: Numerical integration and differentiation; Methods for solution of Initial Value Problems, finite difference methods for ODE and PDE; iterative methods: Jacobi, Gauss-Siedel, and successive over-relaxation.

Complex Number Theory: Analytic function; Cauchy's integral theorem; residue integral method, conformal mapping.

Statistical Methods: Descriptive statistics and data analysis, correlation and regression, probability distribution, analysis of variance, testing of hypothesis.

Text Books:

1. H. Kreyszig, “Advanced Engineering Mathematics”, Wiley, (2006).
2. Gilbert Strang, “Linear Algebra and Its Applications”, 4th edition, Thomson Brooks/Cole, India (2006).
3. J. W. Brown and R. V. Churchill, “Complex Variables and Applications”, McGraw-Hill Companies, Inc., New York (2004).
4. J. W. Brown and R. V. Churchill, “Fourier Series and Boundary Value Problems”, McGraw-Hill Companies, Inc., New York (2009).
5. G. F. Simmons, “Differential Equations with Applications and Historical Notes”, Tata McGraw-Hill Edition, India (2003).
6. S. L. Ross, “Differential Equations” 3rd edition, John Wiley & Sons, Inc., India (2004).
7. K. S. Rao, “Introduction to Partial Differential Equations”, PHI Learning Pvt. Ltd (2005).
8. R. Courant and F. John, “Introduction to Calculus and Analysis, Volume I and II”, Springer-Verlag, New York, Inc. (1989).
9. K. Atkinson and W. Han, “Elementary Numerical Analysis” 3rd edition, John Wiley & Sons, Inc., India (2004).
10. R. A. Johnson and G. K. Bhattacharya, “Statistics, Principles and Methods”, Wiley (2008).

SENSORS AND ACTUATORS

Course Code: 13MT503 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Brief overview of measurement systems, classification, characteristics and calibration of different sensors. Measurement of displacement, position, motion, force, torque, strain gauge, pressure flow, temperature sensor sensors, smart sensor. Optical encoder, tactile and proximity, ultrasonic transducers, opto-electrical sensor, gyroscope. Principles and structures of modern micro sensors, micro-fabrication technologies: bulk micromachining, surface micromachining, LIGA, assembly and packaging.

Pneumatic and hydraulic systems: actuators, definition, example, types, selection. Pneumatic actuator. Electro-pneumatic actuator. Hydraulic actuator, control valves, valve sizing valve selection. Electrical actuating systems: solid-state switches, solenoids, voice coil; electric motors; DC motors, AC motors, single phase motor; 3-phase motor; induction motor; synchronous motor; stepper motors. Piezoelectric actuator: characterization, operation, and fabrication;

Text Books:

1. John G. Webster, Editor-in-chief, “Measurement, Instrumentation, and Sensors Handbook”, CRC Press (1999).
2. Jacob Fraden, “Handbook of modern Sensors”, AIP Press, Woodbury (1997).
3. Nadim Maluf, “An Introduction to Microelectromechanical Systems Engineering”, Artech House Publishers, Boston (2000).
4. Marc Madou, “Fundamentals of Microfabrication”, CRC Press, Boca Raton (1997).
5. Gregory Kovacs, “Micromachined Transducers Sourcebook”, McGraw-Hill, New York (1998).
6. E. O. Deobelin and D. Manik, “Measurement Systems – Application and Design”, Tata McGraw-Hill (2004).
7. D. Patranabis, “Principles of Industrial Instrumentation”, Tata McGraw-Hill, eleventh reprint (2004).
8. B. G. Liptak, “Instrument Engineers’ Handbook: Process Measurement and Analysis”, CRC (2003).

MODELING AND SIMULATION OF MECHATRONIC SYSTEMS

Course Code: 13MT504 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Physical Modelling: Mechanical and electrical systems, physical laws, continuity equations, compatibility equations, system engineering concept, system modelling with structured analysis, modelling paradigms for mechatronic system, block diagrams, mathematical models, systems of differential-algebraic equations, response analysis of electrical systems, thermal systems, fluid systems, mechanical rotational system, electrical-mechanical coupling.

Simulation Techniques: Solution of model equations and their interpretation, zeroth, first and second order system, solution of 2nd order electro-mechanical equation by finite element method, transfer function and frequency response, non-parametric methods, transient, correlation, frequency, Fourier and spectra analysis, design of identification experiments, choice of model structure, scaling, numeric methods, validation, methods of lumped element simulation, modelling of sensors and actuators, hardware in the loop simulation (HIL), rapid controller prototyping, coupling of simulation tools, simulation of systems in software (MATLAB, LabVIEW) environment.

Modelling and Simulation of Practical Problems:

- Pure mechanical models
- Models for electromagnetic actuators including the electrical drivers
- Models for DC-engines with different closed loop controllers using operational amplifiers
- Models for transistor amplifiers
- Models for vehicle system

Text Books:

1. L. Ljung, T. Glad, “Modeling of Dynamical Systems”, Prentice Hall Inc. (1994).
2. D.C. Karnopp, D.L. Margolis and R.C. Rosenberg, “System Dynamics: A Unified Approach”, 2nd Edition, Wiley-Interscience (1990).
3. G. Gordon, “System Simulation”, 2nd Edition, PHI Learning (2009).
4. Giurgiutiu and S. E. Lyshevski, “Micromechatronics, Modeling, Analysis, and Design with MATLAB”, 2nd Edition, CRC Press (2009).

MEMS AND NEMS

Course Code: 13MT534 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Micro and nano mechanics – principles, methods and strain analysis, an introduction to microsensors and MEMS, Evolution of Microsensors & MEMS, Microsensors & MEMS applications, Microelectronic technologies for MEMS, Micromachining Technology – Surface and Bulk Micromachining, Micromachined Microsensors, Mechanical, Inertial, Biological, Chemical,Acoustic, Microsystems Technology, Integrated Smart Sensors and MEMS, Interface Electronics for MEMS, MEMS Simulators, MEMS for RF Applications, Bonding & Packaging of MEMS, Conclusions & Future Trends.

Nanoelectromechanical systems (NEMS) – a journey from MEMS to NEMS, MEMS vs. NEMS, MEMS based nanotechnology – fabrication, film formation and micromachining, NEMS physics – manifestation of charge discreteness, quantum electrodynamical (QED) forces, quantum entanglement and teleportation, quantum interference, quantum resonant tunneling and quantum transport, Wave phenomena in periodic and aperiodic media – electronic and photonic band gap crystals and their applications, NEMS architecture, Surface Plasmon effects and NEMS fabrication for nanophotonics and nanoelectronics, Surface Plasmon detection – NSOM/SNOM

Text Books:

1. Electromechanical Sensors and Actuators, Ilene J. Busch-Vishniac, Springer, 2008.
2. Introduction to Microelectronics Fabrication, Vol. V, G. W. Neudeck and R. F. Pierret (eds.), Addison – Wesley, 1988.
3. Introduction to Microelectromechanical Microwave Systems, H. J. De Loss Santos, 2nd edition, Norwood, MA: Artech, 2004.
4. Microsystems Design, S. D. Senturia, Kluwer – Academic Publishers, Boston MA, 2001.
5. Principles and Applications of Nano-MEMS Physics, H. J. Delos Santos, Springer, 2008.
6. Materials and Process Integration for MEMS Microsystems, Vol. 9, Francis E. H. Tay, Springer, 2002.

Reference Books:

1. Quantum Mechanical Tunneling and its Applications, D. K. Roy, World Scientific, Singapore, 1986
2. Encyclopedia of Nanoscience and Technology, Vol. 5, H. S. Nalwa (ed.), American scientific Publishers, 2004
3. Carbon Nanotubes and Related Structures, P. J. F. Harris, Cambridge University Press, UK, 1986.
4. Carbon Nanoforms and Applications, M Sharon and M. Sharon, Mc Graw Hill, 2010
5. VLSI Technology, S. M. Sze (eds.), Mc-Graw Hill, NY, 1983
6. Quantum Phenomena, S. Datta, Addison – Wesley, 1989.

INDUSTRIAL AUTOMATION

Course Code: 13MT631 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Automation: Introduction, automation principles and strategies, basic elements of advanced functions, levels modeling of manufacturing systems.

Material handling: Introduction, material handling systems, principles and design, material transport system: transfer mechanisms automated feed cut of components, performance analysis, uses of various types of handling systems including AGV and its various guiding technologies.

Storage system: Performance, location strategies, conventional storage methods and equipments, automated storage systems.

Automated manufacturing systems: Components, classification, overview, group technology and cellular manufacturing, parts classification and coding, product flow analysis, cellular manufacturing, application considerations in G.T.

FMS: Introduction, components, application, benefits, planning and implementation, transfer lines and fundamentals of automated production lines, application, analysis of transfer line without internal storage (numerical problems).

Inspection Technology: Introduction, contact and non-contact conventional measuring, gauging technique, CMM, surface measurement, machine vision, other optical inspection techniques, non-contact non-optical inspection technologies versus.

Manufacturing support system: Process planning and concurrent engineering- process planning, CAPP, CE and design for manufacturing, advanced manufacturing planning, production planning and control system, master production schedule, MRP.

Capacity planning, shop floor control, inventory control, MRP-II, J.I.T production systems. lean and agile manufacturing.

Text Books:
1. M.P. Groover, Automation, "Production Systems and Computer Integrated manufacturing", 2nd Edition, Pearson Education (2004).

Reference Text Books:
1. Vajpayee, "Principles of CIM", PHI, 1992.
2. Viswanathan and Narahari, "Performance Modeling of Automated Manufacturing Systems", PHI, 2000.
3. R.S. Pressman, "Numerical Control and CAM, John Wiley , 1993.

ROBOTICS: ADVANCED CONCEPTS AND ANALYSIS

Course Code: 13MT601 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Robotics: Advanced Concepts and Analysis

Introduction to robotics: brief history, types, classification and usage and the science and technology of robots.

Kinematics of robot: direct and inverse kinematics problems and workspace, inverse kinematics solution for the general 6R manipulator, redundant and over-constrained manipulators. **Velocity and static analysis of manipulators:** Linear and angular velocity, Jacobian of manipulators, singularity, static analysis.

Dynamics of manipulators: formulation of equations of motion, recursive dynamics, and generation of symbolic equations of motion by a computer simulations of robots using software and commercially available packages.

Planning and control: Trajectory planning, position control, force control, hybrid control Industrial and medical robotics: application in manufacturing processes, e.g. casting, welding, painting, machining, heat treatment and nuclear power stations, etc; medical robots: image guided surgical robots, radiotherapy, cancer treatment, etc;

Advanced topics in robotics: Modelling and control of flexible manipulators, wheeled mobile robots, bipeds, etc. Future of robotics.

Reference Books

- M. P. Groover, M. Weiss, R. N. Nagel and N. G. Odrey, "Industrial Robotics-Technology, Programming and Applications", McGraw-Hill Book and Company (1986).
- S. K. Saha, "Introduction to Robotics", Tata McGraw-Hill Publishing Company Ltd. (2008).
- S. B. Niku, "Introduction to Robotics–Analysis Systems, Applications", Pearson Education (2001).
- . A. Ghosal, Robotics: "Fundamental Concepts and Analysis", Oxford University Press (2008).
- Pires, "Industrial Robot Programming–Building Application for the Factories of the Future", Springer (2007).
- Peters, "Image Guided Interventions – Technology and Applications", Springer (2008).
- K. S. Fu, R. C. Gonzalez and C.S.G. Lee, "ROBOTICS: Control, Sensing, Vision and Intelligence", McGraw-Hill (1987).
- J. J. Craig, "Introduction to Robotics: Mechanics and Control", 2nd edition, Addison-Wesley (1989).

CONTROL OF MECHATRONIC SYSTEM

Course Code: 13MT602 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Control of Mechatronic Systems

Time response design: Routh-Hurwitz test, relative stability, Root locus design, construction of root loci, phase lead and phase-lag design, lag-lead design.

Frequency response design: Bode, polar, Nyquist, Nichols plot, lag, lead, lag-lead compensator, time delay, process plant response curve. PID controller design.

Modern control: Concept of states, state space model, different form, controllability, observability; pole placement by state feedback, observer design, Lunenburg observer, reduced order observer, observer based control.

Optimal control design: Solution-time criterion, control-area criterion, performance indices; zero steady state step error systems; modern control performance index: quadratic performance index, Ricatti equation.

Digital control: Sampling process, sample and hold, analog to digital converter, use of z-transform for closed loop transient response, stability analysis using bilinear transform and Jury method, digital control design using state feedback.

Non-Linear Control System: Common physical non-linear system, phase plane method, system analysis by phase plane method, stability of non-linear system, stability analysis by describing function method, Liapunov's stability criterion, Popov's stability criterion.

Text Books:

- K. Ogata, "Modern Control Engineering", Prentice Hall India (2002).
- Gene F. Franklin, J. D. Powell, A E Naeini, "Feedback Control of Dynamic Systems", Pearson (2008).
- John Van De Vegte, "Feedback Control Systems", Prentice Hall (1993).
- Thomas Kailath, "Linear Systems", Prentice Hall (1980).
- Alok Sinha, "Linear Systems: Optimal and Robust Control", Taylor & Francis (2007).
- Brian D. O. Anderson and John B. Moore, "Optimal Control: Linear Quadratic Methods", Dover Publications (2007).
- K. Ogata, "Discrete-Time Control Systems", PHI Learning (2009).
- H.K. Khalil, "Nonlinear Systems", Prentice Hall (2001).

PRECISION ENGINEERING

Course Code: 13MT604 **L-T-P:3-1-0**

Prerequisite: **Credits: 3**

Syllabus

Precision Engineering

Concept of Accuracy and Accuracy of NC Systems:
Introduction-General concept of accuracy of machine tool-spindle rotation accuracy-Displacement accuracy-Influence of Geometric Accuracy of Machine Tools on Work piece Accuracy-Definition of Accuracy of NC system-Errors due to Numerical Interpolation-Errors due to displacement measurement system-Periodic errors-Errors due to velocity Lags-Transient Response.

Geometric Dimensioning and Tolerancing:
Tolerance Zone Conversions – Surfaces, Features, Features of Size, Datum Features – Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datums –Datum Feature of Representation – Form Controls, Orientation Controls – Logical Approach to Tolerancing.

Tolerances and Fits:
Sign convention-Tolerance zone-Fits-Basic Hole System of fits-Standards of Limits and Fits-Expected accuracy of a manufacturing process-Commonly used classification of types of fits-Tolerances and Fits for bearings-Methods of specifying Fits on splined shafts and holes-Selective assembly-Gauges for the control of distances between axes.

Surface Roughness and Micro finishing Processes:
Relation among the various indices of surface roughness-Ideal and Final Roughness in Machining-Influence of machining parameters on surface roughness-Ideal surface roughness in slab milling-Bearing area curves-Micro finishing processes in the machining of metals.

Methods of Improving accuracy and surface finish:
Concept of precision Machining-Finish Turning, Boring and Grinding-Precision Cylindrical Grinding-Internal Cylindrical Grinding-Errors in shape of surface grinding

Applications and Future Trends in Nano Technology:
Nano-grating system-Nanolithography, photolithography, electron beam lithography- Machining of soft metals, diamond turning, mirror grinding of ceramics-Devlopment of intelligent products-Nano processing of materials for super high density Ics-Nano-mechanical parts and micromachines.

TEXT BOOKS:

1. Precision Engineering in Manufacturing / murthy R. L., / New Age International(P)
2. limited,1996.
3. Geometric Dimensioning and Tolerancing / James D.Meadows / Marcel Dekker
4. Inc.1995.
5. Norio Taniguchi,- " Nano Technology ", Oxford university,Press,1996.

REFERENCE BOOKS:

1. Precision Engineering- V. C. Venkatesh, & Sudin Izman/ Tata McGraw-Hill

COMPUTATIONAL FLUID DYNAMICS

Course Code: 13MT501 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Elective Courses (Elective I)

Computational Fluid Dynamics

Concept of Computational Fluid Dynamics: Different techniques of solving fluid dynamics problems, their merits and demerits, governing equations of fluid dynamics and boundary conditions, classification of partial differential equations and their physical behavior, Navier-Stokes equations for Newtonian fluid flow, computational fluid dynamics (CFD) techniques, different steps in CFD techniques, criteria and essentialities of good CFD techniques.

Finite Difference Method (FDM): Application of FDM to model problems, steady and unsteady problems, implicit and explicit approaches, errors and stability analysis, direct and iterative solvers. Finite Volume Method (FVM): FVM for diffusion, convection-diffusion problem, different discretization schemes, FVM for unsteady problems.

Prediction of Viscous Flows: Pressure Poisson and pressure correction methods for solving Navier-Stokes equation, SIMPLE family FVM for solving Navier-Stokes equation, modelling turbulence.

CFD for Complex Geometry: Structured and unstructured, uniform and non-uniform grids, different techniques of grid generations, curvilinear grid and transformed equations.

Lattice Boltzman and Molecular Dynamics: Boltzman equation, Lattice Boltzman equation, Lattice Boltzman methods for turbulence and multiphase flows, Molecular interaction, potential and force calculation, introduction to Molecular Dynamics algorithms.

Text Book/ Reference Books:

- J. D. Anderson, "Computational Fluid Dynamics", McGraw-Hill Inc. (1995).
- S. V. Patankar, "Numerical Heat Transfer and Fluid Flow", Hemisphere Pub. (1980).
- K. Muralidhar, and T. Sundarajan, "Computational Fluid Flow and Heat Transfer", Narosa (2003).
- D. A. Anderson, J. C. Tannehill and R. H. Pletcher, "Computational Fluid Mechanics and Heat Transfer", Hemisphere Pub. (1984).
- M. Peric and J. H. Ferziger, "Computational Methods for Fluid Dynamics", Springer (2001).
- H. K. Versteeg and W. Malalaskera, "An Introduction to Computational Fluid Dynamics", Dorling Kindersley (India) Pvt. Ltd. (2008).
- C. Hirsch, "Numerical Computation of Internal and External Flows", Butterworth-Heinemann, (2007).
- J. M. Jaile, "Molecular Dynamics Simulation: Elementary Methods", Willey Professional, 1997.
- A. A. Mohamad, "Lattice Boltzman Method: Fundamentals and Engineering Applications with Computer Codes", Springer (2011)

FUZZY SETS AND ARTIFICIAL INTELLIGENCE

Course Code: 13MT636 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Basic Concepts of Fuzzy Sets, Fuzzy Logic, Zadeh's Extension Principle, Operations on Fuzzy Sets, Fuzzy Measures, Probability and Possibility Measures, Fuzzy Inference Methodologies, Fuzzy Relations, Applications of Fuzzy Sets in Management, Decision Making, Medicine and Computer Science.

Introduction to Artificial Intelligence, Production System and Artificial Intelligence, Problem Solving by Search, Predicate Calculus, Knowledge Representation, Semantics Nets, Frames, Conceptual Dependencies, Knowledge Bases and Expert Systems, Fuzzy Rule, Neuro Fuzzy Approaches, Case Studies in Various Domain.

Text Books:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2nd Ed, Prentice Hall, 2003.
2. H.J.Zimmermann, Fuzzy Set Theory and Its Applications, 2nd Ed., Kluwer Academic Publishers, 1996.
3. D.Dubois and H. Prade, Fuzzy Sets and Systems: Theory and Applications, Academic Press, 1980.

Reference Text Books:

1. E. Charniak and D. McDermott, Introduction to Artificial Intelligence, Addison-Wesley, 1985.
2. E. Rich, Artificial Intelligence, McGraw-Hill, 1983.
3. P. H. Winston, Artificial Intelligence, Addison Wesley, 1993.
4. J.Yen and R.Langari, Fuzzy Logic Intelligence, Control, and Information, Pearson Education, 2005.
5. T.J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.
6. J.Kacprzyk, Multistage Fuzzy Control, Wiley, 1997.

M.TECH (TE)

S.No	**Course Code**	**Course Title**	**L-T-P**	**Credits**
		SEMESTER -1		
1	13TE501	NUMERICAL METHODS IN THERMAL ENGINEERING	3-1-0	4
2	13TE502	ADVANCED THERMODYNAMICS	3-1-0	4
3	13TE503	DESIGN OF THERMAL SYSTEMS	3-1-0	4
4	13TE504	ADVANCED HEAT AND MASS TRANSFER	3-1-0	4
5	13TE531	HEAT EXCHANGER DESIGN	3-0-0	3
6	13TE542	IC ENGINE COMBUSTION AND POLLUTION	3-0-0	3
7	13TE551	SEMINAR	0-0-4	2
8				
		SEMESTER -2		
1	13TE601	INCOMPRESSIBLE AND COMPRESSIBLE FLOWS	3-1-0	4
2	13TE602	COMPUTATIONAL FLUID DYNAMICS	3-1-0	4
3	13TE603	REFRIGERATION AND CRYOGENICS	3-1-0	4
4	13TE604	MEASUREMENTS IN THERMAL ENGINEERING	3-1-0	4
5	13TE632	GAS TURBINE ENGINEERING	3-0-0	3
6	13TE612	RENEWABLE ENERGY TECHNOLOGY	3-0-0	3
7	13TE651	TERM PAPER	0-0-4	2
8				
		SEMESTER -3,4		
	TE	THESIS/PROJECT		36

NUMERICAL METHODS IN THERMAL ENGINEERING

Course Code: 13TE501 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Mathematical Description of the Physical Phenomena: Governing equations—mass, momentum, energy, species, General form of the scalar transport equation, Elliptic, parabolic and hyperbolic equations, Behavior of the scalar transport equation with respect to these equation type; **Discretization Methods:** Methods for deriving discretization equations-finite difference, finite volume and finite element method, Method for solving discretization equations, Consistency, stability and convergence; **Diffusion Equation:** 1D-2D steady diffusion, Source terms, non-linearity, Boundary conditions, interface diffusion coefficient, Under-relaxation, Solution of linear equations (preliminary), Unsteady diffusion, Explicit, Implicit and Crank-Nicolson scheme, Two dimensional conduction, Accuracy, stability and convergence revisited; **Convection and Diffusion:** Steady one-dimensional convection and diffusion, Upwind, exponential, hybrid, power, QUICK scheme,Two-dimensional convection-diffusion, Accuracy of Upwind scheme; false diffusion and dispersion, Boundary conditions; **Flow Field Calculation:** Incompressibility issues and pressure-velocity coupling, Primitive variable versus other methods, Vorticity-stream function formulation, Staggered grid, SIMPLE family of algorithms; **Numerical Methods for Radiation:** Radiation exchange in enclosures composed of diffuse gray surfaces, Finite volume method for radiation, Coupled radiation-conduction for participating media

Text Books:

1. Numerical heat transfer and fluid flow, S. V. Patankar, Hemisphere publishing company (1980)
2. Computational Fluid Mechanics and Heat Transfer, J. C. Anderson, D. A. Tanehil and R. H. Pletcher, Taylor & Francis publications, USA (1997)

Reference Books:

1. Advances in numerical heat transfer, (Eds.) W. J. Minkowycz, E. M. Sparrow, Taylor & Francis publications (1997)
2. Heat Transfer - Mathematical Modelling, Numerical Methods and Information Technology, (Ed.) A. Belmiloudi, InTech Publications (2011)
3. Numerical heat transfer by T. M. Shih, Hemisphere publications company (1984)
4. Numerical methods in thermal problems: Proceedings of seventh international conference held in Staford, USA, Volumes 1-2, (Eds.) K. Morgan (1991)
5. Computational Heat Transfer, Mathematical Modelling, A. A. Samarskii, P. N. Vabishchevich, John Wiley & Sons (1995)
6. Hand book of numerical heat transfer, W. J. Minkowycz, E. M. Sparrow, G. E. Schneider, R. H. Pletcher, Wiley publishers (2001)

ADVANCED THERMODYNAMICS

Course Code: 13TE502 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Review of first and second law of thermodynamics, Maxwell equations, Joule-Thompson experiment, irreversibility and availability, exergy analysis, phase transition, types of equilibrium and stability, multi-component and multi-phase systems, equations of state, chemical thermodynamics, combustion. Third law of thermodynamics, Kinetic theory of gases-introduction, basic assumption, molecular flux, equation of state for an ideal gas, collisions with a moving wall, principle of equi-partition of energy, classical theory of specific heat capacity. Transport phenomena-intermolecular forces, The Vander Waals equation of state, collision cross section, mean free path, Statistical thermodynamics- introduction, energy states and energy levels, macro and micro-scales, thermodynamic probability, Bose-Einstein, Fermi-Dirac, Maxwell-Boltzmann statistics, distribution function, partition energy, statistical interpretation of entropy, application of statistics to gases-mono-atomic ideal gas.

Text Books:

1. Advanced Engineering Thermodynamics, A. Bejan, Wiley and sons, (2006)
2. Thermodynamics, J. P. Holman, McGraw-Hill Inc., (1998)

Reference Books:

1. Advanced Thermodynamics for Engineers, Kenneth Wark, McGraw-Hill
2. Thermodynamics, Kinetic theory, and Statistical thermodynamics, F. W. Sears, and G. L. Salinger, Narosa Publishing House (1998)
3. Fundamentals of Engineering thermodynamics, M. J. Moron, and H. N. Shapiro, John Wiley& Sons
4. Heat and thermodynamics, M. W. Zemansky, and R. H. Dittman, Mc_Graw Hill International (2007)

DESIGN OF THERMAL SYSTEMS

Course Code: 13TE502 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

Modeling of Thermal Systems: types of models, mathematical modeling, curve fitting, linear algebraic systems, numerical model for a system, system simulation, methods for numerical simulation; Acceptable Design of a Thermal System: initial design, design strategies, design of systems from different application areas, additional considerations for large practical systems; Economic Considerations: calculation of interest, worth of money as a function of time, series of payments, raising capital, taxes, economic factor in design, application to thermal systems; Problem Formulation for Optimization: optimization methods, optimization of thermal systems, practical aspects in optimal design, Lagrange multipliers, optimization of constrained and unconstrained problems, applicability to thermal systems; search methods: single-variable problem, multivariable constrained optimization, examples of thermal systems; geometric, linear, and dynamic programming and other methods for optimization, knowledge-based design and additional considerations, professional ethics. Optimization, Objective function formulation, Constraint equations, Mathematical formulation, Calculus method, Dynamic programming, Geometric programming, linear programming methods, solution procedures. Equation fitting, Empirical equation, best fit method, method of least squares. Modeling of thermal equipments such as turbines, compressors, pumps, heat exchangers, evaporators and condensers

Text Books:

1. W.F. Stoecker, Design of Thermal Systems - McGraw-Hill
2. Y. Jaluria, Design and Optimization of Thermal Systems –CRC Press

Reference Books:

1. Bejan, G. Tsatsaronis, M.J. Moran, Thermal Design and Optimization – Wiley.
2. R. F. Boehm, Developments in the Design of Thermal Systems – Cambridge University Press.
3. N.V. Suryanarayana, Design & Simulation of Thermal Systems – MGH.

ADVANCED HEAT AND MASS TRANSFER

Course Code: 13TE504 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus
Introduction - review of heat transfer Fundamentals - transient conduction and extended surface Heat Transfer, Unsteady heat conduction. Lumped capacity model, awareness of one-dimensional unsteady results (charts; Biot and Fourier numbers), Brief review of Steady Laminar and Turbulent Heat Transfer in External and Internal Flows - Heat Transfer at High Speeds - Unsteady Laminar and Turbulent Forced Convection in Ducts and on Plates - Convection with body forces, Boundary layers and internal flows. Awareness of these configurations, some knowledge of internal flow energy balances, Convection correlations. Finding heat transfer coefficients from Reynolds numbers and Rayleigh numbers, Heat Exchangers. Typical configurations and epsilon-NTU analysis, phase-change heat transfer. General awareness of processes of condensation and boiling in a pure substance, some use of correlations, Quenching of metals, Leidenfrost problem, heat transfer of sprays, jets and films, Radiation basics - Radiation in Enclosures - Gas Radiation - Diffusion and Convective Mass Transfer - Combined Heat and Mass Transfer from Plates and in Pipes.

Text Books:
1. Heat transfer, A. Bejan, John Wiley & Sons (1993)
2. Advanced Heat and Mass Transfer, A. Faghri, Y. Zhang, J. Howell, Global Digital Press (2010)

Reference Books:
1. A Heat Transfer Text Book, J. H. Lienhard iv, and J. H. Lienhard V, Phlogiston Press (2008)
2. Heat and Mass Transfer, H. D. Baehr, and K. Stephan, Springer-Verlag (1998)
3. Heat transfer, F. M. White, Addision-Wesley (1984)
4. Basic heat and mass transfer, K. C. Rolle, Prentice-Hall (2000)
5. Heat Transfer – A practical approach, Y. A. Cengel, Tata McGraw-Hill (2002)

HEAT EXCHANGER DESIGN

Course Code: 13TE531 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus
Heat Exchangers-Introduction, C1assfication, and Selection. Heat Exchanger Thermo-Hydraulic Fundamentals. Heat Exchanger Design. Compact Heat Exchangers. Shell and Tube Heat Exchanger Design. Regenerators. Plate Heat Exchangers and Spiral Plate Heat Exchangers. Heat-Transfer Augmentation. Fouling; Flow-Induced Vibration of Shell and Tube Heat Exchangers. Mechanical Design of Shell and Tube Heat Exchangers. Corrosion; Material Selection and Fabrication. Quality Control and Quality Assurance and Nondestructive Testing. Heat Exchanger Fabrication.

Text Books:
1. Heat Exchanges: Selection, Design and Construction, E. A. Saunders, Longman Scientific and Technical (1988)
2. Fundamentals of Heat Exchanger Design, Ramesh K. Shah, Dusan P. Sekulic, Wiley (2002)

Reference Text Books:
1. Heat Transfer, J. P. Holman, McGraw Hill, New York (1989)
2. Process Heat Transfer, CRC Press, G.F. Hewitt, G.L. Shires, T.R. Bott (1994)
3. Fluid Dynamics and Heat Transfer, J.G. Knudsen and D.L. Katz, McGraw Hill, New York (1958)
4. Heat Exchanger Design Handbook, K. Thulukkanam**,** CRC Press (2013)
5. Heat Exchangers: Selection, Rating and Thermal Design, S. Kakaç and H. Liu, CRC Press (2002)
6. Fluid Mechanics and Transfer Processes, Cambridge University Press, J. M. Kay, and R. M. Nedderman (1985)
7. Heat exchanger design handbook, Hemisphere publishing corp., (1981)

IC ENGINE COMBUSTION AND POLLUTION

Course Code: 13TE542 **L-T-P:3-0-0**
Prerequisite: **Credits: 3**

Syllabus

Role of fuel in engine combustion, selection of fuels, Basic combustion processes for SI and CI engines - Factors affecting combustion in these engines - Combustion chambers - Instrumentation to study the combustion process in engines. Pollution formation in SI and CI engines - Factors affecting emissions - Control measures for evaporative emissions - Thermal reactors and catalytic converters - Engine modifications to reduce emissions - Instrumentation to measure pollutants - Emission standards and testing.

Text Books:

1. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, New York
2. Engineering fundamental of the I.C.Engine – Willard W. Pulkrabek Pub. PHI, India

Reference Books:

1. Fundamentals of I.C. Engines - P.W. Gill, J.H. Smith & Ziurys- IBH & Oxford pub.
2. Internal Combustion Engines –V. Ganesan, Pub.-Tata McGraw-Hill.
3. Internal Combustion Engines & Air pollution- Obert E.F, Pub.-Hopper & Row Pub., New York

INCOMPRESSIBLE AND COMPRESSIBLE FLOWS

Course Code: 13TE601 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

INCOMPRESSIBLE AND COMPRESSIBLE FLUID FLOWS

L-T-P
3-1-0

Definition and properties of Fluids, Fluid as continuum, Langragian and Eulerian description, Velocity and stress field, Fluid statics, Fluid Kinematics, Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum and energy conservation equation, Couette flows, Poiseuille flows, Fully developed flows in non-circular cross-sections, Unsteady flows, Creeping flows, Revisit of fluid kinematics, Stream and Velocity potential function, Circulation, Irrotational vortex, Basic plane potential flows: Uniform stream; Source and Sink; Vortex flow, Doublet, Superposition of basic plane potential flows, Flow past a circular cylinder, Magnus effect; Kutta-Joukowski lift theorem; Concept of lift and drag, Boundary layer equations, Boundary layer thickness, Boundary layer on a flat plate, similarity solutions, Integral form of boundary layer equations, Approximate Methods, Flow separation, Entry flow into a duct, Basic concepts of thermodynamics, governing equations in various forms, concept of Mach number, one dimensional flows and normal shock wave, Rayleigh and Fanno flows, Two dimensional flows and oblique shock waves, θ-B-M relations, understanding of shock interaction and shock reflection with various graphs, Prandtl- Mayer expansion, shock-expansion theory, quasi one dimensional flows, method of characteristics and, unsteady wave motion and introduction to various experimental facilities for these speed ranges.

TEXT BOOKS:

1. Boundary layer theory, H. Schlichting, and K. Gersten, Springer (2000)
2. Elements of gas Dynamics, H. W. Liepmann & A. Roshko, Dover Publications (2002)
3. Viscous fluid flow, F. M. White, Mc-Graw Hill (2005)

REFERENCE BOOKS:

1. Introduction to Fluid Mechanics, E. J. Shaughnessy, I. M. Katz and J. P. Schaffer, Oxford University Press (2004)
2. Compressible fluid flow, M. A. Saad, Prentice Hall (1985)
3. Incompressible flow, R. L. Panton, John Wiley & Sons (2005)
4. Advanced Fluid Mechanics, Som, and Biswas, Tata McGraw Hill (2008)
5. The dynamics and thermodynamics of compressible fluid flow, Vol. 1 & 2, A. H. Shapiro, Ronald Press (1954)

COMPUTAITONAL FLUID DYNAMICS

Course Code: 13TE602 **L-T-P:3-0-2**
Prerequisite: **Credits: 3**

Syllabus

COMPUTATIONAL FLUID DYNAMICS

L-T-P
3-0-2

Introduction: Conservation equation; mass; momentum and energy equations; convective forms of the equations and general description, Classification and Overview of Numerical Methods: Classification into various types of equation; parabolic elliptic and hyperbolic; boundary and initial conditions; over view of numerical methods, Finite Difference Technique: Finite difference methods; different means for formulating finite difference equation; Taylor series expansion, integration over element, local function method; treatment of boundary conditions; boundary layer treatment; variable property; interface and free surface treatment; accuracy of FD method, Finite Volume Technique: Finite volume methods; different types of finite volume grids; approximation of surface and volume integrals; interpolation methods; central, upwind and hybrid formulations and comparison for convection-diffusion problem, Finite Element Methods: Finite element methods; Rayleigh-Ritz, Galerkin and Least square methods; interpolation functions; one and two dimensional elements; applications, Methods of Solution: Solution of finite difference equations; iterative methods; matrix inversion methods; ADI method; operator splitting; fast Fourier transform, Time integration Methods: Single and multilevel methods; predictor-corrector methods; stability analysis; Applications to transient conduction and advection-diffusion problems, Numerical Grid Generation: Numerical grid generation; basic ideas; transformation and mapping, Navier-Stokes Equations: Explicit and implicit methods; SIMPLE type methods; fractional step methods, Turbulence modeling: Reynolds averaged Navier-Stokes equations, RANS modeling, DNS and LES.

TEXT BOOKS:

1. Numerical Computation of Internal and External Flows, C. Hirsch, Vols. I & II, John Wiley & Sons (2004)
2. An Introduction to Computational Fluid Dynamics, H. K. Versteeg & W. Malalasekera, Longman Scientific & Technical (1995)

REFERENCE BOOKS:

1. Computational Fluid Mechanics and Heat Transfer, J. C. Anderson, D. A. Tannehil and R. H. Pletcher, Taylor & Francis publications, USA (1997)
2. Fundamentals of CFD, T. K. Sengupta, Universities Press (2004)
3. Computational Fluid Dynamics, T. J. Chung, Cambridge University Press (2002)
4. Computational Methods for Fluid Dynamics, J. H. Ferziger and M. Peric, Springer (1997)
5. Computational Techniques for Fluid Dynamics, C. A. J. Fletcher, Vols. I & II, Springer-Verlag (1996)

REFRIGERATION AND CRYOGENICS

Course Code: 13TE603 **L-T-P:3-1-0**
Prerequisite: **Credits: 4**

Syllabus

REFRIGERATION AND CRYOGENICS

L-T-P
3-1-0

Review of Basic Thermodynamics, Properties of Cryogenic fluids, First and Second Law approaches to the study of thermodynamic cycles, Isothermal, Adiabatic and Isenthalpic processes. Production of Low Temperatures: Liquefaction systems, ideal, Cascade, Linde Hampson and Claude cycles and their derivatives; Refrigerators: Stirling, Gifford-McMahon cycles and their derivatives. Cryogenic Insulations: Foam, Fibre, powder and Multilayer. Applications of Cryogenics in Industry, Space Technology, Nuclear Technology, Biology and Medicine, Matter at low temperatures: specific heat, thermal conductivity, electrical conductivity, magnetic and mechanical properties; Review of free electron and band theory of solids: Basic properties of Superconductors; out lines of Ginzbarg Landau and Bardeen-Cooper-Schrieffer theories of superconductivity: Super-conducing tunneling phenomena; Introduction to type II superconductivity including flux flow and critical current density: High temperature superconductivity. Properties of liquid ^{4}He and ^{3}He; Production of very low temperatures by Adiabatic demagnetization, dilution refrigeration and nuclear demagnetization and their measurements.

TEXT BOOKS:

1. Refrigeration and Air conditioning, Stoecker, and Jones ()
2. Cryogenics Systems, R. F. Barron, Oxford Univesity Press (1985)
3. Cryogenics: Theory, Processes and Applications, Allyson E. Hayes, Nova Science Pub Incorporated (2010)

REFERENCE BOOKS:

1. Refrigeration and Air Conditioning, Jordan, and Priester, Prentice Hall India ()
2. A text book of Cryogenics, V. V. Kostionk, Discovery publishing house pvt. Ltd. (2003)
3. Principles of Refrigeration by Dossat. , Thomas J. Horan: Books.
4. Heating, Ventilating, Air-Conditioning and Refrigeration by Billy C. Langley, Prentice Hall
5. Haselden, G. G. (1971) *Cryogenic fundamentals* Academic Press, New York

MEASUREMENTS IN THERMAL ENGINEERING

Course Code: 13TE604 **L-T-P: 3-**

Prerequisite: **Credits:3**

MEASUREMENTS IN THERMAL ENGINEERING

L-T-P
3-1-0

Introduction to measurements for scientific and engineering applications - need and goal - broad category of methods for measuring field and derived quantities; Principles of measurement - parameter estimation - regression analysis - correlations - error estimation and data presentation - analysis of data; Measurement of field quantities - thermometry - heat flux measurement - measurement of force, pressure, flow rate, velocity, humidity, noise, vibration - measurement of the above by probe and non intrusive techniques; Measurement of derived quantities - torque, power, thermo-physical properties - radiation and surface properties; Analytical methods and pollution monitoring - mass spectrometry - chromatography - spectroscopy.

TEXT BOOKS:

1. Measurement in fluid mechanics, S. Tauvulorais, Cambridge University Press (2009)
2. Experiments and Uncertainty Analysis for Engineers, H.W. Coleman and W.G. Steele Jr., Wiley & Sons, New York, (1989)
3. Fundamentals of temperature, pressure and flow measurement, R. P. Benedict, John Wiley and Sons (2003)

REFERENCE BOOKS:

1. Fluid mechanics and measurements, R. J. Goldstein, Taylor & Francis (1996)
2. Hand book of experimental fluid mechanics, C. Tropea, Y. Alexander, J. F. Foss, Springer (2007)
3. The measurement of turbulent fluctuations, Smolyakov, and Tkachenko, Springer-Verlag (1983)
4. Thermal and flow measurements, T. W. Lee, CRC Press (2008)

GAS TURBINE ENGINEERING

Course Code: 13TE632 — **L-T-P:3-1-0**

Prerequisite: — **Credits: 3**

Syllabus

GAS TURBINE ENGINEERING

L-T-P
3-0-0

Thermodynamics of gas turbines: Cycle analysis; Gas Turbine Components: compressor, combustor, heat exchangers, turbine - description: analytical considerations, performance; Matching of compressor and turbine: cooling of turbine blades. Compressor and turbine impeller construction, blade fixing details, sealing; Material selection for components, Protective coating for hot turbine parts, Components fabrication techniques, Gas turbine turbocharger, gas turbine power generation, turbo expander, gas turbine application, Closed cycle gas turbines, Co-generation - Introduction, Thermodynamics of co-generation, Criteria for component performance, Some practical schemes.

TEXT BOOKS:

1. Elements of gas turbine technology, J. D. Mattingly, Tata McGrawHill (2005)
2. Gas turbine theory, Cohen, Rogers, Saravanamutto, Pearson education (2001)

REFERENCE BOOKS:

1. Ahmed F. El-Sayed; Aircraft Propulsion and Gas Turbine Engines; CRC press, 2008.
2. Turbine, Compressors and Fans by S.M.Yahya, TMH

RENEWABLE ENERGY TECHNOLOGY

Course Code: 13TE612 **L-T-P:3-0-0**

Prerequisite: **Credits: 3**

Syllabus

RENEWABLE ENERGY TECHNOLOGY

L-T-P
3-0-0

Sources: Renewable Energy Sources in India - Potential sites, availability. Solar Energy: Measurement and collection, flat plate collectors, concentrating collectors, solar ponds, photovoltaic conversion, Thermal energy storage. Ocean Energy: Principles of OTEC; wave energy, tidal energy, energy conversion systems. Wind Energy: Principle, potential and status; Wind Characteristics; National Wind Atlas; Theory of wind turbine blades; Types of wind turbines and their characteristics. Biofuels: Sources and potential, properties and characterization; Biogas generation through aerobic and anaerobic digestion; Thermochemical methods of biofuel utilization: Combustion and gasification; Status of biofuel technology. Geothermal Energy-Nature, types and utilization. Applications: Applications of renewable energy sources - Typical examples.

TEXT BOOKS

1. Renewable Energy Resources, Twidell & Wier, CRC Press
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.

REFERENCE BOOKS:

1. L.L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990
2. Renewable energy resources - Tiwari and Ghosal - Narosa.
3. Renewable Energy Technologies - Ramesh & Kumar - Narosa
4. Non-Conventional Energy Systems / K Mittal /Wheeler
5. Renewable energy sources and emerging technologies by D.P.Kothari,K.C.Singhal, P.H.I
6. Non-Conventional EnergySources - G.D.Rai, KhannaPublishers