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CERTIFICATE

This is to certify that the scheme & syllabi of _B. TECH (ECE), 2019-20_ (course name) is duly approved by the competent body/authority and to the best of my knowledge the contents of the same, are correct in all respect.

Chairperson
Deptt. of Electronics Engineering
J.C. Bose University of Science
and Technology, YMCA, Faridaba

Date: _03/02/2021_

Signature & Stamp of Chairperson

Name: _PROF. NEELAM TURK_

Deptt. Name _ELECTRONICS ENGG._
DEPTT.

The Scheme + Syllabus is approved in 12th BOS meeting held online on 16/4/2020.

Neelam
03/02/2021

SCHEME & SYLLABUS

for

B.TECH. COURSE

in

Electronics and Communication Engineering

(w.e.f. Session 2019-20)

DEPARTMENT OF ELECTRONICS ENGINEERING

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

J.C.BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA, FARIDABAD

VISION

J. C. Bose University of Science & Technology, YMCA, Faridabad (erstwhile YMCA University of Science and Technology) aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.

- To provide an enviable research environment and state-of-the-art technological exposure to its scholars.

- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

Department of Electronics Engineering

VISION

To be a Centre of Excellence for producing high quality engineers and scientists capable of providing sustainable solutions to complex problems and promoting cost effective indigenous technology in the area of Electronics, Communication & Control Engineering for Industry, Research Organizations, Academia and all sections of society.

MISSION

- To frame a well-balanced curriculum with an emphasis on basic theoretical knowledge as well the requirements of the industry.

- To motivate students to develop innovative solutions to the existing problems for betterment of the society.

- Collaboration with the industry, research establishments and other academic institutions to bolster the research and development activities.

- To provide infrastructure and financial support for culmination of novel ideas into useful prototypes.

- To promote research in emerging and interdisciplinary areas and act as a facilitator for knowledge generation and dissemination through Research, Institute - Industry and Institute-Institute interaction.

About Electronics Engineering Department

J. C. Bose University of Science & Technology, Faridabad (erstwhile YMCA University of Science & Technology, Faridabad) established in 2009, formerly known as YMCA Institute of Engineering, Faridabad, established in year 1969 as a Joint Venture of Govt. of Haryana and National Council of YMCA of India with active assistance from overseas agencies of West Germany to produce highly practical oriented personnel in specialized field of engineering to meet specific technical manpower requirement of industries. Electronics Engineering Department started in 1969 and has been conducting B.Tech. Courses in Electronics Instrumentation and Control and Electronics and Communication Engineering of 4-Years duration since 1997. Students are admitted through centralized counseling nominated by state govt. in 1st Year and 2nd year through lateral entry entrance test. Besides under graduate degree courses, it is also running M.Tech. Courses in VLSI, Instrumentation and Electronics & Communication. Department of Electronics Engineering is also running Ph.D. Programme. All courses are duly approved by AICTE/ UGC. The Electronics Engineering Department has been well known for its track record of employment of the pass out students since its inception. The Department has good infrastructure consisting of 11 laboratories, 10 Lecture Halls and 1 Conference Room beside 6 workshops. It has excellent faculty with 2 Professors, 4 Associate Professors and 23 Assistant Professors. At present, 8 faculty members are PhD in various specializations. The various syllabi of UG/PG courses have been prepared with active participation from Industry. The Department is organizing number of expert lectures from industry experts for students in every semester. Seven month training is mandatory for every B.Tech. student. Emphasis has been given on project work and workshop for skill enhancement of students. Choice based credit system allows students to study the subjects of his/her choice from a number of elective courses /audit courses.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

1. To prepare students to excel in undergraduate programmes and succeed in industry/ technical profession through global, rigorous education.

2. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.

3. To provide students with foundation in skill development required to design, develop and fabricate engineering products.

4. To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context, additional courses with regard to physical, psychological and career growth.

5. To provide student with an academic environment aware of excellence, outstanding leadership, written ethical codes and guidelines with moral values, and the life-long learning needed for successful professional career.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

1) Engineering knowledge: Apply knowledge of mathematics, science, engineering fundamentals, and Electronics Engineering to the solution of engineering problems.

2) Problem analysis: Identify, formulate, review literature and analyze Electronics Engineering problems to design, conduct experiments, analyze data and interpret data.

3) Design /development of solutions: Design solution for Electronics Engineering problems and design system component of processes that meet the desired needs with appropriate consideration for the public health and safety, and the cultural, societal and the environmental considerations.

4) Conduct investigations of complex problems: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in Electronics Engineering.

5) Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to Electronics Engineering activities with an understanding of the limitations.

6) The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to mechanical engineering practice.

7) Environment and sustainability: Understand the impact of the Electronics Engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.

8) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the Electronics Engineering practice.

9) Individual and team work: Function affectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings in Electronics Engineering.

10) Communication: Communicate effectively on complex engineering activities with the engineering committee and with society at large, such as, being able to comprehend and write affective reports and design documentation, make effective presentations in Electronics Engineering.

11) Project Management and finance: Demonstrate knowledge & understanding of the mechanical engineering principles and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments in Electronics Engineering.

12) Life - long learning: Recognize the need for, and the preparation and ability to engage in independent research and lifelong learning in the broadest contest of technological changes in Electronics Engineering.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. To apply the fundamental and design concepts in the areas of analog & digital circuits, Communication Systems, VLSI and Embedded system.
   (Professional Skill)
2. To pursue higher studies or get placed in Industries and Organizations. (Competitive Skill)

Grading Scheme

Marks %	Grade	Grade points	Category
90-100	O	10	Outstanding
80 ≤ marks <90	A+	9	Excellent
70 ≤ marks < 80	A	8	Very good
60 ≤ marks < 70	B+	7	Good
50 ≤ marks < 60	B	6	Above average
45 ≤ marks < 50	C	5	Average
40 ≤ marks < 45	P	4	Pass
<40	F	0	Fail
	Ab	0	Absent

Percentage calculation= CGPA * 9.5

SEMESTER WISE SUMMARY OF THE PROGRAMME: B.TECH. (ECE)

S.No.	Semester	No. of Contact Hours	Marks	Credits
1	I	26	600	18.5
2	II	25	650	19.5
3	III	31	850	23
4	IV	35	950	27
5	V	29	800	20
6	VI	32	850	24
7	VII	21	600	18
8	VIII	-	500	10
9	MOOCs	-	-	12*
Total		193	5800	172

Note:

1. The scheme will be applicable from Academic Session 2019-20 onwards.

2. ***It is mandatory to pass the MOOC course(s) by all the students as per implementation of credit transfer/ mobility policy of on line courses of the University-as mentioned in Annexure-A at the end of the syllabus.**

Chapter -1

General, Course structure & Theme
&
Semester-wise credit distribution

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits
2 Hours Practical(Lab)/week	1 credit

B. Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
PROJ	Project

C. Category of Courses:

BASIC SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1		Physics	3	1	3	5.5
2		Chemistry	3	1	3	5.5
3		Mathematics –I	3	1	0	4
4		Mathematics –2	3	1	0	4

ENGINEERING SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1		Basic Electrical Engineering	3	1	2	5
2		Engineering Graphics & Design	0	0	4	2
3		Programming for Problem Solving	3	0	4	5
4		Workshop I	0	0	4	2
5		Workshop II	0	0	4	2

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sl. No.	Course Code	Course Title	Hours per week			Credits
			L	T	P	
1		English	2	0	2	3

Chapter -2
Detailed first year curriculum contents

I. **Mandatory Induction program**

[Induction program for students to be offered right at the start of the first year.]

3 weeks duration
• Physical activity
• Creative Arts
• Universal Human Values
• Literary
• Proficiency Modules
• Lectures by Eminent People
• Visits to local Areas
• Familiarization to Dept./Branch & Innovations

B. TECH 1st YEAR ECE (SEMESTER -I)
COURSE STRUCTURE

S.No	Course Code	Course Title	L	T	P	Credits	Sessional	External	Category Code
1	BSC101C	Physics (Waves and Optics)	3	1	-	4	25	75	BSC
2	BSC103 D	Mathematics-I (Calculus and Linear Algebra)	3	1	-	4	25	75	BSC
3	ESC102	Engineering Graphics & Design	-	-	4	2	30	70	ESC
4	ESC103	Programming for Problem solving	3	-	-	3	25	75	ESC
5	ESC104	Workshop- I	-	-	4	2	30	70	ESC
6	BSC104C	Physics (Waves and Optics) lab	-	-	3	1.5	15	35	BSC
7	ESC105	Programming for Problem solving Lab	-	-	4	2	15	35	ESC
	TOTAL		9	2	15	18.5	165	435	

B. TECH 1st YEAR ECE (SEMESTER -II)
COURSE STRUCTURE

S.No.	Course Code	Course Title	L	T	P	Credits	Sessional	External	Category Code
1	BSC106 D	**Mathematics-II** (Calculus, Ordinary Differential Equations and Complex Variable)	3	1	-	4	25	75	BSC
2	ESC101 ESC101A*	Basic Electrical Engineering *Basic Electrical Technology	3	1	-	4	25	75	AECC
3	BSC 102	Chemistry	3	1	-	4	25	75	BEC
4	ESC106	Workshop- II	-	-	4	2	30	70	BEC
5	HSMC101	English	2	-	-	2	25	75	BEC
6	ESC107/ ESC107A*	Basic Electrical Technology Lab	-	-	2	1	15	35	BSC
7	BSC 105	Chemistry Lab	-	-	3	1.5	15	35	BEC
8	HSMC102	English Lab	-	-	2	1	15	35	BEC
	TOTAL		**11**	**3**	**11**	**19.5**	**175**	**475**	

*Applicable from session 2020-21 onwards

Note: Workshop I and Workshop II can be decided for specific branch by the respective Dean/Principal of respective UTD/Institutions.

Note: (a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration
(b) Additional 3 credits per year to be earned through MOOCs

B. TECH 2nd YEAR ECE (SEMESTER -III)
COURSE STRUCTURE

Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Sessional Marks	Final Marks	Total
				L	T	P				
1	PCC	EC301	Electronics Devices	3	0	0	3	25	75	100
2	PCC	EC302	Digital System Design	3	0	0	3	25	75	100
3	PCC	EC304	Network Theory	3	0	0	3	25	75	100
4	ESC	ESC01	Engineering Mechanics	3	1	0	4	25	75	100
5	BSC	BS301	Mathematics-III	3	1	0	4	25	75	100
6	MC	MC01/ MC02	Indian Constitution/ Essence of Indian Traditional Knowledge	2	0	0	0	25	75	100
7	PCC	EC351	Electronics Devices Lab	0	0	2	1	15	35	50
8	PCC	EC352	Digital System Design Lab	0	0	2	1	15	35	50
9	PCC	EC353	Network Theory Lab	0	0	2	1	15	35	50
10	PROJ	ES303	Electronics Project Workshop-I	0	0	6	3	30	70	100
			Total Credits				23	225	625	850

B.TECH 2nd YEAR ECE (SEMESTER -IV)
COURSE STRUCTURE

Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Sessional Marks	Final Marks	Total
				L	T	P				
1	PCC	EC401	Analog and Digital Communication	3	0	0	3	25	75	100
2	PCC	EC402	Analog Circuits	3	0	0	3	25	75	100
3	PCC	ECC03	Microprocessors & Microcontrollers	3	0	0	3	25	75	100
4	PCC	EC404	Computer Architecture	3	0	0	3	25	75	100
5	PCC	ECC01	Signal and Systems	3	0	0	3	25	75	100
6	HSMC	HSMC01	Effective Technical Communication	3	0	0	3	25	75	100
7	BSC	BSC01	Biology	2	1	0	3	25	75	100
8	PCC	EC451	Analog and Digital Communication Lab	0	0	2	1	15	35	50
9	PCC	EC452	Analog Circuits Lab	0	0	2	1	15	35	50
10	PCC	ECC51	Microprocessors & Microcontrollers Lab	0	0	2	1	15	35	50
11	PROJ	ES402	Electronics Project Workshop-II	0	0	6	3	30	70	100
			Total Credits				27	250	700	950

Note: (a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration
(b) Additional 3 credits per year to be earned through MOOCs

B.TECH 3rd YEAR ECE (SEMESTER -V)
COURSE STRUCTURE

Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Sessional Marks	Final Marks	Total
				L	T	P				
1	PCC	ECC02	Electromagnetic Waves	3	0	0	3	25	75	100
2	PCC	EC502	Probability Theory and Stochastic Processes	3	0	0	3	25	75	100
3	PCC	ECC04	Digital Signal Processing	3	0	0	3	25	75	100
4	PEC		Program Elective-I	3	0	0	3	25	75	100
5	MC	MC03	Environmental Sciences	2	0	0	0	25	75	100
6	OEC		OE-1	3	0	0	3	25	75	100
7	PCC	ECC53	Digital Signal Processing Lab	0	0	2	1	15	35	50
8	PCC	ECC52	Electromagnetic Waves Lab	0	0	2	1	15	35	50
9	PROJ	ES555	Electronics Project Workshop-III	0	0	6	3	30	70	100
			Total Credits				20	210	590	800

	Course Code	Course Title
Program Elective-I	ECEL501	CMOS Design
	ECEL502	Nano Electronics
	ECEL503	Power Electronics
	ECEL504	Introduction to MEMS

	Course Code	Course Title
Open Elective-I	OEL501	Smart Materials and Systems
	OEL502	Electrical Measurement and Instrumentation
	OEL503	Intelligent Instrumentation
	OEL504	Electromechanical Energy Conversion
	OEL505	Renewable Power Generation Systems

Note: (a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration
(b) Workshop exam will be of 8 hours duration
(c) Additional 3 credits per year to be earned through MOOCs

B.TECH 3rd YEAR ECE (SEMESTER -VI)
COURSE STRUCTURE

Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Sessional Marks	Final Marks	Total
				L	T	P				
1	PCC	EC601	Control System	3	0	0	3	25	75	100
2	PCC	EC602	Computer Network	3	0	0	3	25	75	100
3	PEC		Program Elective-II	3	0	0	3	25	75	100
4	PEC		Program Elective-III	3	0	0	3	25	75	100
5	PEC		Program Elective-IV	3	0	0	3	25	75	100
6	OEC		OE-II	3	0	0	3	25	75	100
7	PCC	EC652	Computer Networks Lab	0	0	2	1	15	35	50
8	PCC	EC653	Electronics Measurement Lab	0	0	2	1	15	35	50
9	PEC	**ECEL655A/ ECEL655B/ ECEL655C	Microwave Lab /Digital Image Processing Lab /SDR Lab	0	0	2	1	15	35	50
9	PROJ	ES654A (ES654-old code)	Electronics Project Workshop-IV	0	0	6	3	30	70	100
			Total Credits				24	225	625	850

	Course Code	Course Title
Program Elective-II	ECEL601	Bio Medical Electronics
	ECEL602	Introduction to Information Theory & Coding (Information Theory & Coding*-old name)
	ECEL603	Speech and Audio Processing
	ECEL604	Scientific Computing
Program Elective-III	ECEL605	Microwave Theory & Techniques
	ECEL606	Digital Image and Video Processing
	ECEL607	Software Defined Radio
Program Elective-IV	ECEL608	Mobile Communication Network
	ECEL609	Introduction to Wireless Sensor Networks (Wireless Sensor Networks*- Old name)
	ECEL610	MIMO Wireless Communication

	Course Name	Old Course Code	Course Title
Open Elective-II	OEL601		Virtual Instruments Design
	OEL602		Data Structure
	OEL603		Cyber Laws and Security
	PEC-ME-461	OEL604*	Study of Quality Management (Quality Management*-Old Name)
	OEL605		Measurement Data Analysis

* Old Name/code

Note: (a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration

(b) Workshop exam will be of 8 hours duration

(c) Additional 3 credits per year to be earned through MOOCs

The Lab relevant to PEC-III should be chosen.

B.TECH 4th YEAR ECE (SEMESTER -VII)
COURSE STRUCTURE
(May be carried out in 8th Semester***)

Sr. No.	Category	Course Code	Course Title	L	T	P	Credits	Sessional Marks	Final Marks	Total
1	PEC		Program Elective-V	3	0	0	3	25	75	100
2	PEC		Program Elective-VI	3	0	0	3	25	75	100
3	PEC		Program Elective-VII	3	0	0	3	25	75	100
4	OEC		OE-III	3	0	0	3	25	75	100
5	OEC		OE-IV	3	0	0	3	25	75	100
6	PROJ	ECP701	Major Project	0	0	2	1	15	35	50
7	ESC	ES751	Electronics Workshop-V	0	0	4	2	15	35	50
			Total Credits				18	155	445	600

	Course Name	Course Title
Program Elective-V	ECEL701	Antenna and Propagation
	ECEL702	High Speed Electronics
	ECEL703	Wavelets
Program Elective-VI	ECEL704	Fiber Optic Communication
	ECEL705	Adaptive Signal Processing
	ECEL706	Mixed Signal Design
Program Elective-VII	ECEL707	Basics of Satellite Communication (Satellite Communication*-Old Name)
	ECEL708	Embedded Systems
	ECEL709	Error Correcting Codes

	Course Code	Old Course Code	Course Title
Open Elective-III	OEC-CS-602-I	OEL701*	Human Resource Management
	OEL702		Introduction to Power Plant Engineering (Power Plant Engineering*- Old Name)
	PEC-CSD-602	OEL703*	Soft Computing
	OEL704		Display Devices
	OEC-CS-701(I)	OEL705*	Financial Management
Open Elective-IV	OEL706		Non Linear Control System
	OEL707		Operational Research
	OEL708		Fundamental of Operating System (Operating System*-Old Name)
	OEL709		Industrial Safety Engineering
	OEL710		Introduction to Cloud Computing (Cloud Computing*-Old Name)

* Old Name/code

Note: (a) Theory exams will be of 03 hours duration and Practical exams will be of 02 hours duration
(b) Workshop exam will be of 8 hours duration

(c) Additional 3 credits per year to be earned through MOOCs

The course contents of 7th Semester may be pursued by the students of UTDs/Departments of Affiliated colleges in 8th semester. In the case of pursuance of internship in 7th semester, the course contents of 7th semester will be taught in 8th semester and vice-versa. The approval of such interchangeability should be requested from the authority before the commencement of 7th semester.

B.TECH 4th YEAR ECE (SEMESTER -VIII)
COURSE STRUCTURE
(May be carried out in 7th semester*)

Sr No.	Course	Title	Teaching Schedule	Examination Schedule (Marks)			Credits
				Annual Exam.	Continuous Assessment	Total	
1	EIP801	Industrial Training	6 Months	350	150	500	10

A) PROCEDURE FOR ANNUAL EXAMINATION AND MARKS.
1. PROJECT EVALUATION   150 MARKS
2. PROJECT SEMINAR   100 MARKS   **350**
3. PROJECT VIVA   100 MARKS

B) CONTINUOUS ASSESSMENT MARKS
1. ASSESSMENT BY INSTITUTE FACULTY   50 MARKS.
2. ASSESSMENT BY INDUSTRIAL GUIDE   50 MARKS.   **150**
3. CONDUCT MARKS   50MARKS.

    TOTAL   **500**

Note: Additional 3 credits per year to be earned through MOOCs

*** The Industry Internship may be pursued by UTDs/Departments of Affiliated colleges in 7th or 8th semester. In the case of pursuance of internship in 7th semester, the course contents of 7th semester will be taught in 8th semester and vice-versa. The approval of such interchangeability should be requested from the authority before the commencement of 7th semester.

Course code	BSC101C (Th)/ BSC104C (Lab)				
Category	Basic Science Course				
Course title	**Physics (Waves and Optics) (Theory & Lab.)**				
Scheme and Credits	**L**	**T**	**P**	**Credit**	Semester-I
	3	**1**	**3**	**5.5**	

(i) Physics (Waves and Optics) ([L : 3; T:1; P : 0 (4 credits)]

Course Objective:

- To acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature.
- To be able to identify and illustrate physical concepts and terminology used in optics and to be able to explain them in appropriate detail.
- To be able to make approximate judgements about optical and other wave phenomena when necessary.
- To acquire skills allowing the student to organise and plan simpler laboratory course experiments and to prepare an associated oral and written report.

Prerequisites:

(i) Mathematics course on Differential equations

Unit 1: Simple harmonic motion, damped and forced simple harmonic oscillator (7) Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator

Unit 2: Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion (7): Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Unit 3: The propagation of light and geometric optics (10): Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method

Unit 4: Wave optics (6): Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

Unit 5: Lasers (8): Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO_2), solid-state lasers(ruby,Neodymium), dye lasers; Properties of laser beams:

monochromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Course Outcome:

- Student will be able to identify and apply formulas of optics and wave physics using course literature.
- Illustration of physical concepts and terminology used in optics and to be able to explain them in appropriate detail.
- To be able to make approximate judgements about optical and other wave phenomena when necessary.
- To acquire skills allowing the student to organise and plan simpler laboratory course experiments and to prepare an associated oral and written report.

Reference books:

(i)   Ian G. Main, Oscillations and waves in physics
(ii)   H.J. Pain, The physics of vibrations and waves
(iii)   E. Hecht, A. Ghatak, Optics
(iv)   O. Svelto, Principles of Lasers

(ii) Physics (Waves & Optics) Lab [L : 0; T:0 ; P : 3 (1.5credits)]

At least 06 experiments from the following

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify $\lambda 2$ –T law.
2. To study Lissajous Figures.
3. Familiarization with: Schuster`s focusing; determination of angle of prism.
4. To determine refractive index of the Material of a prism using sodium source.
5. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
6. To determine the wavelength of sodium source using Michelson's interferometer.
7. To determine wavelength of sodium light using Fresnel's Biprism.
8. To determine wavelength of sodium light using Newton's Rings.
9. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
10. To determine dispersive power and resolving power of a plane diffraction grating.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine angular spread of He-Ne laser using plane diffraction grating

LABORATORY OUTCOMES

On the successful competition of this course, the students should be able to:

- Analyze Lissajous Figures.
- Understand the various physical phenomenon used to determine the wavelength.
- Understand the concept of dispersive power.

Note: Experiments may be added or deleted as per the availability of equipments.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 1511,Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal,1985, V Pub.

Course code	**BSC103D**
Category	Basic Science Course
Course title	**MATHEMATICS 1** **(Calculus and Linear Algebra)**

Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester –I
	3	**1**	**-**	**4**	

Pre-requisites (if any)	**-**

COURSE OBJECTIVES:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the objectives are:

- To introduce the idea of applying differential and integral calculus to notions of curvature and to improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.

- To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.

- To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.

Module 1: Calculus: (6 hours): Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Calculus: (6 hours): Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 3:Sequences and series: (10 hours): Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 4:Multivariable Calculus (Differentiation): (8 hours): Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Module 5:Matrices (10hours): Inverse and rank of a matrix,rank-nullity theorem; System of linear equations; Symmetric, skew- symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Couse Outcome:

- Students were familiarized with functions of several variables that is essential in most branches of engineering.

- Essential tool of matrices and linear algebra in a comprehensive manner developed.

Textbooks/References:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition,Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.
5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course code	ESC 102				
Category	Engineering Science Courses				
Course title	**Engineering Graphics & Design (Theory & Lab.)**				
Scheme and Credits	**L**	**T**	**P**	**Credit**	Semester - I
	0	**0**	**4**	**2**	
Pre-requisites (if any)	-				

Engineering Graphics & Design
[L : 0; T:0; P : 4 (2 credits)]
Course Objectives:

- To Learn about the visual aspects of engineering design.

- To Analyse engineering graphics standards.

- To Prepare orthographic and isometric projection.

- To Draw section of solids and conic sections.

- To Exposure to computer-aided geometric design

Detailed contents
Traditional Engineering Graphics:
Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

Module 1: Introduction to Engineering Drawing covering,

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Module 2: Orthographic Projections covering,

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module 3: Projections of Regular Solids covering,

Those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Module 4: Sections and Sectional Views of Right Angular Solids covering,

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

Module 5: Isometric Projections covering,

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Module 6: Overview of Computer Graphics covering,

listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module 7: Customisation& CAD Drawing

consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually

and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.

Course Outcomes

All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to:

- Learn about the visual aspects of engineering design.

- Analyse engineering graphics standards.

- Prepare orthographic and isometric projection.

- Draw section of solids and conic sections.

- Exposure to computer-aided geometric design

Suggested Text/Reference Books:

i. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House

ii. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

iii. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

iv. Aggarwal M L & Sandhya Dixit (2017), Engineering Graphics and Machine Drawing, Dhanpat Rai & Company P Ltd.

v. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

vi. Corresponding set of) CAD Software Theory and User Manuals

Course code	ESC103(Th)/ESC105(Lab)
Category	Engineering Science Course
Course title	**Programming for Problem Solving (Theory & Lab.)**
Scheme and Credits	L | T | P | Credit | Semester – I/II 3 | 0 | 4 | 5
Pre-requisites (if any)	-

(i) Programming for Problem Solving ([L : 3; T:0; P : 0 (3 credits)] [contact hrs : 40]

Course Objectives
- To formulate simple algorithms for arithmetic and logical problems.
- To translate the algorithms to programs (in C language).
- To test and execute the programs and correct syntax and logical errors.
- To implement conditional branching, iteration and recursion.
- To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

Detailed contents

Unit 1 **Introduction to Programming (4 lectures)** Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - **(1 lecture).**

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. **(1 lecture)**

From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code- **(2 lectures)**

Unit 2: **Arithmetic expressions and precedence (2 lectures)** Conditional Branching and Loops **(6 lectures)** Writing and evaluation of conditionals and consequent branching **(3 lectures)** Iteration and loops **(3 lectures)**

Unit 3 **Arrays (6 lectures)** Arrays (1-D, 2-D), Character arrays and Strings

Unit 4 **Basic Algorithms (6 lectures)** Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Unit 5 **Function (5 lectures)** Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference

Unit 6 **Recursion (4 -5 lectures)** Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 7 **Structure (4 lectures)** Structures, Defining structures and Array of Structures

Unit 8 **Pointers (2 lectures)** Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9 **File handling** (only if time is available, otherwise should be done as part of the lab)

Suggested Text Books
(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books
(ii) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Outcomes
- Use of arrays, pointers and structures to formulate algorithms and programs established.
- Programming application to solve matrix addition and multiplication problems and searching and sorting problems developed.
- Programming solution for simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

(ii)Laboratory - Programming for Problem Solving[L : 0; T:0 ; P : 4 (2credits)]
[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling:
Lab 12: File operations

Laboratory Outcomes

- To formulate the algorithms for simple problems
- To translate given algorithms to a working and correct program
- To be able to correct syntax errors as reported by the compilers
- To be able to identify and correct logical errors encountered at run time

- To be able to write iterative as well as recursive programs
- To be able to represent data in arrays, strings and structures and manipulate them through a program
- To be able to declare pointers of different types and use them in defining self-referential structures.
- To be able to create, read and write to and from simple text files.

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Course code	BSC106D
Category	Basic Science Course
Course title	**Mathematics -II (Calculus, Ordinary Differential Equations and Complex Variable)**

Scheme and Credits	**L**	**T**	**P**	**Credit**	Semester-II
	3	**1**	**0**	**4**	
Pre-requisites (if any)	**-**				

Course objectives:

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines. More precisely, the objectives are:

a. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

b. To introduce effective mathematical tools for the solutions of differential equations that model physical processes.

c. To introduce the tools of differentiation and integration of functions of complex variable that are used in various techniques dealing engineering problems.

Module 1:Multivariable Calculus (Integration): (10 hours) Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities);Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Module 2:First order ordinary differential equations:(6 hours) Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations of higher orders:(8 hours) Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Complex Variable – Differentiation:(8 hours): Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 5: Complex Variable – Integration:(8 hours): Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Course Outcome:

- Students will be able to develop mathematical tools needed in evaluating multiple integrals and their usage.
- Effective mathematical tools for the solutions of differential equations that model physical processes built.
- Differentiation and integration of functions of complex variable will be developed that are used in various techniques dealing engineering problems.

Textbooks/References:
1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
6. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
7. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc- Graw Hill, 2004.
8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010

Course code	ESC 101(Th)/ESC107(Lab)				
Category	Engineering Science Course				
Course title	**Basic Electrical Engineering (Theory & Lab.)**				
Scheme and Credits	**L**	**T**	**P**	**Credit**	Semester –I/II
	3	**1**	**2**	**5**	
Pre-requisites (if any)	**-**				

(i) Basic Electrical Engineering [L : 3; T:1; P : 0 (4 credits)]

Detailed contents :

Module 1 : DC Circuits (8 hours) Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits (8 hours) Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Transformers (6 hours) Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module 4: Electrical Machines (8 hours) Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Module 5: Power Converters (6 hours) DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module 6: Electrical Installations (6 hours) Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Suggested Text / Reference Books
(i) D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
(ii) D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
(iii) L. S. Bobrow, " Fundamentals of Electrical Engineering", Oxford University Press, 2011.
(iv) E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
(v) V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Course Outcomes

- To understand and analyze basic electric and magnetic circuits
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations

(ii) Basic Electrical Engineering Laboratory [L : 0; T:0 ; P : 2 (1 credit)]

List of experiments/demonstrations:

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
- Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Laboratory Outcomes

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.
- Get an exposure to the working of power electronic converters.

Course code	ESC 101A*(Th)/ESC107A*(Lab)				
Category	Engineering Science Course				
Course title	**Basic Electrical Technolgy (Theory & Lab.)**				
Scheme and Credits	**L**	**T**	**P**	**Credit**	Semester –I/II
	3	**1**	**2**	**5**	
Pre-requisites (if any)	**-**				

[ESC101-A] Basic Electrical Technology (Theory) [L : 3; T : 1; P:0, (4 credit)] Course Outcomes:

• • To analyze and solve D. C. networks by different analysis methods and theorems.

• • To formulate and solve complex AC single phase and three circuits

• • To identify the type of electrical machines and their applications

• • To introduce the components of low voltage electrical installations

Module 1: DC Circuits (8 hours)

Basic definitions, Electrical circuit elements (R, L and C), voltage and current sources, Ohm's law and its limitations, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation by mesh analysis and node analysis, Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems.

Module 2: AC Circuits (8 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance.

Module3: Poly Phase Systems (5 hours)

Advantages of 3-phase systems, generation of 3-phase voltages, three phase connections (star and delta), voltage and current relations in star and delta connections, three phase powers, analysis of 3-phase balanced circuits, measurement of 3-phase power- 2 wattmeter method.

Module 4: Transformers (6 hours)

Magnetic Circuits, construction and working of single phase transformer, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency, Auto- transformer

Module 5: Electrical Machines (8 hours)

Induction motor: Construction, principle and working of a three-phase induction motor, Single-phase induction motor: Construction, principle and working, Applications

DC machine: Construction, principle and working of dc motor and generator.

Applications Synchronous machine: Construction, principle and working of synchronous motor and generators. Applications

Module 6: Electrical Installations (6 hours)

Components of LT Switchgear: Fuses, MCB, ELCB, MCCB, Types of Wires, Earthing, Power factor improvement.

TEXT / REFERENCE BOOKS

1.D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010. 2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Online Recourses:

- 1. **NPTL Web Course, Basic Electrical Technology,** Prof. G. D. Roy, Prof. N. K. De, Prof. T.K. Bhattacharya, IIT Kharagpur (https://nptel.ac.in/courses/108/105/108105053/)

- 2. **NPTL Web Course, Electrical Machines-I,** Prof. P. Sasidhara Rao, Prof. G. Sridhara Rao, Dr. Krishna Vasudevan, IIT Madras (https://nptel.ac.in/courses/108/106/108106071/)

- 3. **NPTL Web Course, Electrical Machines-II,** Prof. P. Sasidhara Rao, Prof. G. Sridhara Rao, Dr. Krishna Vasudevan, IIT Madras https://nptel.ac.in/courses/108/106/108106072/

[ESC107-A] Basic Electrical Technology Laboratory [L : 0; T:0 ; P : 2 (1 credit)]
List of experiments/demonstrations:

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- Verification of network theorem in DC circuits, Thevenin's Theorem, Norton's, Theorem, Superposition Theorem etc.
- Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
- Poly phase systems, three phase connections (star and delta), measurement of three phase power
- Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Demonstration of cut-out sections of machines: dc machine (commutator- brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.
- Components of LT switchgear

LABORATORY OUTCOMES

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines

Course code	BSC102(Th)/BSC105(Lab)				
Category	Basic Science Course				
Course title	**Chemistry (Theory & Lab.)** **Contents** (i) Chemistry (Concepts in chemistry for engineering) (ii) Chemistry Laboratory				
Scheme and Credits	L	T	P	Credits	Semester –II
	3	1	3	5.5	
Pre-requisites (if any)	-				

(i)Chemistry (Concepts in chemistry for engineering) [L : 3; T:1; P : 0 (4 credits)]

Detailed contents
(i) Atomic and molecular structure (12 lectures)
    Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

(ii) Spectroscopic techniques and applications (8 lectures)
    Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

(iii) Intermolecular forces and potential energy surfaces (4 lectures)
    Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

(iv) Use of free energy in chemical equilibria (6 lectures)
    Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

(v) Periodic properties (4 Lectures)
    Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

(vi) Stereochemistry (4 lectures)
    Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity,

absolute configurations and conformational analysis. Isomerism in transitional metal compounds

(vii) Organic reactions and synthesis of a drug molecule (4 lectures)
Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Suggested Text Books
1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition

Course Outcomes
The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Quantum theory is more than 100 years old and to understand phenomena at nanometer levels; one has to base the description of all chemical processes at molecular levels. The course will enable the student to:
- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

(ii) Chemistry Laboratory[L : 0; T:0 ; P : 3 (1.5 credits)]
Choice of 10-12 experiments from the following:
- Determination of surface tension and viscosity
- Thin layer chromatography
- Ion exchange column for removal of hardness of water
- Determination of chloride content of water
- Colligative properties using freezing point depression
- Determination of the rate constant of a reaction
- Determination of cell constant and conductance of solutions
- Potentiometry - determination of redox potentials and emfs
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Lattice structures and packing of spheres
- Models of potential energy surfaces
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal
- Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of

minimum viscosity for gelatin sols and/or coagulation of the white part of egg .

Laboratory Outcomes
- The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

Course code	HSMC 101(Th)/HSMC102(Lab)				
Category	Humanities and Social Sciences including Management				
Course title	**English (Theory & Lab.)**				
Scheme and Credits	**L**	**T**	**P**	**Credit**	Semester – II
	2	**0**	**2**	**3**	
Pre-requisites (if any)	-				

English
Detailed contents
1. Vocabulary Building
    The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

2. Basic Writing Skills
    Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

3. Identifying Common Errors in Writing
    Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés

4. Nature and Style of sensible Writing
    Describing, Defining, Classifying, Providing examples or evidence

5. Writing introduction and conclusion

6. Writing Practices
    Comprehension, Précis Writing, Essay Writing

7. Oral Communication
(This unit involves interactive practice sessions in Language Lab)
- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Suggested Readings:
(i) *Practical English Usage.* Michael Swan. OUP. 1995.
(ii) *Remedial English Grammar.* F.T. Wood. acmillan.2007
(iii) *On Writing Well.* William Zinsser. Harper Resource Book. 2001
(iv) *Study Writing.* Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) *Communication Skills.* Sanjay Kumar and PushpLata. Oxford University Press. 2011.
(vi) *Exercises in Spoken English.* Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Course Outcomes
The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course code	ESC 104				
Category	Engineering Science Courses				
Course title	**Workshop-I**				
Scheme and Credits	**L**	**T**	**P**	**Credit**	Semester-I
	-	**0**	**4**	**2**	
Pre-requisites (if any)	**-**				

Workshop-I
PART-A
Computer Engineering Workshop

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1. To study and demonstrate Block diagram of Digital Computer System and brief explanation of each unit.
2. To demonstrate History/ Generation/ classifications and different types of Personnel Computer.To study and demonstrate internal parts of a Computer System (Card level) and other peripheral devices and explanation of POST & BIOS.
3. To study and demonstrate primary memory and secondary memory.
4. To demonstrate CPU Block diagram and other Peripheral chips, Mother Board/ Main Board and its parts, Connectors, Add On Card Slots etc.
5. To study working of various types of monitors: CRT type, LCD type & LED type.
6. To study Keyboard and Mouse: Wired, Wireless, Scroll & Optical with detail working.
7. To study Printers: Dot Matrix Printers, Daisy wheel Printers, Ink-Jet Printers and Laser Jet Printers with detailed working explanation.
8. Assembly / Installation and Maintenance of Personnel Computer Systems: Practical exercise on assembly of Personnel Computer System, Installation of Operating System: Windows & Linux etc, Installation of other Application Softwares and Utility Softwares, Fault finding in Personnel Computers: Software or Hardware wise, Virus: Introduction, its Types & Removal techniques, Data Backup and Restore, Data Recovery Concepts, Typical causes of Data loss.
9. To demonstrate networking concepts: Introduction of Connecting devices: Hub, Switch & Router etc, Networking Cable preparation: Normal & Cross Cables, Data Transferring Techniques from one Computer System to another Computer System, Configuration of Switch/ Routers etc.

PART-B
Electrical Workshop

1. Introduction of Electrical Safety precautions, Electrical Symbols, Electrical Materials, abbreviations commonly used in Electrical Engg. and familiarization with tools used in Electrical Works.
2. To make a Straight Joint & Tee joint on 7/22 PVC wire and Britannia Joint on GI wire.
3. To study fluorescent Tube Light, Sodium Lamp and High Pressure Mercury Vapour Lamp.
4. To study different types of earthing and protection devices e.g. MCBs, ELCBs and fuses.

5. To study different types of domestic and industrial wiring and wire up a circuit used for Stair case and Godown wiring.
6. To make the connection of fan regulator with lamp to study the effect of increasing and decreasing resistance in steps on the lamp.
7. To fabricate half wave and full wave rectifiers with filters on PCB.
8. Maintenance and Repair of Electrical equipment i,e Electric Iron , Electric Toaster ,Water heater, Air coolers and Electric Fans etc.
9. To study soldering process with simple soldering exercises.
10. To make the connection of a three core cable to three pin power plug and connect the other cable end by secured eyes connection using 23/0.0076"or 40/0.0076" cable.

PART- C
Electronics Workshop

1. To study and demonstrate basic electronic components, Diode, Transistor, Resistance, Inductor and capacitor.
2. To study and demonstrate resistance color coding, measurement using color code and multimeter and error calculation considering tolerance of resistance.
3. To study and demonstrate Multimeter and CRO- front panel controls, description of block diagram of CRT and block diagram of CRO.
4. To study and demonstrate Vp(peak voltage),Vpp(peak to peak voltage), Time, frequency and phase using CRO.
5. Introduction to function generator. Functions of front panel controls and measurement of different functions on CRO.
6. To study and demonstrate variable DC regulated power supply, function of controls and DC measurement using multimeter and CRO.
7. Soldering practice on wire mesh or a resistance decade board includes fabrication, soldering, lacing, harnessing forming and observation.
8. Testing of components using multimeter and CRO like diode, transistor, resistance capacitor, Zener diode and LED.
9. To study and demonstrate rectification, half wave, Full wave and bridge rectifier. Fabrication,assembly and waveform observation.
10. To design and fabricate a printed circuit board of a Zener regulated/ series regulated power supply and various measurements, testing of power supply.

Note: At least 8 exercises are to be performed from each part by the students.

Course Outcomes (COs):
After the completion of the course the student will be able to:
CO1- Acquire skills in basic engineering practice.
CO2- Have working knowledge of various equipments used in workshop.
CO3- Have hands on experience about various machines and their components.
CO4- Obtain practical skills of basic operation and working of tools used in the workshop

Course code	ESC 106	
Category	Engineering Science Courses	
Course title	**Workshop-II**	

Scheme and Credits	L	T	P	Credit	Semester-II
	-	0	4	2	

Pre-requisites (if any)	-

MECHANICAL WORKSHOP

Course Outcomes (COs): After studying this course the students would:
CO 1- Have exposure to mechanical workshop layout and safety aspects.
CO 2- Understand the functions of various machines and cutting tools used in machine shop.
CO 3- Practice real time job preparation using various operations related to machine shop such as filing, drilling, milling & turning.
CO 4 - Practice job preparation in welding shop.
CO 5 - Learn to use different measuring tools like vernier caliper, vernier height gauge and micrometer.
CO 6 - Practice job preparation in sheet metal shop.
List of Exercises:
Fitting, sheet metal and welding workshop:
1. To study layout, safety measures and different engineering materials (mild steel, medium carbon steel, high carbon steel, high speed steel and cast iron etc) used in workshop.
2. To study and use of different types of tools, equipments, devices & machines used in fitting, sheet metal and welding section.
3. To determine the least count of vernier calliper, vernier height gauge, micrometer and take different reading over given metallic pieces using these instruments.
4. To study and demonstrate the parts, specifications & operations performed on lathe machine.
5. To study and demonstrate the parts, specifications & operations performed on milling machine.
6. To study and demonstrate the parts, specifications & operations performed on shaper machine.
7. To prepare a job involving different type of filing practice exercise in specified dimensions.
8. To prepare a job involving multi operational exercise (drilling, counter sinking, tapping, reaming, hack sawing etc.)
9. To prepare a multi operational sheet metal job (self secured single groove joint/ hasp & stay etc.).
10. To practice striking an arc, straight short bead, straight continuous bead and restart of electrode in flat position by arc welding on given M.S. plate as per size.
11. To practice tack weld of two close plate in flat position by arc welding on given M.S. plate as per size.
12. To practice close butt joint in flat position by arc welding on given M.S. plate as per size.

NOTE: - At least nine exercises should be performed from the above list; remaining three may either be performed from above list or designed by the concerned institution as per the scope of the syllabus and facilities available in institute.

EC301   **Electronics Devices**

L T P CR   Theory   :   75
3 0 0 3   Class Work   :   25
                                                    Total   :   100
                                                    Duration of Exam.   :   3 Hrs.

Course Objects:
- To give exposure to students about Semiconductor Physics.
- To give the exposure about characteristics of semiconductor devices.
- To introduce the working of different semiconductor electronics devices.
- To introduce about the fabrication technologies of semiconductor electronics devices.

Syllabus

Unit 1: Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon: Carrier transport: diffusion current, drift current, mobility and resistivity, sheet resistance, design of resistors

Unit 2: Generation and recombination of carriers, Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models: Avalanche breakdown, Zener diode, Schottky diode

Unit 3: Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell

Unit 4: Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the principles of semiconductor Physics.
- Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.
- Understand the design & characteristics of semiconductor device.
- Understand various semiconductor, fabrication process.

Text /Reference Books:
1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.
2. D. Neamen, D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

EC302   **Digital System Design**
L T P CR   Theory   :   75
3 0 0 3   Class Work   :   25
                                                              Total   :   100
                                                     Duration of Exam   :   3 Hrs.

Course Objectives:
- To introduce the fundamentals of digital electronics.
- To familiar the students about the design and analyze various combinational circuits.
- To give exposure to the students about design and analyze various sequential circuits.
- To introduce logic families & semiconductor memories.
- To introduce the basic knowledge of HDL & their ways of implementation.

Syllabus

Unit 1: Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

Unit 2: MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

Unit 3: Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation

Unit 4: Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices.

Unit 5: VLSI Design flow: Design entry, Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Course outcomes: On successful completion of this course, the students should be able to:
A. Design and analyze combinational logic circuits.
B. Acquire basic knowledge of digital logic families & semiconductor memories.
C. Design & analyze synchronous sequential logic circuits.
D. Use HDL & appropriate EDA tools for digital logic design and simulation.

Text/Reference Books:
1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989.
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

EC304   **Network Theory**

L T P CR   **Theory**   :   **75**
3 0 0 3   **Class Work**   :   **25**
                                                                Total   :   **100**
                                                                Duration of Exam : **3 Hrs.**

Course Objectives:
- To introduce students about basic electrical circuits with nodal & mesh analysis.
- To give exposure to the students about various network theorem applicable to AC & DC circuits.
- To introduce the application of Laplace & Fourier behavior.
- To introduce students about synthesis and analysis of electrical network.
- To introduce students about transient analysis, two port of network and various types of filters.

Syllabus

Unit 1: Node and Mesh Analysis, matrix approach of network containing voltage and current sources, and reactances, source transformation and duality. Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC, circuits. Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.

Unit 2: Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.

Unit 3: Transient behavior, concept of complex frequency, Driving points and transfer functions poles and zeros of admittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and Two four port network and interconnections, Behaviors of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand basics electrical circuits with nodal and mesh analysis.
- Appreciate electrical network theorems.
- Apply Laplace Transform for steady state and transient analysis.
- Determine different network functions.
- Appreciate the frequency domain techniques.

Text/Reference Books
1. Van, Valkenburg; "Network analysis"; Prentice hall of India, 2000.
2. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 1994.
3. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education.

ESC01   **Engineering Mechanics**
L T P CR   Theory   :   75
3 1 0 4   Class Work   :   25
                                                                 Total   : 100
                                                      Duration of Exam   :   3 Hrs.

Course Objective:-
- To provide an introductory treatment of Engineering
- To give a working knowledge of statics with emphasis on force equilibrium and free body diagrams.
- To provide an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems.
- To give an understanding of the mechanical behavior of materials under various load conditions

Syllabus

Unit 1: Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy

Unit 2: Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.

Unit 3: Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

Unit 4: Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Unit 5: Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

Unit 6: Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique).

Unit 7:Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

Unit 8:Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums; Tutorialsfrom the above **Unit**s covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack

Course Outcomes: On successful completion of this course, the students should be able to:
- Use scalar and vector analytical techniques for analyzing forces in statically determinate structures
- Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems
- Apply basic knowledge of maths and physics to solve real-world problems, Understand measurement error, and propagation of error in processed data.
- Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts);
- Understand basic dynamics concepts – force, momentum, work and energy; Understand and be able to apply Newton's laws of motion;
- Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficient of restitution;
- Extend all of concepts of linear kinetics to systems in general plane motion (applying Euler's Equation and considering energy of a system in general plane motion, and the work of couples and moments of forces)
- Learn to solve dynamics problems. Appraise given information and determine which concepts apply, and choose an appropriate solution strategy; and Attain an introduction to basic machine parts such as pulleys and mass-spring systems.

Text/Reference Books:
1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

BS301   **Mathematics-III**

L T P CR	Theory	:	75
3 1 0 4	Class Work	:	25
	Total	:	100
	Duration of Exam	:	3 Hrs.

COURSE OBJECTIVES:
To gain knowledge about: Laplace Transform, Fourier Transform, Z- transform and Numerical Methods.

Unit 1: Transform Calculus-1: Polynomials – Orthogonal Polynomials – Lagrange's, Chebysev Polynomials; Trigonometric Polynomials. Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.

Unit 2: Transform Calculus-2: Fourier transforms, Z-transform : Properties, methods, inverses and their applications.

Unit 3: Vector differentiation, gradient, divergence and curl, line and surface integrals, path independence, statements and illustrations of theorems of Green, Stokes and Gauss, arc length parameterization, applications.

Course Outcome:

- To understand Laplace Transform and its applications
- To understand Fourier Transform, Z Transform and their applications
- To solve the curl, gradient and divergence
- To apply the applications curl, gradient and divergence in various theorems in various applications

Textbooks/References
1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
3. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
4. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
5. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.

MC01   **Indian Constitution**

L T P CR   Theory   :75
2 0 0 0   Class Work   :25
                                                  Total   :100

Course Objectives:
- To gain knowledge about Historical perspectives, Salient Features and Characteristics of Constitution of India.
- To gain knowledge about various schemes of Fundamental Rights, Fundamental Duties, Article-19, Article-21 and D.P.S.P
- To know about the basic structure of the Government of India.
- To know about Constitutional Amendments & Emergency Provisions.
- To gain knowledge about the Local Govt. of India and its Three Tier Structure.

Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content
1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States

8. Parliamentary Form of Government in India – The constitution powers and status of the President of India

9. Amendment of the Constitutional Powers and Procedure

10. The historical perspectives of the constitutional amendments in India

11. Emergency Provisions: National Emergency, President Rule, Financial Emergency

12. Local Self Government – Constitutional Scheme in India

13. Scheme of the Fundamental Right to Equality

14. Scheme of the Fundamental Right to certain Freedom under Article 19

15. Scope of the Right to Life and Personal Liberty under Article 21.

Course Outcomes:
On successful completion of this course the student should be able to:
- Understand the Historical Perspective of Constitution of India.
- Understand various schemes and scope of Fundamental Rights, Fundamental Duties and D.P.S.P
- Understand the Type of Government in India and its Federal Structure.
- Understand Constitutional Amendments and Emergency Provisions in India.
- Understand Local Self Government and its Three Tier Structure

REFERENCES:

1. The Constitutional Law Of India 9th Edition, by Pandey. J. N.
2. The Constitution of India by P.M.Bakshi
3. Constitution Law of India by Narender Kumar
4. Bare Act by P. M. Bakshi

MC02   **Essence of Indian Tradition Knowledge**

L T P CR
2 0 0 0

Theory	:	75
Class Work	:	25
Total	:	100
Duration of Exam:		3 Hrs.

Course objective

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course Contents

Basic structure of Indian Knowledge System: अष्टादशविद्या -४वेद,४उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि) द्वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)

– Modern Science and Indian Knowledge System

– Yoga and Holistic Health care

– Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014

- Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan

- Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan

- Fritzof Capra, *Tao of Physics*

- Fritzof Capra, *The Wave of life*

- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam

- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata

- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, Vidyanidhi Prakashan, Delhi 2016

- RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, Vidyanidhi Prakashan, Delhi 2016

- P B Sharma (English translation), *Shodashang Hridayan*

Pedagogy: Problem based learning, group discussions, collaborative mini projects.

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

EC 351   **Electronics Devices Lab**

L T P CR   **Theory**   **:**   **35**

0 0 2 1   **Class Work**   **:**   **15**

                                               Total   **:**   **50**

List of Experiments

1. Study of IV Characteristics of PN junction diode.

2. Study of IV Characteristics of zener diode.

3. Study of transistor common base characteristics

4. Study of transistor common emitter characteristics.

5. Study of Zener diode as a voltage regulator.

6. Study of FET common source amplifier.

7. Study of FET common Drain amplifier.

8. Study of Zener diode as a voltage regulator.

9. Study of CC amplifier as a buffer.

10. Study of 3-terminal IC regulator.

11. Study of LED, photo diode and solar cell.

Course Outcomes: On successful complete of this course, the students should be able to:

- Understand the characteristics of PN junction diode.
- Understand the application of diode & Zener diode experimentally.
- Obtain input and output characteristics of transistors in CE, CB & CC configurations.
- Obtain FET characteristics.
- Write experimental reports and work in a team in professional way.

EC 352   **Digital System Design Lab**
L T P CR   **Theory   :   35**
0 0 2 1   **Class Work :   15**
                                                                 Total   :   50

List of Experiments
1.   Study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.

2.   Design & realize a given function using K-maps and verify its performance.

3.   To verify the operation of multiplexer & Demultiplexer.

4.   To verify the operation of comparator.

5.   To verify the truth tables of S-R, J-K, T & D type flip flops.

6.   To verify the operation of bi-directional shift register.

7.   To design & verify the operation of 3-bit synchronous counter.

8.   Design all gates using VHDL.

9.   Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. half adder b. full adder

10.   Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. multiplexer b. demultiplexer

11.   Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. decoder b. encoder

12.   Write a VHDL program for a comparator and check the wave forms and the hardware generated

13.   Write a VHDL program for a code converter and check the wave forms and the hardware generated

14.   Write a VHDL program for a FLIP-FLOP and check the wave forms and the hardware generated

15.   Write a VHDL program for a up/down counter and check the wave forms and the hardware generated.

Course Outcome: On the successful competition of this course, the students should be able to:
- Verify the operation of basic & universal gates.
- Design & verify the standards of combinational circuits.
- Verify the operations of different type of flip flops.
- Design the counters using flip flops for a given sequence.
- Verify the working of shift registers.
- Write experimental reports and work in a team in professional way

EC 353   **Network Theory Lab**

L T P CR	Theory	:	35
0 0 2 1	Class Work	:	15
	Total	:	50

List of Experiments

1. Transient response of RC circuit.

2. Transient response of RL circuit.

3. To find the resonance frequency, Band width of RLC series circuit.

4. To calculate and verify ―Z" parameters of a two port network.

5. To calculate and verify "Y" parameters of a two port network.

6. To determine equivalent parameter of parallel connections of two port network.

7. To plot the frequency response of low pass filter and determine half-power frequency.

8. To plot the frequency response of high pass filters and determines the half-power frequency.

9. To plot the frequency response of band-pass filters and determines the band-width.

10. To calculate and verify "ABCD" parameters of a two port network.

11. To synthesize a network of a given network function and verify its response.

12. Introduction of P-Spice

Course Outcomes: On successful complete of this course, the students should be able to:
- Design RC & RL circuits and check their transient response experimentally.
- Design RLC series circuits & find the frequency response.
- Analyse the circuits of two port network and verify 'ABCD' 'Z' & 'Y' parameters of two port network.
- Design & plot the frequency response of low pass filter, high pass filter & band-pass filter experimentally.
- Synthesize a network using Foster & Cauer Forms.
- Write experimental reports and work in a team in professional way.

ES 303   **Electronics Project Workshop-I**

L T P CR		
Theory	:	70
Class Work	:	30
Total	:	100

0 0 6 3

List of Problems

1. Testing of Electronics Devices

   1) Diode   2) Transoms   3) Capacitors   4) Inductor

2. Design, Fabrication, Testing & Measurement of half & full wave rectifier

3. Design and fabrication of fixed & variable regulators (Zenes, Transistor and IC)

4. Design of transistor as a switch, amplifier and multivibrator.

5. To study of 555 as Astable, Monostable, Bistable multivibrator.

6. To design various applications of OP amp such as

   1) Amplifiers (Inverting & Non Inverting)

   2) Adder, Subtractor & scale changer

   3) Integrator and differentiator

   4) Oscillator and Schmitt trigger

7. Mini project based on anolog circuits of above.

Course Outcomes: On successful complete of this course, the students should be able to:

- Understand the operation of half wave & full wave rectifier.

- Understand the application of diode experimentally.

- Understand the transistor as an amplifier.

- Implement amplifiers, differentiator, Integrator and active filters circuit using opamp.

- Write experimental reports and work in a team in professional way.

EC401   **Analog and Digital Communication**
L T P CR   Theory   :   75
3 0   0   3   Class Work   :   25
                                                                      Total   :   100
                                                                      Duration of Exam :   3 Hrs.

Course Objectives:
- To study the concepts of signal & system as well as various modulation techniques.
- To study the concept of probability and random process as well as behavior of noises in communication system.
- To introduce the concept of Sampling Theorem and Pulse Modulation Techniques.
- To introduce the concept of different digital modulations schemes and evaluate their bit error performances.

Syllabus

Unit 1: Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems, DSB, SSB and VSB modulations, Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Unit 2: Review of probability and random process, Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems, Pre-emphasis and Deemphasis, Threshold effect in angle modulation.

Unit 3: Pulse modulation, sampling process, Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation, Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Unit 4: Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms, Probability of Error evaluations, Baseband Pulse Transmission, Inter symbol Interference and Nyquist criterion, Pass band Digital Modulation schemes, Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Unit 5: Digital Modulation tradeoffs, Optimum demodulation of digital signals over band-limited channels, Maximum likelihood sequence detection (Viterbi receiver), Equalization Techniques, Synchronization and Carrier Recovery for Digital modulation.

Course Outcomes: On successful completion of this course, the students should be able to:
- Analyze and compare different analog modulation schemes for their efficiency and bandwidth.
- Analyze the behaviour of a communication system in presence of noise.
- Investigate pulsed modulation system and analyze their system performance.
- Analyze different digital modulation schemes and can compute the bit error performance.

Text/Reference Books:
1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

EC402   **Analog Circuits**

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objectives:
- To study the concept of diode circuits, BJT and FET with their configurations
- To familiar with different types of power amplifiers and different types of feedback configuration.
- To introduce the concept of different types of oscillators.
- To give exposure to the students regarding OP-AMP and their various applications
- To give exposure to the students regarding the concepts of different types of DAC and ADC.

Syllabus

Unit 1: Diode Circuits, Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

Unit 1: High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Unit 2: Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.

Unit 3: Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.

Unit 4: OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Unit 5: Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistorstring etc., Analog to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the characteristics of diodes and transistors.
- Design and analyze various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.
- Design ADC and DAC.

Text/Reference Books:

1. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11
5. Publishing, Edition IV.
6. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition.

ECC03   **Microprocessors and Microcontrollers**

L T P CR	Theory	:	75
3 0 0 3	Class Work	:	25
	Total	:	100
	Duration of Exam	:	3 Hrs.

Course Objectives:
- To study and familiarise with building blocks of micro computers systems and Assembly programming of 8086.
- To apply the fundamental of programming and Interfacing through 8051.
- To know about virtual, cache and architecture of advance processors.
- To know fundamentals of RISC and ARM microcontrollers and interfaces design.

Syllabus

Unit 1: Overview of microcomputer systems and their building blocks, memory interfacing, concepts of interrupts and Direct Memory Access, 8086 Instruction, addressing modes, instruction set of Microcontroller (with examples of 8085 and 8086)

Unit 2: Peripherals and Interfacing with Microprocessor (8086)-PPI-8255, Timers-8253/8254, Programmable Interrupt Controller 8259, Interfacing of Microprocessor with I/O, A/D, D/A, Switches & LEDs

Unit 3: Microcontroller 8051, Architecture, programming, interfacing with peripherals - timer, serial I/O, parallel I/O, A/D and D/A converters, Arithmetic Coprocessors, System level interfacing design

Unit 4: Concepts of virtual memory, Cache memory, advanced coprocessor Architectures- 286, 486, Pentium

Unit 5: Introduction to RISC processors, PIC, ARM microcontrollers architectures.

Course Outcomes: On successful completion of this course, the students should be able to:
- Do assembly language programming
- Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc.
- Develop systems using different microcontrollers
- Understand RSIC processors and design ARM microcontroller based systems

Text/Reference Books:
1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996.
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.
4. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.

Course Objects:
- To study the basic of computer system.
- To study general system architecture.
- To study memory hierarchy & I/O techniques.
- To study basic non-pipelined CPU architecture & how its performance can be enhanced using pipelining.

Syllabus

Unit 1: Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines.

Unit 2: Processor organization, Information representation, number formats.

Unit 3: Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point Formats, Control Design, Instruction sequencing, Interpretation, Hard wired control-Design methods, and CPU control unit, Microprogrammed Control-Basic concepts, minimizing microinstruction size, multiplier control unit, Microprogrammed computers-CPU control unit

Unit 4: Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory. System organization, Input-Output systems, Interrupt, DMA, Standard I/O interfaces

Unit 5: Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network

Course Outcomes: On successful completion of this course, the students should be able to:
- Learn how computers work.
- Know basic principles of computer's working.
- Analyze the performance of computers.
- Know how computers are designed and built.
- Understand issues affecting modern processors (caches, pipelines etc.).

Text/Reference Books:
1. V.Carl Hammacher, "Computer Organisation", Fifth Edition.
2. A.S.Tanenbum, "Structured Computer Organisation" , PHI, Third edition.
3. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J., Prentice Hall Edition.
4. M.M.Mano, "Computer System Architecture", Edition.
5. C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition.
6. Hayes J.P, "Computer Architecture and Organization", PHI, Second edition.

ECC01   **Signal and Systems**
L T P CR   **Theory   :   75**
3 0 0   3   **Class Work :   25**
                                                       Total   :   100
                                                Duration of Exam :   3 Hrs.

Course Objects:
- To introduce students about various types of signals and their classifications.
- To introduce students about LSI (linear shift invariant) systems and their properties.
- To introduce students about properties of Fourier Series, Fourier Transforms like DTFT and DFT.
- To introduce students about Laplace Transform, Z Transform and State-Space Analysis.

Syllabus

Unit 1: Signals and systems as seen in everyday life, and in various branches of engineering and science, Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals, System properties, linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.

Unit 2: Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input output behavior with a periodic convergent inputs, Characterization of causality and stability of linear shift-invariant systems, System representation through differential equations and difference equations.

Unit 3: Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT), Parseval's Theorem, the idea of signal space and orthogonal bases

Unit 4: The Laplace Transform, notion of eigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior

Unit 5: The z-Transform for discrete time signals and systems eigen functions, region of convergence, z-domain analysis.

Unit 6: State-space analysis and multi-input, multi-output representation, the state-transition matrix and its role, The Sampling Theorem and its implications spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first order hold, and so on, Aliasing and its effects, relation between continuous and discrete time systems.

Course outcomes: On successful completion of this course, the students should be able to:
- Analyze different types of signals.
- Represent continuous and discrete systems in time and frequency domain using different transforms.
- Investigate stability of system.
- Perform sampling and reconstruction of a signal.

Text/Reference books:
1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.

3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: 1999.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, 1998.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

HSMC01   **Effective Technical Communication**

L T P CR   Theory   :   75
3 0 0   3   Class Work   :   25
                                                        Total   :   100
                                                 Duration of Exam   :   3 Hrs.

Course Objectives

- To provide with the confidence to use written communication in your work and personal experience beyond college,

- To acquaint students with the concept of a writer-reader relationship and identify the need for active participation from both writer and reader,

- To teach the skills needed to successfully communicate in a modern world through written materials.

Unit 1: Module 1: Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

Unit 2: Module 2: Technical Writing, Grammar and Editing, Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

Unit 3: Module 3: Self Development and Assessment: Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem, Managing Time, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity

Unit 4: Module 4: Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

Unit 5: Module 5: Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

COURSE OUTCOMES
1. Clearly convey specialized information from a technical field to a non-specialized audience.
2. Identify and use appropriate formats and conventions derived from individual disciplines.
3. Assess effectiveness and validity of information sources, such as web sites, business documents, and professional journals.
4. Develop strategies for information design, to include producing visually enhanced documents.
Text/Reference Books:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004.
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843).
3. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
5. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4).
6. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.
7. Xebec, Presentation Book, TMH New Delhi, 2000. (ISBN 0402213).

BSC01   **Biology**

L T P CR		
2 1 0 3		

Theory	:	**75**
Class Work	:	**25**
Total	:	**100**
Duration of Exam	:	**3 Hrs.**

Pre- Requisite: Nil
Successive: Environmental Science

Course Objectives:

To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.

1) "Genetics is to biology what Newton's laws are to Physical Sciences", 2) all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine, 3) without catalysis life would not have existed on earth, 4) molecular basis of coding and decoding (genetic information) is universal and that 5) fundamental principles of chemical and physical energy transactions are the same in physical/chemical and biological world.

 Module 1.(2 hours)- Introduction

> Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry
>
> Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

 Module 2. (3 hours)- Classification

> Purpose: To convey that classification per se is not what biology is all about.The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M.musculus

 Module 3. (4 hours)-Genetics

> Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele.Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring.Concepts of recessiveness

and dominance.Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4. (4 hours)-Biomolecules

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins.Nucleotides and DNA/RNA.Two carbon units and lipids.

Module 5. (4 Hours). Enzymes

Purpose: To convey that without catalysis life would not have existed on earth

Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification.Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module 6. (4 hours)- Information Transfer

Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code.Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. (5 hours). Macromolecular analysis

Purpose: How to analyses biological processes at the reductionistic level Proteins-structure and function. Hierarch in protein structure.Primary secondary, tertiary and quaternary structure.Proteins as enzymes, transporters, receptors and structural elements.

Module 8. (4 hours)- Metabolism

Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions.Concept of Keq and its relation to standard free energy.Spontaneity.ATP as an energy currency. This should include the breakdown of glucose to CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Module 9. (3 hours)- Microbiology

Concept of single celled organisms.Concept of species and strains.Identification and classification of microorganisms.Microscopy.Ecological aspects of single celled organisms.Sterilization and media compositions.Growth kinetics.

Course Outcomes (COs)

1. Classify enzymes and distinguish between different mechanisms of enzyme action.

2. Identify DNA as a genetic material in the molecular basis of information transfer.
3. Analyze biological processes at the reductionist level
4. Apply thermodynamic principles to biological systems.
5. Identify and classify microorganisms.

Textbooks/ References:

1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd

2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons

3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company

4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher

5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

EC451   **Analog and Digital Communication Lab**
L T P CR   **Theory**   :   **35**
0 0 2   1   **Class Work**   :   **15**
                                                         Total   :   **50**
                                                         Duration of Exam :   **3 Hrs.**

List of Experiments

1. Study of Amplitude Modulation and determination of Modulation index.

2. Study of Frequency Modulation and determination of Modulation index.

3. Study of Phase Modulation.

4. Study of Pulse Amplitude Modulation.

5. Study of Pulse Width Modulation.

6. Study of Pulse Frequency Modulation.

7. Study of Pulse Code Modulation.

8. Study of frequency Shift Keying.

9. Study of ASK

10. Study of PSK

11. Study of Delta modulation

Course Outcomes: On successful complete of this course, the students should be able to:
- Demonstrate about various blocks in communication system.
- Analyze the types of modulations.
- Analyze and design the analog modulator and demodulator circuits.
- Generate the waveforms of AM,FM, PM, PWM,PPM and PAM.
- Calculate Power relations in Amplitude and Frequency modulated waves.
- Write experimental reports and work in a team in professional way

EC452   **Analog Circuits Lab**

L T P CR   **Theory : 35**

0 0 2   1   **Class Work : 15**

                                               Total : 50

                                   Duration of Exam : 3 Hrs.

List of Experiments

1. Design & measure the frequency response of an RC coupled amplifier using discrete components.
2. Design a two stage RC coupled amplifier and determine the effect of cascading on gain and bandwidth.
3. Design & realize inverting amplifier, non-inverting and buffer amplifier using 741 Op Amp.
4. Verify the operation of a differentiator circuit using 741 op amp and show that it acts as a high pass filter.
5. Verify the operation of a integrator circuit using 741 op amp and show that it ac ts as a low pass filter.
6. Design and verify the operations of op amp adder and subtractor circuits.
7. To design & realize Schmitt trigger using op amp 741.
8. Design and realize Wein-bridge oscillator using op amp 741
9. To design & realize square wave generator using op amp 741.
10. To design & realize zero crossing detector using op amp 741

Course Outcomes: On successful complete of this course, the students should be able to:

- Measure & verify the frequency response of RC coupled amplifier.

- Measure the effect of various types of feedback on amplifiers.

- Implement amplifiers, differentiator, Integrator and active filters circuit using op amp.

- Design op-amp as Wein-Bridge Oscillator, Square Wave Generator, Logarithmic Amplifier and Voltage Controlled Circuits.

- Write experimental reports and work in a team in professional way.

ECC51   **Microprocessors and Microcontrollers Lab**

L T P CR   **Theory**   **:**   **35**

0 0 2   1   **Class Work**   **:**   **15**

                                                    Total   **:**   **50**

List of Experiments

1. Study of architecture of 8085 & familiarization with its hardware , commands & operation of Microprocessor kit.

2. Write a program using 8085 and verify for :

   (i) Addition of two 8-bit numbers.

   (ii) Addition of two 8-bit numbers (with carry).

3. Write a program using 8085 and verify for :

   (i) 8-bit subtraction (display borrow)

   (ii) 16-bit subtraction (display borrow)

4. Write a program using 8085 for multiplication of two 8- bit numbers by repeated addition method. Check for minimum number of additions and test for typical data.

5. Write a program using 8085 for multiplication of two 8- bit numbers by bit rotation method and verify.

6. Write a program using 8085 for division of two 8- bit numbers by repeated subtraction method and test for typical data.

7. Write a program using 8085 for dividing two 8- bit numbers by bit rotation method and test for typical data.

8. Write a program using 8086 and verify for:

   (i) Finding the largest number from an array.

   (ii) Finding the smallest number from an array.

9. Write a program using 8086 for arranging an array of numbers in descending order and verify.

10. Write a program using 8086 for arranging an array of numbers in ascending order and verify.

11. Write a program for finding square of a number using look-up table and verify.

12. Write a program to interface microprocessor with 8253 to generate square wave. Use 8085/8086 microprocessor.

13. Write a program to interface microprocessor with 8253 to generate interrupt on terminal count. Use 8085/8086 microprocessor.

14. Write a program to interface a two digit number using seven-segment LEDs. Use 8085/8086 microprocessor and 8255 PPI.

15. Write a program to control the operation of stepper motor using 8085/8086 microprocessor and 8255 PPI.

Course Outcomes: On successful complete of this course, the students should be able to:
- Identify various modules embedded on the kit.
- Write the assembly code for various operations on 8-bit and 16-bit numbers.
- Interface various peripherals with microprocessor and to write the program for same.
- Interface various devices such as seven segment LEDS & stepper motor with microprocessor through 8255 and to write the program for same.

ES 402   **Electronics Project Workshop-II**
L T P CR   **Theory   :   70**
0 0 6 3   **Class Work :   30**
                                                                 Total   :   100

List of Problems

1.   Fabrication of all the gates using Diode & transistors and verification of truth table.
2.   To design & realize combinational circuit using K-map & logic simplification.
3.   To design 4 bit parallel adder/ subtractor/ for unsigned/ signed numbers.
4.   To verify the operation of Multiplexer & to implement any given function with a MUX.
5.   To verify the operation of DEMUX & decoder.
6.   To indentify common cathode & common anode of seven segment display with its various segment.
7.   Implement binary to BCD conversion.
8.   To fabricate BCD to seven segment decoder
9.   To verify the truth table of SR, JK, D & T Flip-Flop & conversion of one Flip-Flop to another FF.
10.   To design Mod-8 Synchronous Counter using T Flip-Flop.
11.   To design UP-DOWN decade counter using JK/T Flip-Flop & derive o/p into SSD.
12.   To design a minute clock.
13.   To verify the function of Universal Shift Register.
14.   To design Ring & Johson counter using Universal shift Register.
15.   To verify the function of RAM.
16.   To verify the function of 4- bit ALU.
17.   To study the operation of 8-bit A/D converter.
18.   To design 4 bit DAC.
19.   Mini project based on concepts of digital electronics.

Course outcomes: On successful completion of this course, the students should be able to:
•   Design and analyze combinational logic circuits.
•   Design & analyze synchronous sequential logic circuits.
•   Acquire basic knowledge of memories and ALU.
•   Understand the A/D and D/A converter.

ECC02   **Electromagnetic Waves**
L T P CR   Theory   :   75
3 0 0   3   Class Work   :   25
                                                   Total   :   100
                                                   Duration of Exam :   3 Hrs.

Course Objects:
- To introduce the concept of Transmission line, how the no loss transmission occurs and understanding the concept of Smith Chart.
- To give exposure to the students regarding the physical meaning and importance of Maxwell's equation and how it derived from basic laws of Electromagnetic.
- To introduce how the Electromagnetic waves are formed, its propagation in different medium and the concept of Poynting Vector.
- To introduce the phenomenon of Reflection or refraction of wave when strikes obliquely or normally to any surface.
- To introduce the concept of travelling of wave in waveguides and other phenomena.
- To impart the knowledge of principle of radiation and radiation characteristics of an antenna.

Syllabus

Unit 1: Transmission Lines: Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines, Impedance Matching, use transmission line sections as circuit elements.

Unit 2: Maxwell's Equations- Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface.

Unit 3: Uniform Plane Wave: Uniform plane wave, Propagation of wave, Wave polarization, Poincare's Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor

Unit 4: Plane Waves at a Media Interface: Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.

Unit 5: Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.

Unit 6: Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna,

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand characteristics and wave propagation on high frequency transmission lines as well as carryout impedance transformation on TL.
- Use sections of transmission line sections for realizing circuit elements.
- Characterize uniform plane wave and calculate reflection & transmission of waves at media interface.
- Analyze wave propagation on metallic waveguides in modal form.
- Understand principle of radiation and radiation characteristics of an antenna.

Text/Reference Books:
- R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005.
- E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India.
- Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.
- David Cheng, Electromagnetics, Prentice Hall.

EC502   **Probability Theory and Stochastic Processes**
L T P CR   Theory   :   75
3 0 0   3   Class Work   :   25
                                                                 Total   :   100
                                                                 Duration of Exam :   3 Hrs.

Course Objectives:
- To introduce the concepts of probability & random signals.
- To give exposure to the students about the properties of random signal & random processes.
- To know the theorems related to random signals.
- To introduce the concepts of transmission of random process through LTI.

Syllabus

Unit 1: Sets and set operations; Probability space: Conditional probability and Bayes theorem, Combinatorial probability and sampling models.

Unit 2: Discrete random variables, probability mass function, probability distribution function, example random variables and distributions, Continuous random variables, probability density function, probability distribution function, example distributions.

Unit 3: Joint distributions, functions of one and two random variables, moments of random variables, Conditional distribution, densities and moments, Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

Unit 4: Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square), Limit theorems, Strong and weak laws of large numbers, central limit theorem.

Unit 5: Random process. Stationary processes, Mean and covariance functions. Ergodicity, Transmission of random process through LTI, Power spectral density.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand representation of random signals.
- Investigate characteristics of random processes.
- Make use of theorems related to random signals.
- To understand propagation of random signals in LTI systems.

Text/Reference Books:
1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing,'' Third Edition, Pearson Education.
2. A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes,'' Fourth Edition, McGraw Hill.
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International.
4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers.
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers.
6. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

ECC04   **Digital Signal Processing**

L T P CR   Theory   :   75
3 0 0 3   Class Work :   25
                                                          Total   :   100
                                                          Duration of Exam : 3 Hrs.

Course objectives:
- To study concept of basic signal and implementation of discrete time system.
- To introduce concept of Z-transform & discrete Fourier Transform and FFT.
- To give exposure to students about design of FIR digital filter.
- To familiar with the concept of multirate signal processing and spectral estimation.

Syllabus

Unit 1: Discrete time signals: Sequences, representation of signals on orthogonal basis, Sampling and reconstruction of signals, Discrete systems attributes, Z-Transform, Analysis of LSI systems, frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems

Unit 2: Design of FIR Digital filters: Window method, Park-McClellan's method, Design of IIR Digital Filters, Butterworth, Chebyshev and Elliptic Approximations, Low pass, Band pass, Band stop and High pass filters.

Unit 3: Effect of finite register length in FIR filter design, Parametric and non-parametric spectral estimation, Introduction to multirate signal processing, Application of DSP

Course Outcomes: On successful completion of this course, the students should be able to:
- Represent signals mathematically in continuous and discrete time and frequency domain.
- Get the response of an LSI system to different signals.
- Design of different types of digital filters for various applications.
- Understand multirate signal processing

Text/Reference Books:
1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH.
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
6. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

Program Elective – I

ECEL501   **CMOS Design**

L T P CR		
3 0 0 3	**Theory** :	**75**
	Class Work :	**25**
	Total :	**100**
	Duration of Exam :	**3 Hrs.**

Course Objectives:
- To introduce the micro-electronics technology based on MOSFET, design concepts of MOS circuits.
- To learn the basics of MOS modelling and non ideal effects in MOSFET.
- To learn the basics of MOS circuits layout and estimation of various performance parameter.
- To introduce both combinational and sequential Circuits designs.

Syllabus

Unit 1. Review of MOS Transistor Model: Introduction to IC technology, MOS Transistor enhancement mode and depletion mode operations, fabrication of NMOS, CMOS, Equivalent circuit model for MOSFET.

Unit 2. Ideal and Non Ideal Behaviour of MOS Transistor: Ideal I-V characteristics, threshold voltage, MOS transistor transconductance, , Non ideal I-V effects, velocity saturation, channel length modulation, body effects, subthreshold conduction, junction leakage, tunneling and temperature dependence. Transistor as a switch, Pass transistor, alternative forms of pull-up in inverter, Inverter characteristics, CMOS and nMOS-inverters. Latch up in CMOS circuitry.

Unit 3. Integrated Circuit Layout: Basic physical design of simple logic gates using n-MOS, p-MOS and CMOS, stick diagrams, design rules.

Unit 4. MOS Performance Estimation Delay, RC delay model, linear delay model, Parasitic delay, logical path efforts, power dissipation, interconnect and robustness in CMOS circuits.

Unit 5. Combinational Logic Design: CMOS logic family including static, dynamic and dual rail logic.

Unit6. Sequential Logic Design: Static circuits, design of latches and flip flop.

Course Outcomes: On successful complete of this course, the students should be able to:
- Understand about the trends in MOSFET based semiconductor technology, and design concept of MOS circuits.
- Analyse the MOS equivalent model and non ideal effects.
- Design MOSFET circuit layouts and estimate various performance parameters.
- Design combination and sequential CMOS circuits.

Text Books:
1. N. H.E. Weste and D.M. Harris, CMOS VLSI DESIGN: A Circuit and System perspective, Pearson Education India.
2. D.A. Pucknell, K. Eshraghian, Basic VLSI Design, Prentice Hall India, Third Edition, 1994
3. S.M. Kang, Y. Leblebici, CMOS Digital Integrated Circuits, Analysis and Design, Tata McGraw Hill,Third Edition, 2003.
4. D. Das, VLSI Design, Oxford Higher Education, 2010

Reference Books:
1. Integrated Circuits: K.R. Botkar; Khanna Publication.
2. C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1971.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.

ECEL502   **Nano Electronics**

L T P CR   Theory : 75
3 0 0 3   Class Work : 25
                 Total : 100
              Duration of Exam : 3 Hrs.

Course Objectives:
- To learn the basics of quantum mechanics and the processes involved in making nanomaterial.
- To study the band theory of solids.
- To learn the shrink-down approaches of CMOS.
- To give exposure to students regarding the advantages of the nanomaterial.

Syllabus

Unit 1: Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics, Schrodinger equation, Density of States, Particle in a box Concepts, Degeneracy, Band Theory of Solids. Kronig-Penny Model, Brillouin Zones.

Unit 2: Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)

Unit 3: Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand various aspects of nano-technology and the processes involved in making nano components and material.
- Able to understand the band theory of solids.
- Understand the various shrink down approaches of CMOS.
- Leverage advantages of the nano-materials and appropriate use in solving practical problems.

Text/ Reference Books:
1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003.

ECEL503   **Power Electronics**

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objectives:
- To introduce the students about various types of power devices & their characteristics.
- To introduce the students about controlled rectifiers, choppers & inverters.
- To impart the knowledge regarding the analysis of inverters.
- To impart the knowledge regarding switching power supplies & their applications.

Syllabus

Unit 1: Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz, TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based), Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Unit 2: Controlled Rectifiers: Single phase, Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current, Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Unit 3: Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers, TRC and CLC, Detailed analysis of Type A chopper, Step up chopper, Multiphase Chopper.

Unit 4: Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.

Unit 5: Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters need, concept of soft switching, switching trajectory and SOAR, Load resonant converter series loaded half bridge DC-DC converter. Applications: Power line disturbances, EMI/EMC, power conditioners, Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS, Separately excited DC motor drive, P M Stepper motor Drive.

Course Outcomes: On successful completion of this course, the students should be able to:
- Build and test circuits using power devices such as SCR.
- Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters.
- Learn how to analyze these inverters and some basic applications.
- Design SMPS and UPS.

Text /Reference Books:
1. Muhammad H. Rashid, "Power electronics" Prentice Hall of India.
2. Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.
3. P.C. Sen., "Modern Power Electronics", edition II, Chand& Co.
4. V.R.Moorthi, "Power Electronics", Oxford University Press.
5. Cyril W., Lander," Power Electronics", edition III, McGraw Hill.
6. G K Dubey, S R Doradla,: Thyristorised Power Controllers", New Age International Publishers. SCR manual from GE, USA.

ECEL504   **Introduction to MEMS**

L T P CR		
3 0 0 3		

Theory   :   **75**
Class Work   :   **25**
Total   :   **100**
Duration of Exam   :   **3 Hrs.**

Course Objectives:
- To introduce about MEMS & Micro fabrications.
- To give exposure about essential material properties.
- To introduce about various sensing and transducers techniques.
- To introduce about various fabrication & machining process of MEMS.

Syllabus

Unit 1: Introduction and Historical Background, Scaling Effects. Micro/Nano Sensors, Actuators and Systems overview, Case studies, Review of Basic MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining, Surface Micromachining, sacrificial layer processes, Stiction, Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding, Mechanics of solids in MEMS/NEMS, Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending, Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Unit 2: MEMS types and their applications: Mechanical MEMS, Strain and pressure sensors, Accelerometers etc., Electromagnetic MEMS, Micromotors, Wireless and GPS MEMS etc Magnetic MEMS, all effect sensors, SQUID magnetometers, Optical MEMS, Micromachined fiber optic component, Optical sensors, Thermal MEMS, thermo-mechanical and thermo-electrical actuators, Peltier heat pumps.

Course Outcomes: On successful completion of this course, the students should be able to:
- Appreciate the underlying working principles of MEMS and NEMS devices.
- Be comfortable with the design, analysis & testing of MEMS. .
- Apply the MEMS for different applications.
- Understand about the different MEMS process used in MEMS/NEMS devices.

Text/Reference Book:
1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.
7. R.C Jaeger, "Introduction to Microelectronics Fabrication", 2nd edition, Addison Wesley, 2000.

L T P CR   Theory   :   75
2 0 0 0   Class Work :   25
                                                                Total   :   100
                                                                Duration of Exam : 3 Hrs.

Course Objective
   - The prime objective of the course is to provide the students a detailed knowledge on the threats and challenges to the environment due to developmental activities.
   - The students will be able to identify the natural resources and suitable methods for their conservation and sustainable development.
   - The focus will be on awareness of the students about the importance of ecosystem and biodiversity for maintaining ecological balance.
   - The students will learn about various attributes of pollution management and waste management practices.
   - The course will also describe the social issues both rural and urban environment and environmental legislation.

Unit 1: THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES Definition, scope and importance. Need for public awareness.

Unit 2: NATURAL RESOURCES: RENEWABLE AND NON-RENEWABLE RESOURCES Natural resources and associated problems, *Forest resources*: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. *Water resources*: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. *Mineral resources*: Use and exploitation, environmental effects of extracting and mineral resources, case studies. *Food resources*: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. *Energy resources*: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification., Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit 3: ECOSYSTEMS Concept of an ecosystem Structure and Concept of an ecosystem, Structure and function of an ecosystem. Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit 4: BIODIVERSITY AND ITS CONSERVATION Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: insitu and ex-situ conservation of biodiversity.

Unit 5: ENVIRONMENTAL POLLUTION Definition, Causes, effects and control measures of: Air pollution b) Water pollution c) Soil pollution d) Marine pollution e) Noise pollution f) Thermal pollution g) Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

Unit 6: SOCIAL ISSUES AND THE ENVIRONMENT

From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies, Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products, Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act , Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation , Public awareness.

Unit 7: HUMAN POPULATION AND THE ENVIRONMENT Population growth, variation among nations. Population explosion, Family Welfare Programme, Environment and human health, Human Rights, Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.

Unit 8: FIELD WORK: Visit to a local area to document environmental assets-river, forest, grassland, hill, mountain, Visit to a local polluted site, Urban, Rural, Industrial, Agricultural, Study of common plants, insects, birds. Study of simple ecosystems, pond, river, hill slopes, etc.

Course Outcome

- The course is to will provide the students a detailed knowledge on the threats and challenges to the environment due to developmental activities.

- The students learned suitable methods for their conservation and sustainable development.

- The importance of ecosystem and biodiversity for maintaining ecological balance defined.

- The various attributes of pollution management and waste management practices learned.

The course will also describe the social issues both rural and urban environment and environmental legislation.

TEXT/ REFERENCES

1. "Perspectives in Environmental Studies" by A. Kaushik and C. P. Kaushik, New age international publishers.

2. "Environmental Studies by Benny Joseph", Tata McGraw Hill Co, New Delhi

3. "Environmental Science: towards a sustainable future" by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.

4. "Environmental Engineering and science" by Gilbert M. Masters and Wendell P. Ela 2008 PHI Learning Pvt Ltd.

5. "Environmental Science" by Daniel B. Botkin& Edwards A. Keller, Wiley INDIA edition.

6. "Fundamentals of Ecology" by Odum, E.P., Barrick, M. and Barret, G.W. Thomson Brooks/Cole Publisher, California, 2005

L T P CR   Theory   :   75
3 0 0   3   Class Work   :   25
                                                           Total   :   100
                                                           Duration of Exam :   3 Hrs.

Course Objectives:
- To familiarize the students with the different smart materials and their characteristics.
- To expose the students to understand the functionalities through the mathematical equations.
- To teach the students about the significant features of smart materials in sensing, actuation and control.
- To teach the students to design and develop smart structures using smart material based actuators and sensors.

Syllabus

Unit 1: Piezoelectric materials: Properties, Piezoelectricity, characteristics, applications, vibration control, health monitoring, energy harvesting.

Unit2: Shape-memory materials: Properties, shape memory materials, characteristics, applications – vibration control, shape control, health monitoring.

Unit 3: Electro-Rheological (ER) fluids: Suspensions and ER fluids, ER phenomenon, charge migration mechanism, ER fluid actuators, applications of ER fluids.

Unit 4: Magneto-Rheological (MR) fluids: Composition of MR fluid, applications of MR fluids.

Unit 5: Other smart materials and their applications: Magnetostrictive materials, Electrostrictive materials, Magnetic Shape Memory Alloy, Composites, Ionic Polymer Metal Composites. Bio inspired engineering and micro electro mechanical systems using smart materials.

Course Outcomes: On successful completion of this course, the students should be able to:
- Acquire knowledge about the smart materials, their characteristics and design aspects.
- Design, model and control smart materials based structures/systems, through simulation and experimentation.
- Understand the various applications of smart materials.
- Analyze and design techniques, to offer solutions to industrial problems using smart materials.

Text Books:
1. Mukesh V Gandhi, Brian S Thompson, Smart Materials and Structures, Chapman & Hall Publishers, 1st Edition, 1992.
2. Mel Schwartz, Encyclopedia of smart materials, John Wiley and Sons, 1st Edition,2002.
3. Srinivasan A.V., Michael McFarland D., Smart Structures Analysis and Design, Cambridge University Press, 1st Edition,2010.
4. Culshaw B., Smart structures and Materials, Artech house, 1st Edition, 2004.
5. Leo, D.J. Engineering Analysis of Smart Material Systems, John Wiley & sons,1st Editon 2008.
6. R.C.Smith, smart material systems: model development, frontiers in applied mathematics, SIAM, 2005.

7. H.Janocha, Adaptronics and smart structures: Basics, Materials, Design,and Applications, springer, 2nd Edition, 2007.

Reference Material:
1. www.iop.org/sms
2. http:jim.sagepub.com.

OEL502   **Electrical Measurement and Instrumentation**

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objectives:
- To introduce the fundamentals of various types of Instruments.
- To introduce the principle, working and applications of various types of measuring instruments.
- To introduce the principle, working and applications of various types of Wattmeters and Energy Meters.
- To introduce the principle, working and applications of various types of Instrument Transformers.
- To introduce the principle, working and applications of various types of AC and DC bridges.
- To introduce the various types of transducers and Electronics Instruments.

Syllabus

Unit 1: Analog Ammeters and Voltmeters: PMMC and MI Instruments, Construction, Torque Equation, Range Extension, Effect of temperature, Classification, Errors, Advantages and Disadvantages.

Unit 2: Analog Wattmeters and Power Factor Meters: Power and Power Factor, Electrodynamometer type wattmeter, power factor meter, Construction, theory, Shape of scale, torque equation, Advantages and disadvantages, active and reactive power measurement in single phase, Measurement in three phase.

Unit 3: Analog Energy Meter: Single phase induction type energy meters, construction, theory, Operation, lag adjustments, Max Demand meters/indicators, Measurement of VAH and VARh.

Unit 4: DC and AC Bridges: Measurement of resistance, Wheatstone Bridge, Kelvin's Bridge, Kelvin's Double Bridge, Measurement of inductance, Capacitance, Maxwell's Bridge, Desauty Bridge, Anderson Bridge, Schering Bridge, Wien Bridge, Applications and Limitations.

Unit 5: Instrument Transformers: Current Transformer and Potential Transformer construction, theory, phasor diagram, errors, testing and applications.

Unit 6: Transducers: Transducers Measurement of Temperature, RTD, Thermistors, LVDT, Strain Gauge, Piezoelectric Transducers, Digital Shaft Encoders, Tachometer, Hall effect sensors.

Unit 7: Electronic Instruments: Electronic Display Device, Digital Voltmeters, CRO, Digital Storage Oscilloscope, measurement of voltage and frequency, Lissajous Patterns, Wave Analyzers, Harmonic Distortion Analyzer.

Course Outcomes: On successful complete of this course, the students should be able to:
- Compare performance of MC, MI and Dynamometer types of measuring instruments, Energy meters and CRO.
- Determine the circuit parameters using AC and DC bridges.

- Understand the principle and working of various types of Instrument Transformers.
- Select transducers for the measurement of various electrical quantities like temperature, displacement and strain
- Understand operating principles of electronic measuring instruments

TEXT BOOK:
1. A course in Electrical And Electronic measurement and instrumentation : A.K. Sawhney, Dhanpat Rai Publication.

REFERENCE BOOKS:
1. Electrical Measurements: E.W. Golding, TMH
2. Electrical and Electronic measurement and instrumentation: J.B. Gupta, Kataria and Sons.
3. Electronic instrumentation and measurement technique : W.D. Cooper & A.D. Helfrick
4. Measuring systems: E.O. Doeblin; TMH.

OEL503   **Intelligent Instrumentation**

L T P CR	Theory	:	75

L T P CR   Theory   :   75
3 0 0   3   Class Work   :   25
                                                 Total   :   100
                                                 Duration of Exam :   3 Hrs.

Course Objectives:
- To introduce the students about intelligent instrumentation system and characteristics of intelligent instrumentation.
- To introduce the students for various types of instrumentation/computer networks.
- To introduce students virtual instrumentation and programming in Labview.
- To introduce the students about various types of interfacing techniques.
- To introduce the students about various types of analysis techniques.

Syllabus

Unit 1: Introduction: Definition of an intelligent instrumentation system, Static and Dynamic characteristics of intelligent instrumentation, feature of intelligent instrumentation, Block Diagram of an intelligent instrumentation.

Unit 2: Instrumentation/Computer Networks: Serial & parallel interfaces, serial communication standards, parallel data bus, EEE 488bus, Local area networks (LANs), Star networks, Ring & bus networks, Fiber optic distributed networks.

Unit 3: Virtual Instrumentation: Introduction to graphical programming data flow & graphical programming techniques, advantage of Virtual Instrumentation techniques, Virtual Instrumentations and sub Virtual Instrumentation loops and charts, arrays, clusters and graphs, case and sequence structure, formula notes, string and file Input/Output.

Unit 4: Interfacing Instruments & Computers: Basic issues of interfacing, Address decoding, Data transfer control, A/D converter, D/A converter, other interface consideration.

Unit 5: Analysis Technique: DSP software, Measurement filters and wavelets, windows, curve fitting probability and statistics.

Course Outcomes: On successful complete of this course, the students should be able to:
- Define the meaning of intelligent instrumentation syatem and its static and dynamic characteristics.
- Understand the various serial and parallel data transfer standards i.e. RS232 and IEEE488.
- Write VI program in LABVIEW to implement various virtual instrumentation system.
- Do interfacing of ADC and DAC and other peripherals to microprocessor using decoders.
- To implement various filters and wavelets using DSP software.

BOOKS:
1. Intelligent instrumentation :G.C. Barney: PHI.
2. Labview for everyone: Lisa, K. Wells and Jeffery Travis: PHI.

REFRENCES:
1. Principles of measurement & instrumentation: Alan S. Moris; PHI.
2. Labview graphical programming 2nd edition: Gray Johanson; TMH.

Electromechanical Energy Conversion

L T P CR	Theory	:	75
3 0 0 3	Class Work	:	25
	Total	:	100
	Duration of Exam	:	3 Hrs.

Course Objectives:
- To provide the knowledge of the Energy balance equation, Principle of Electromechanical Energy Conversion, force & torque equations of singly excited magnetic system as well as dynamic equations.
- To explain construction, theory, working Principle of transformer, O.C.,S.C. test, regulation & efficiency, auto-transformer, three phase transformer.
- To explain construction, theory, working principle of d.c. motors and generators, load characteristics, starting & speed control of d.c. motors.
- To explain construction, theory, working principle, phasor diagram, equivalent circuit, phasor diagram, load characteristics, introduction to single phase induction motors, stepper, servo, reluctance and universal motors.

Syllabus

Unit 1: Electromechanical Energy Conversion: Principles Of Force and torque in magnetic field system, energy balance, energy and force in singly excited magnetic field system, concept of co-energy, forces and torques in system with permanent magnets, dynamic equation.

Unit 2: Transformers: Basic theory, construction, operation at no-load and full-load, equivalent circuit, phasor diagram, O.C. and S.C., tests for parameters determination, efficiency and regulation, auto-transformer, introduction to three-phase transformer, Current and Potential Transformers, Principle, construction, analysis and applications.

Unit 3: DC Machines: Basic theory of DC generator, brief idea of construction, emf equation, load characteristics, basic theory of DC motor, concept of back emf, torque and power equations, load characteristics, starting and speed control of DC motors, applications.

Unit 4: Induction Motor: Basic theory, construction, Phasor diagram, Equivalent circuit, Torque equation, Load characteristics, starting and speed control of induction motor, Introduction to single phase Induction motor and its applications, Fractional H.P. Motors, Introduction to stepper, servo reluctance and universal motors.

Unit 5: Synchronous Machines: Construction and basic theory of synchronous generator, emf equation, model of generator, Phasor diagram, Regulation, Basic theory of synchronous motor, v-curves, synchronous condenser, applications.

Course Outcomes: On successful complete of this course, the students should be able to:
- Know basics of various types of electric machines, singly excited magnetic field system, dynamic equations.
- Understand theory, various tests, calculate various parameters of transformers.
- Design d.c machine depending on the performance characteristics & use them in various applications.
- Understand the basic principles of Induction machines, synchronous machines and their characteristics.

Text Book:

1. Electrical Machines: Nagarath and Kothari; TMH.

Reference Books:
1. Electrical Machines :P.S. Bimbhra; Khanna.
2. Electrical Machines: Mukherjee and Chakravorti; DhanpatRai& Sons.
3. Electrical Technology (Vol-II) : B.L Theraja; S. Chand.

OEL505   Renewable Power Generation Systems

L T P CR	Theory : 75	
3 0 0 3	Class Work : 25	
	Total : 100	
	Duration of Exam : 3 Hrs.	

Course Objectives:
- To introduce the environmental impacts of conventional energy resources.
- To introduce the process of PV generation.
- To introduce the process of wind power generation.
- To impart the knowledge regarding fuel cell power generation and hybrid systems.

Syllabus

Unit 1: Environmental aspects of electric power generation from conventional sources: Limitation of fossil fuels, Atmospheric pollution, effects of hydro-electric projects, disposal of nuclear waste, GHG emission from various energy sources and its effects, need for renewable energy sources.

Unit 2: Solar Photo-Voltaic system: Solar radiation and its measurement, Angle of sun rays on solar collector, optimal angle for fixed collector, sun tracking, an introduction to solar cell, solar PV module, PV system design and applications, stand-alone and grid connected systems, environmental impacts.

Unit 3: Wind power generation: Wind energy, classification of wind turbines, aerodynamic operation of wind turbine, extraction of wind turbine power, wind turbine power curve, horizontal axis wind turbine generator, modes of wind power generation, stand-alone and grid connected system, environmental impacts.

Unit 4: Fuel cell system: Principle of operation of fuel cell, technical parameters of fuel cell, Type of fuel cell, advantages of fuel cell power plants, energy output, efficiency and emf of fuel cell, operating characteristics, applications and environmental impacts.

Unit 5: Hybrid energy systems: Need for hybrid systems, types, configuration and coordination, electrical interface, PV-Diesel, Wind diesel, wind-PV, wind-PV, fuel cell.

Course Outcomes: On successful complete of this course, the students should be able to:
- Apprise the environmental impacts of conventional energy sources and the need of renewable energy.
- Explain the process of PV generation and design stand-alone and grid connected system.
- Explain the process of wind power generation and choose stand-alone and grid connected configuration.
- Explain the process of fuel cell power generation and its applications.
- Suggest and configure the various hybrid systems

Text Books:
1. G D Rai, 'Non-conventional Energy sources', Khanna Publishers, 5th Edition, 2014.
2. D P Kothari, K C Singal and Rakesh Ranjan, 'Renewable Energy Sources and Emerging Technologies' 2nd Edition, 2012.
3. C S Solanki, 'Solar Photo-voltaics – Fundamentals, Technologies and Applications', PHI Pvt., Ltd., 2 nd Edition, 2011.
4. S N Bhadra, D Kastha and S Banerjee, 'Wind Electric Systems', Oxford Publications, 2nd Edition, 2007.

EC601   **Control System**

L T P CR   Theory   :   75
3 0 0   3   Class Work   :   25
                                                      Total   :   100
                                                 Duration of Exam   :   3 Hrs.

Course Objectives:
- To study different control problem, control hardware and their models.
- To study different control algorithm and to familiarize with stability of a system using different tests.
- To study designing of various controllers and tuning of process controller.
- To study linear, nonlinear and optimal control problems.

Syllabus

Unit 1: Introduction to Control Problem: Industrial Control examples, Transfer function, System with dead-time, System response, Control hardware and their models, potentiometers, synchros, LVDT, dc and ac servomotors, tacho-generators, electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators, Closed-loop systems. Block diagram and signal flow graph analysis.

Unit 2: Feedback control systems: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness, proportional, integral and derivative systems, Feedforward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Unit 3: Time response of second order systems, steady-state errors and error constants, Performance specifications in time-domain, Root locus method of design, Lead and lag compensation

Unit 4: Frequency-response analysis- Polar plots, Bode plot, stability in frequency domain, Nyquist plots, Nyquist stability criterion, Performance specifications in frequency-domain, Frequency domain Methods of design, Compensation & their realization in time & frequency domain, Lead and Lag compensation, Op-amp based and digital implementation of compensators, Tuning of process controllers, State variable formulation and solution.

Unit 5: State variable Analysis: Concepts of state, state variable, state model, state modelsfor linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability

Unit 6: Introduction to Optimal control & Nonlinear control, Optimal Control problem, Regulator problem, Output regulator, treking problem, Nonlinear system, Basic concept & analysis.

Course Outcomes: On successful completion of this course, the students should be able to:
- Characterize a system and find its study state behaviour.
- Investigate stability of a system using different tests.
- Design various controllers.
- Solve liner, non-liner and optimal control problems.

Text/Reference Books:
1. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997.
2. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
3. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991.
4. Nagrath & Gopal, "Modern Control Engineering", New Age International, New Delhi

EC602   **Computer Network**

L T P CR   Theory   :   75
3 0 0   3   Class Work   :   25
                                                                   Total   :   100
                                                                   Duration of Exam :   3 Hrs.

Course Objectives:
- To give exposure to student that how data is transferred in computers.
- To study the performance of a network.
- To study the basics of different layers of TCP/ & how information is transferred between them.
- To solve issues occurring at different layers.

Syllabus

Unit 1: Introduction to computer networks and the Internet: Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic ail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

Unit 2: Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing

Unit 3: Transport layer: Connectionless transport, User Datagram Protocol, Connection oriented transport – Transmission Control Protocol, Remote Procedure Call.

Unit 4: Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.

Unit 5: Network layer: Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing.

Unit 6: Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the concepts of networking thoroughly.
- Design a network for a particular application.
- Analyze the performance of the network.
- Understand various issues at different layers.

Text Reference books:
1. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 5th Edition
2. L. Peterson and B. Davie, "Computer Networks – A Systems Approach" Elsevier Morgan Kaufmann Publisher, 5th Edition.
3. T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall
4. S. Keshav, "An Engineering Approach to Computer Networking" , Pearson Education
5. B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition
6. Andrew Tanenbaum, "Computer networks", Prentice Hall
7. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall
8. William Stallings, "Data and computer communications", Prentice Hall

Program Elective – II

ECEL601   **Bio-Medical Electronics**

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objectives:
- To introduce the students about human anatomy and imparting knowledge about types of Bio-electric signals.
- To give exposure to students about various machines used for medical diagnosis of illness.
- To introduce the students about recording systems used for measurement of the bio-electric signals.
- To introduce students about latest technologies.

Syllabus

Unit 1: Brief introduction to human physiology, origin of bioelectric signals, basic biomedical instrumentation system, transducers and sensors, displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases.

Unit 2: Measurement of blood temperature, blood pressure, blood flow, blood pH, pCO_2, pO_2.

Unit 3: Bio-electrodes and biomedical recorders, ECG, EMG, EEG, Phono cardiograph,

Unit 4: MRI and ultrasonic imaging systems, X-Ray machines, X-Ray computed tomography, Echo-cardiograph. Prostheses and aids, pacemakers, External pacemaker, implantable pacemaker, programmable pacemaker, defibrillators, heart-lung machine, artificial kidney.

Unit 5: Introduction to bio telemetry and its applications in patient care, patient monitoring system, aids for the handicapped, Safety aspects

Unit 6: LASER application in bio-medical field.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the human anatomy and types of bioelectric signals and analyze the biological processes like other electronic processes.
- Understand mechanism of various machines used for medical diagnosis of illness.
- Understand various types of recording systems used for measurement of the bio-electric signals.
- Understand about latest technologies.

Text Books:
1. Introduction to Bio-Medical Instrumentation: R.S. Khandpur,Tata McGraw Hill, New Delhi
2. Bio-Medical Instrumentation: Crambell, Tata McGraw Hill, New Delhi

Reference Books:
1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

ECEL602   **Introduction to Information Theory and Coding**
(Information Theory and Coding*-old Name)

L T P CR		
3 0 0 3	**Theory** :	**75**
	Class Work :	**25**
	Total :	**100**
	Duration of Exam :	**3 Hrs.**

Course Objectives:
- To study the concept of information, measurement and entropy.
- To impart the knowledge to analyze different types of channel and their capacity.
- To study the concept of Gaussian channel and Gaussian theorem.
- To study different types of encoders for source coding.

Syllabus

Unit 1: Measures of Information: Basics of information theory, information theory versus coding theory, model of information processing system, information and probability, Information measurement, self information, mutual information and joint information, Entropy, discrete and continuous entropy, Relative Entropy, Joint and conditional entropy, Encoding a source alphabet,

Unit 2: Channel Capacity: Stationary Markov Sources, Entropy Rate and Data Compression, Discrete Memory Less Channels, Statics of discrete channel, Channel Capacity And Its Computation Of Discrete Memory Less Channels (BNC, BSC, BEC, Cascaded Channels, Noiseless Channels, distortion-less channel, Noisy Typewriter), The Channel Coding Theorem, Shannon's theory And The Physical Significance Of Capacity, Continuous channel, capacity of Gaussian channel, bandwidth and S/N trade off

Unit 3: Data Compression by Fixed-To-Variable-Length Codes: Unique Decodability and The Prefix Condition, Kraft Inequality, Relationship of Average Codeword Length to Source Entropy, source efficiency and redundancy, Fixed and Variable length coding, Examples of Coding Techniques, Huffman, Shannon-Fano-Elias, Lempel-Ziv, Universal coding.

Unit 4: Line Coding: Line coding and its properties, to understand the various PAM formats or line codes, Unipolar RZ & NRZ, Polar RZ & NRZ, Bipolar NRZ, Split Phase Manchaster format, Polar Quaternary NRZ format.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the concept of information and entropy.
- Understand different types of channel and Calculation of channel capacity.
- Understand Shannon's theorem for coding.
- Encode messages using different types of coding techniques.
- Encode source message using line coding technique.

Textbooks/References
1. T.M. Cover and J.A. Thomas, Elements of Information Theory, John Wiley (1991).
2. R.G. Gallager, Information Theory and Reliable Communication, Wiley (1968).
3. R.J. McEliece, Theory of Information and Coding, Addison-Wesley (1977).
4. Stefan M. Moser, Po-Ning Chen, Coding and Information Theory, Cambridge University Press, 2012.
5. N. Abramson, "Information and coding" McGraw Hill, 1963.

Speech and Audio Processing
L T P CR   Theory   :   75
3 0 0   3   Class Work   :   25
                                                                   Total   :   100
                                                                   Duration of Exam :   3 Hrs.

Course Objectives:
- To introduce the students about production & modelling of speech signal, coding techniques & speech signal processing.
- To study linear prediction of speech & speech quantization.
- To familiarize with LPC model & scalar quantization.
- To familiarize with CELP model & speech coding standards.

Syllabus

Unit 1: Introduction: Speech production and modelling, Human Auditory System, General structure of speech coders, Classification of speech coding techniques, parametric, waveform and hybrid, Requirements of speech codecs, quality, coding delays, robustness.

Unit 2: Speech Signal Processing: Pitch-period estimation, all-pole and all-zero filters, convolution, Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Unit 3: Linear Prediction of Speech: Basic concepts of linear prediction, Linear Prediction Analysis of non-stationary signals, prediction gain, examples, Levinson-Durbin algorithm, Long term and short-term linear prediction models, Moving average prediction.

Unit 4: Speech Quantization: Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers, Vector quantization, distortion measures, codebook design, codebook types.

Unit 5: Scalar Quantization of LPC: Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency, LPC to LSF conversions, quantization based on LSF.

Unit 6: Linear Prediction Coding: LPC model of speech production, Structures of LPCencoders and decoders, Voicing detection, Limitations of the LPC model.

Unit 7: Code Excited Linear Prediction: CELP speech production model, Analysis-by-synthesis, Generic CELP encoders and decoders, Excitation codebook search, state-save method, zero-input zero state method, CELP based on adaptive codebook, Adaptive Codebook search, Low Delay CELP and algebraic CELP.

Unit 8: Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards.

Course Outcomes: On successful completion of this course, the students should be able to:
- Mathematically model the speech signal.
- Analyze the quality and properties of speech signal.
- Modify and enhance the speech and audio signals.
- To familiarize with CELP model & speech coding standards

Text/Reference Books:
1. "Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students_ *Edition), 2004.*
2. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

ECEL604   **Scientific Computing**

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objective:
- To understand the significance of computing methods, their strengths and application areas.
- To understand the significance strengths and application areas of.
- To perform the computations on various data using appropriate computation tools.

Unit 1: Introduction: Sources of Approximations, Data Error and Computational, Truncation Error and Rounding Error, Absolute Error and Relative Error, Sensitivity and Conditioning, Backward Error Analysis, Stability and Accuracy

Unit 2: Computer Arithmetic: Floating Point Numbers, Normalization, Properties of Floating Point System, Rounding, Machine Precision, Subnormal and Gradual Underflow, Exceptional Values, Floating-Point Arithmetic, Cancellation

Unit 3: System of liner equations: Linear Systems, Solving Linear Systems, Gaussian elimination, Pivoting, Gauss-Jordan, Norms and Condition Numbers, Symmetric Positive Definite Systems and Indefinite System, Iterative Methods for Linear Systems

Unit 4: Linear least squares: Data Fitting, Linear Least Squares, Normal Equations Method, Orthogonalization Methods, QR factorization, Gram-Schmidt Orthogonalization, Rank Deficiency, and Column Pivoting

Unit 5: Eigen values and singular values: Eigen values and Eigenvectors, Methods for Computing All Eigen values, Jacobi Method, Methods for Computing Selected Eigenvalues, Singular Values Decomposition, Application of SVD

Unit 6: Nonlinear equations: Fixed Point Iteration, Newton's Method, Inverse Interpolation Method Optimization, One-Dimensional Optimization, Multidimensional Unconstrained Optimization, Nonlinear Least Squares

Unit 7: Interpolation: Purpose for Interpolation, Choice of Interpolating, Function, Polynomial Interpolation, Piecewise Polynomial Interpolation

Unit 8: Numerical Integration And Differentiation: Quadrature Rule, Newton-Cotes Rule, Gaussian Quadrature Rule, Finite Difference Approximation, Initial Value Problems for ODES, Euler's Method, Taylor Series Method, Runga-Kutta Method, Extrapolation Methods, Boundary Value Problems For ODES, Finite Difference Methods, Finite Element Method, Eigenvalue Problems, Partial Differential Equations, Time Dependent Problems, Time Independent Problems, Solution for Sparse Linear Systems, Iterative Methods, Fast Fourier Transform, FFT Algorithm, Limitations, DFT, Fast polynomial Multiplication, Wavelets, Random Numbers And Simulation, Stochastic Simulation, Random Number Generators, Quasi-Random Sequences

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the significance of computing methods, their strengths and application areas.
- Perform the computations on various data using appropriate computation tools.

Text/ Reference Books:

1. Heath Michael T., "Scientific Computing: An Introductory Survey" , McGraw-Hill, 2nd Ed., 2002.
2. Press William H., Saul A. Teukolsky, Vetterling William T and Brian P. Flannery, "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press, 3rd Ed., 2007.
3. Xin-she Yang (Ed.)., "Introduction To Computational Mathematics", World Scientific Publishing Co., 2nd Ed., 2008.
4. Kiryanov D. and Kiryanova E., "Computational Science", Infinity Science Press, 1st Ed., 2006.
5. Quarteroni, Alfio, Saleri, Fausto, Gervasio and Paola, "Scientific Computing With MATLAB And Octave", Springer, 3rd Ed., 2010.

Program Elective - III

ECEL605   **Microwave Theory and Techniques**
L T P CR   Theory   :   75
3 0 0   3   Class Work :   25
                                                      Total   :   100
                                                      Duration of Exam :   3 Hrs.

Course Objectives:

- To familiarize with microwave frequency band and understand the mathematical model of microwave the transmission.
- To give exposure regarding analysis of the RF and Microwave transmission line and microwave networks.
- To study the microwave active and passive devices and understand design principle of filters, amplifiers, oscillators and microwave antennas.
- To study the microwave measurement and understand the concept of microwave systems.

Syllabus

Unit 1: Introduction to Microwaves: History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC.

Unit 2: Mathematical Model of Microwave Transmission: Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

Unit 3: Analysis of RF and Microwave Transmission Lines: Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line.

Unit 4: Microwave Network Analysis: Equivalent voltages and currents for non- TEMlines, Network parameters for microwave circuits, Scattering Parameters.

Unit 5: Passive and Active Microwave Devices: Microwave passive components, Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator, Microwave active components, Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices, Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes, Klystron, TWT, Magnetron.

Unit 6: Microwave Design Principles: Impedance transformation, Impedance Matching,Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas, Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas.

Unit 7: Microwave Measurements: Power, Frequency and impedance measurement atmicrowave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure, Measurement of Microwave antenna parameters.

Unit 8: Microwave Systems: Radar, Terrestrial and Satellite Communication, Radio Aidsto Navigation, RFID, GPS. Modern Trends in Microwaves Engineering Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.

Course Outcomes: On successful completion of this course, the students should be able to:

- Understand various microwave system components their properties.
- To understand passive & active microwave devices and design principles.
- Appreciate that during analysis/ synthesis of microwave systems, the different mathematical treatment is required compared to general circuit analysis.
- Design microwave systems for different practical application.

Text/Reference Books:
1. R.E. Collins, Microwave Circuits, McGraw Hill
2. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

ECEL606   **Digital Image & Video Processing**
L T P CR   Theory   :   75
3 0 0 3   Class Work   :   25
                                                             Total   :   100
                                                             Duration of Exam :   3 Hrs.

Course Objectives:
- To introduce the students with the fundamentals of digital image processing techniques as well as image enhancement & filtering.
- To give exposure to students regarding color image processing & image segmentation.
- To introduce the concept of Multi-resolution image processing tech, as well as image compression techniques and standards.
- To impart knowledge regarding video coding & video segmentation.

Syllabus

Unit 1: Digital Image Fundamentals: Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels–neighbourhood, adjacency, connectivity, distance measures.

Unit 2: Image Enhancements and Filtering: Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters, linear and order-statistics, pixel-domain sharpening filters, first and second derivative, two-dimensional DFT and its inverse, frequency domain filters, low-pass and high-pass.

Unit 3: Color Image Processing: Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Unit 4: Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.

Unit 5: Wavelets and Multi-resolution image processing: Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

Unit 6: Image Compression: Redundancy, inter-pixel and psycho-visual, Lossless compression predictive, entropy, Lossy compression, predictive and transform coding, Discrete Cosine Transform, Still image compression standards, JPEG and JPEG-2000.

Unit 7: Fundamentals of Video Coding: Inter-frame redundancy, motion estimation techniques fullsearch, fast search strategies, forward and backward motion prediction, frame classification-I, P and B, Video sequence hierarchy, Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards, MPEG and H.26X.

Unit 8: Video Segmentation: Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts, spatial segmentation – motion-based, Video object detection and tracking.

Course Outcomes: On successful completion of this course, the students should be able to:
- Mathematically represent the various types of images and analyze them.
- Process these images for the enhancement of certain properties or for optimized use of the resources.
- Develop algorithms for image compression and coding.
- Understand the various types of video segmentation.

Text/Reference Books:
1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008.
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004.
3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015.

ECEL607	Software Defined Radio		
L T P CR	Theory	:	75
3 0 0 3	Class Work	:	25
	Total	:	100
	Duration of Exam	:	3 Hrs.

Course Objectives:
- To make student capable of the SDR and implementation details
- To introduce the students about the blocks of SDR for a specific application
- To introduce the students about the challenges in the implementation of SDR
- To introduce the students about transmitter and receiver architectures in SDR

Syllabus

Introduction – Software Defined Radio – A Traditional Hardware Radio Architecture – Signal Processing Hardware History – Software Defined Radio Project Complexity.

A Basic Software Defined Radio Architecture – Introduction – 2G Radio Architectures- Hybrid Radio Architecture- Basic Software Defined Radio Block Diagram- System Level Functioning Partitioning-Digital Frequency Conversion Partitioning.

RF System Design – Introduction- Noise and Channel Capacity- Link Budget- Receiver Requirements- Multicarrier Power Amplifiers- Signal Processing Capacity Tradeoff.

Analog-to-Digital and Digital-to-Analog Conversion- Introduction – Digital Conversion Fundamentals- Sample Rate- Bandpass Sampling- Oversampling- Antialias Filtering – Quantization – ADC Techniques-Successive Approximation- Figure of Merit-DACs- DAC Noise Budget- ADC Noise Budget.

Digital Frequency Up- and Down Converters- Introduction- Frequency Converter Fundamentals- Digital NCO- Digital Mixers- Digital Filters- Halfband Filters- CIC Filters- Decimation, Interpolation, and Multirate Processing-DUCs - Cascading Digital Converters and Digital Frequency Converters.

Signal Processing Hardware Components- Introduction- SDR Requirements for Processing Power- DSPs- DSP Devices- DSP Compilers- Reconfigurable Processors- Adaptive Computing Machine- FPGAs

Software Architecture and Components – Introduction- Major Software Architecture Choices – Hardware – Specific Software Architecture- Software Standards for Software Radio- Software Design Patterns- Component Choices- Real Time Operating Systems- High Level Software Languages- Hardware Languages.

Smart Antennas for Software Radio- Introduction- 3G smart Antenna Requirements- Phased Antenna Array Theory- Applying Software Radio Principles to Antenna Systems- Smart Antenna Architectures- Optimum Combining/ Adaptive Arrays- DOA Arrays- Beam Forming for CDMA- Downlink Beam Forming.

Course Outcomes: On successful complete of this course, the students should be able to:
- Conceptualize the SDR and implementation details
- Identify the blocks of SDR for a specific application
- Recognize the challenges in the implementation of SDR
- Analyze the transmitter and receiver architectures in SDR

Text Books:

1. Paul Burns, Software Defined Radio for 3G, Artech House, 2002.
2. Tony J Rouphael, RF and DSP for SDR, Elsevier Newnes Press, 2008
3. Jouko Vanakka, Digital Synthesizers and Transmitter for Software Radio, Springer, 2005.
4. P Kenington, RF and Baseband Techniques for Software Defined Radio, Artech House, 2005.

Program Elective – IV

ECEL608   **Mobile Communication Network**

L T P CR		
3 0 0 3	Theory	:	75

Class Work	:	25
Total	:	100
Duration of Exam	:	3 Hrs.

Course Objectives:
- To introduce working principles of mobile communication system.
- To introduce various technologies of mobile communication.
- To introduce various analysis techniques of communication systems.
- To introduce various multiple access techniques for mobile communication.

Syllabus

Unit 1: Cellular concepts: Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control, Wireless Standards, Overview of 2G and 3G cellular standards.

Unit 2: Signal propagation: Propagation mechanism, reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading, Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Unit 3: Capacity of flat and frequency selective channels. Antennas: Antennas for mobile terminal monopole antennas, PIFA, base station antennas and arrays.

Unit 4: Multiple access schemes: FDMA, TDMA, CDMA and SDMA, Modulation schemes, BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

Unit 5: Receiver structure: Diversity receivers, selection and MRC receivers, RAKE receiver, equalization, linear-ZFE and adaptive, DFE, Transmit diversity-Altamonte scheme.

Unit 6: MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff, Performance measures, Outage, average snr, average symbol/bit error rate. System examples, GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the working principles of the mobile communication systems.
- Understand the relation between the user features and underlying technology.
- Analyze mobile communication systems for improved performance.
- Understand various multiple access techniques.

Text/Reference Books:
1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

ECEL609   **Introduction to Wireless Sensor Networks**
                               (Wireless Sensor Networks*-Old Name)

L T P CR   **Theory**   :   **75**
3 0 0 3   **Class Work**   :   **25**
                                                 Total   :   **100**
                                                 Duration of Exam :   **3 Hrs.**

Course Objectives:
- To introduce designing of wireless sensor network applications.
- To introduce various research areas in wireless sensor networks.
- To introduce various MAC protocol used in WSN.
- To teach students how to explore new protocols for WSN.

Syllabus

Unit 1: Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks.

Unit 2: Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

Unit 3: Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee.

Unit 4: Dissemination protocol for large sensor network, Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

Unit 5: Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

Unit 6: Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.

Course Outcomes: On successful completion of this course, the students should be able to:
- Design wireless sensor networks for a given application
- Understand emerging research areas in the field of sensor networks
- Understand MAC protocols used for different communication standards used in WSN
- Explore new protocols for WSN

Text/Reference Books:
1. Waltenegus Dargie , Christian Poellabauer, "Fundamentals Of Wireless Sensor Networks Theory And Practice", By John Wiley & Sons Publications ,2011
2. Sabrie Soloman, "Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications,2004
4. Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science
5. Philip Levis, And David Gay "TinyOS Programming" by Cambridge University Press 2009

ECEL610 **MIMO Wireless Communication**

L T P CR	Theory : 75
3 0 0 3	Class Work : 25
	Total : 100
	Duration of Exam : 3 Hrs.

Course Objectives:
- To introduce basic terms of performance measurement.
- To introduce fading channel characteristics
- To introduce the students performance of multi channel receivers
- To introduce multi channel transmission
- To introduce error probability analysis

Unit1: Introduction: System Performance Measures, Average Signal-to-Noise Ratio (SNR), Outage Probability, Average Bit Error Probability (BEP) , Amount of Fading , Average Outage Duration, Conclusions

Unit2: **Fading Channel Characterization and Modeling:** Main Characteristics of Fading Channels, Envelope and Phase Fluctuation, Slow and Fast Fading , Frequency-Flat and Frequency-Selective Fading, Modeling of Flat-Fading Channels, Multipath Fading, Rayleigh, Nakagami-q (Hoyt), Nakagami-n (Rice), Nakagami-m , Weibull , Log-Normal Shadowing , Composite Multipath/, Composite Gamma/Log-Normal Distribution , Suzuki Distribution, Rician Shadowed Distributions ,Modeling of Frequency-Selective Fading Channels

Unit 3: **Performance of Multichannel Receivers:** Diversity Combining , Diversity Concept, Mathematical Modeling , Brief Survey of Diversity Combining Techniques, Pure Combining Techniques, Complexity–Performance ,Maximal-Ratio Combining (MRC),Receiver, PDF-Based , MGF-Based Approach.

Unit 4: Multichannel Transmission—Transmit Diversity and Space-Time : A Historical Perspective, Transmit versus Receive Diversity—Basic Concepts, Alamouti's Diversity Technique—a Simple Transmit Diversity Scheme Using Two Transmit Antennas, Generalization of Alamouti's Diversity Technique to Orthogonal Space-Time Block Codes. MIMO channel, MIMO information Theory.

Unit 5: Error probability analysis, Transmit diversity and space-time coding, Linear STBC design, Differential coding for MIMO, Precoding, Multiuser MIMO

Course Outcomes: On successful complete of this course, the students should be able to:
- Understand the basic terms of performance measurement.
- Understand fading channel characteristics
- Understand the students performance of multi channel receivers
- Understand multi channel transmission
- Understand error probability analysis

Textbook:
1. E. G. Larsson and P. Stoica, Space-Time Block Coding for Wireless Communications, Cambridge University Press, 2003.
2. Marvin K. Simon and Mohamed-Slim Alouini, Digital Communication over Fading Channels, Second Edition, A JOHN WILEY & SONS, INC., PUBLICATION

Reference:
A. Paulraj, R. Nabar and D. Gore, Introduction to Space-Time Wireless Communications, Cambridge Univ. Press, 2003.

OEL601　　　　　　　　　　**Virtual Instruments Design**

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objectives:
- To introduce to the students about the interfacing techniques of various transducers.
- To expose the students to different signal conditioning circuits.
- To impart knowledge on the hardware required to build Virtual Instrument.
- To impart knowledge to build GUI for Virtual Instrument.

Syllabus

Unit 1: Transducer Interfacing: Interfacing techniques for the following transducers, Potentiometers, Temperature sensors, Thermocouple, RTD, Thermistors, Load cells, High and low range tension, Low and mid range precision, Torque Sensors, Pressure sensors, Vibration Sensors, Acoustic Sensors, Automotive Sensors, Displacement sensors, Biomedical transducers.

Unit 2: Signal Conditioning: Filtering, Cold Junction Compensation, Amplification, Instrumentation Amplifier, Linearization, Circuit Protection, Ground loops, CMRR, Noise Reduction and Isolation, Attenuation, Multiplexing, Digital signal conditioning, IEEE1451 standards, Transducer Electronic Data Sheet (TEDS)

Unit 3: Data Acquisition and Hardware Selection: Overview of DAQ architecture, Analog IO & Digital IO, Finite and continuous buffered acquisition, Data acquisition with C language, Industrial Communication buses, Wireless network standards, Micro-controller selection parameters for a virtual instrument, CPU, code space (ROM), data space (RAM) requirements.

Unit 4: Real-Time OS for Small Devices: Small device real-time concepts, Resources, Sequential programming, Multitasking, RTOS, Kernels, Timing loops, Synchronization and scheduling, Fixed point analysis, Building embedded real-time application for small devices.

Unit 5: Graphical User Interface for Virtual Instrument: Building an embedded Virtual Instrument GUI, Text and Number display, GUI Windows management, Simulation, Display drivers, Creating and distributing applications, Examples of Virtual Instrument design using GUI in any of the applications like consumer goods, robotics, machine vision, and process control automation.

Course Outcomes: On successful completion of this course, the students should be able to:
- Interface the target transducer to the signal conditioning board.
- Condition the acquired signal from the transducer to standard data formats.
- Select the most appropriate hardware for the virtual instrument to be built.
- Implement the real-time OS for the selected micro-controller and the GUI interface for the virtual instrument.

Text Books:
1. Daniel H. Sheingold, Transducer Interfacing Handbook – A Guide to Analog Signal Conditioning, Analog Devices Inc. 1980.
2. Kevin James, PC Interfacing and Data Acquisition - Techniques for Measurement, Instrumentation and Control, Newnes, 2000.
3. Timothy Wilmshurst, Designing Embedded Systems with PIC Microcontrollers- Principles and Applications, Elsevier, 2007.

Reference Books:
1. Jean Labrosse, Embedded System Building Blocks, 2nd Edition. R&D Books, 2000
2. Jean Labrosse, MicroC/OS-II – The Real-Time Kernel, 2nd Edition. CMP Books, 2002

Data Structure

Theory   :   75
Class Work :   25
                                     Total   :   100
                                     Duration of Exam : 3 Hrs.

Course Objectives:
- To study in detail the concept of Loops, Conditional statements, Arrays, Functions, pointers, structures, file handling file concepts, file organization in C language.
- To study link list, Header Link list, Multiway link list and perform various data structure operations.
- To study the concept of stack and Queues and implement the same using array and link list form.
- To implement Binary Trees type and implement the same in array and link list form.
- To study the Graphs using set, linked and matrix representation.
- To study and implement file handling concepts.

Syllabus

Unit 1: Overview of 'C': Introduction, Flow of Control, Input output functions, Arrays and Structures, Functions.

Unit 2: Data structures and Algorithms an overview: concept of data structure, choice of right data structures, types of data structures, basic terminology Algorithms, how to design and develop an algorithm, stepwise refinement, use of accumulators and counters, algorithm analysis, complexity of algorithms Big-oh notation, Arrays, Searching Sorting, Introduction, One Dimensional Arrays,

Unit 3: Operations Defined: traversal, selection, searching, insertion, deletion, and sorting, Multidimensional arrays, address calculation of a location in arrays. Searching: Linear search, Recursive and Non recursive binary Search. Sorting: Selection sort, Bubble sort, Insertion sort, Merge sort, Quick sort, Shell sort, Heap sort

Unit 4: Stacks and queues: Stacks, array representation of stack, Applications of stacks, Queues, Circular queues, array representation of Queues, Deque, priority queues, Applications of Queues.

Unit 5: Pointers and Linked Lists: Pointers, Pointer variables, Pointer and arrays, array of pointers, pointers and structures, Dynamic allocation. Linked Lists: Concept of a linked list,. Circular linked list, doubly linked list, operations on linked lists. Concepts of header linked lists. Applications of linked lists, linked stacks, linked Queues.

Unit 6: Tree and Graphs: Trees: Introduction to trees, binary trees, representation and traversal of trees, operations on binary trees, types of binary trees, threaded binary trees, B Trees, Application of trees. Graphs: Introduction, terminology, set, linked and matrix representation, Graph traversal techniques: BFS, DFS, operations on graphs, Minimum spanning trees, Applications of graphs.

Unit 7: File Handling and Advanced data Structure: Introduction to file handling, Data and Information, File concepts, File organization, files and streams, working with files. AVL trees, Sets, list representation of sets, applications of sets, skip lists

Course Outcomes: On successful complete of this course, the students should be able to:

- Understand the programming of C language from basic to advance level.
- Understand the Concept of link list, stack, queue, binary tree its usage in real life.
- Understand the Working of binary trees and graph with their applications.
- Understand the concept of files and their organization of memory.

Text Books:
1. Data Structures using C by A. M. Tenenbaum, Langsam, Moshe J. Augentem, PHI Pub.
2. Data Structures using C by A. K. Sharma, Pearson

Reference Books:
1. Data Structures and Algorithms by A.V. Aho, J.E. Hopcroft and T.D. Ullman, Original edition, Addison-Wesley, 1999, Low Priced Edition.
2. Fundamentals of Data structures by Ellis Horowitz & SartajSahni, Pub, 1983,AW
3. Fundamentals of computer algorithms by Horowitz Sahni and Rajasekaran.
4. Data Structures and Program Design in C By Robert Kruse, PHI,
5. Theory & Problems of Data Structures by Jr. SymourLipschetz, Schaum's outline by TMH.
6. Introduction to Computers Science -An algorithms approach , Jean Paul Tremblay, Richard B. Bunt, 2002, T.M.H.

OEL603   **Cyber Laws and Security**
L T P CR   **Theory   :   75**
3 0 0   3   **Class Work :   25**
                                                   Total   :   100
                                                   Duration of Exam :   3 Hrs.

Course Objectives:
The Objectives of This Course is
- To enable learner to understand, explore, a critical understanding cyber law.
- To Develop Competencies for dealing with frauds and deceptions (confidence tricks, scams)
- To acquire knowledge on other Cyber Crimes that are taking place via the internet.

Unit 1: History of Information Systems and its Importance, basics, Changing Nature of Information Systems, Need of Distributed Information Systems, Role of Internet and Web Services, Information System Threats and attacks, Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Laptops Security Basic Principles of Information Security, Confidentiality, Integrity Availability and other terms in Information Security, Information Classification and their Roles.

Unit 2: Security Threats to E Commerce, Virtual Organization, Business Transactions on Web, E Governance and EDI, Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Physical Security- Needs, Disaster and Controls, Basic Tenets of Physical Security and Physical Entry Controls, Access Control- Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of biometrics, Design Issues in Biometric Systems, Interoperability Issues, Economic and Social Aspects, Legal Challenges.

Unit 3: Model of Cryptographic Systems, Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls, Design and Implementation Issues, Policies Network Security- Basic Concepts, Dimensions, Perimeter for Network Protection, Network Attacks, Need of Intrusion Monitoring and Detection, Intrusion Detection Virtual Private Networks- Need, Use of Tunneling with VPN, Authentication Mechanisms, Types of VPNs and their Usage, Security Concerns in VPN.

Unit 4: Security metrics- Classification and their benefits Information Security & Law, IPR, Patent Law, Copyright Law, Legal Issues in Data mIning Security, Building Security into Software Life Cycle Ethics- Ethical Issues, Issues in Data and Software Privacy Cyber Crime Types & overview of Cyber Crimes.

Course Outcomes:
1. Make learner conversant with the social and intellectual property issues emerging from cyberspace.
2. Explore the legal and policy developments in various countries to regulate cyberspace;
3. Develop the understanding of relationship between commerce and cyberspace;
4. Give learners in depth knowledge of information technology act and legal frame work of rightto privacy, data security and data protection.
5. Make study on various case studies on real time crimes.

References:

1. Godbole,— Information Systems Security‖, Willey
2. Merkov, Breithaupt, — Information Security‖, Pearson Education
3. Yadav, —Foundations of Information Technology‖, New Age, Delhi
4. Schou, Shoemaker, — Information Assurance for the Enterprise‖, Tata McGraw Hill Sood,—Cyber Laws Simplified‖, Mc Graw Hill
5. Furnell, —Computer Insecurity‖, Springer 7. IT Act 2000

PEC-ME-461   **Study of Quality Management**
OEL604* (Old Code)   **(Quality Management*- Old Name)**

L T P CR			
3 0 0 3	Theory	:	75
	Class Work	:	25
	Total	:	100
	Duration of Exam	:	3 Hrs.

Course Objectives:
To facilitate the understanding of total quality management principles and processes
To understand TQM principles tools and application
To analyse seven traditional tools of quality
To examine and understand Quality editing

Course Contents:
Unit 1: Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

Unit 2: TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

Unit 3: The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

Unit 4: TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

Unit 5: Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Course Outcomes:
Upon completion of this course,
- The students will be able to use the tools and techniques of TQM in manufacturing and service sectors.
- The students will understand TQM principles tools and application
- Will be able to analyse seven traditional tools of quality
- Will develop understanding of Quality editing

Text Books:
1. Besterfield D.H. et al., Total qualityManagement, 3rd ed., Pearson Education Asia, 2006.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

OEL605   **Measurement Data Analysis**

L T P CR	Theory	:	75
3 0 0 3	Class Work	:	25
	Total	:	100
	Duration of Exam	:	3 Hrs.

Course Objectives:
- To familiarize the student regarding measurement inaccuracies.
- To give exposure to students about measurement system based on its quality and cost.
- To familiarize the student regarding both theoretical knowledge and practical skills in working with measurement data.
- To give exposure to students about design and conduct experiments to analyze and interpret the data and generate reports.

Syllabus

Unit 1: General information about measurements, measuring instruments and their properties: Statistical methods for Experimental Data Processing, Estimation of the parameters, Construction of confidence intervals, Methods for testing Hypotheses and sample homogeneity, Trends in applied statistics and experimental data processing, Direct measurements, Method for calculating the errors and uncertainties, Methods for combining systematic and random errors.

Unit 2: Indirect measurements: Correlation coefficient and its calculation, the method of reduction, method of transformation, errors and uncertainty of indirect measurement. Examples of measurements and measurement data processing.

Unit 3: Combined Measurements: Method of least squares, linearization of nonlinear conditional equations, and determination of the parameters in formulas from empirical data and construction of calibration curves, combining the results of measurements, Calculation of the errors of measuring instruments.

Course Outcomes: On successful completion of this course, the students should be able to:
- Estimate measurement inaccuracies.
- Evaluate the measurement system based on its quality and cost.
- Acquire both theoretical knowledge and practical skills in working with measurement data.
- Design and conduct experiments to analyze and interpret the data and generate reports.

Text Books:
1. Semyon G. Rabinovich, Measurement Errors and Uncertainties – Theory and Practice, Springer Publication, 3rd Edition, 2005.
2. S.V. Gupta, Measurement Uncertainties: Physical Parameters and Calibration of Instruments, Springer, 2012.

Reference Books:
1. Ifan Hughes and Thomas Hase, Measurements and Their Uncertainties: A Practical Guide to Modern Error Analysis, Oxford University Press, 2010.
2. Michael, Grabe, Measurement Uncertainties in Science and Technology, Springer 2005.

EC653   **Electronics Measurement Lab**

L T P CR   **Theory** :   35
0 0 2   1   **Class Work** :   15
                                                          Total   :   **50**

List of Experiments

1. Find the value of unknown resistance using Wheatstone Bridge.

2. To measure unknown frequency using CRO by Lissajous pattern

3. To find value of unknown resistance using Kelvin Double Bridge

4. To measure power factor of AC load using voltage current method.

5. Study and analysis of working principle of energy meter.

6. To study potential transformer (PT).

7. To study current transformer (CT).

8. To measure high power using Instrument Transformer.

9. To determine B-H curve of ferromagnetic material.

10. To study AC bridges (Hay's bridge, Maxwell bridge, Schering bridge)

Course Outcomes: On successful complete of this course, the students should be able to:
- Operate and make the various measurements on Wheatstone Bridge, CRO, Kelvin Double Bridge and thermocouple.
- Operate potential transformer and current transformer.
- Measure high power using Instrument Transformer.
- Determine B-H curve of ferromagnetic material

Program Elective – V

ECEL701   **Antenna and Propagation**

L T P CR   Theory   :   75
3 0 0   3   Class Work :   25
                                          Total   :   100
                                  Duration of Exam :   3 Hrs.

Course Objectives:
- To study the fundamental concepts of antennas.
- To familiarize the design concept of aperture, reflector and microstrip antennas.
- To familiarize the concept of antenna arrays.
- To study the basic concept of smart antenna and radio wave propagation.

Syllabus

Unit 1: Fundamental Concepts: Physical concept of radiation, Radiation pattern, near-andfar-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

Unit 2: Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

Unit 3: Aperture and Reflector Antennas: Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas.

Unit 4: Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas.

Unit 5: Micro strip Antennas: Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

Unit 6: Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

Unit 7: Basic Concepts of Smart Antennas: Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming. Different modes of Radio Wave propagation used in current practice.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the properties and various types of antennas.
- Analyze the properties of different types of antennas and their design.
- Operate antenna design software tools and come up with the design of the antenna of required specifications.
- Understand the concept of smart antenna and radio wave propagation.

Text/Reference Books:
1. J.D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw ill, 1984.
5. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
6. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005.
7. R.E. Crompton, Adaptive Antennas, John Wiley

ECEL702   **High Speed Electronics**

L T P CR	Theory	:	75
3 0 0 3	Class Work	:	25
	Total	:	100
	Duration of Exam	:	3 Hrs.

Course Objectives:
- To introduce the basics of transmission line and impact of various parameters for optimisation.
- To give exposure to students regarding myriad electronics devices for distortion free output.
- To impart the knowledge of various signal conversion techniques with transceiver, architecture.
- To introduce CAD tools for PCB designing & identify control & design challenges.

Syllabus

Unit 1: Transmission line theory (basics) crosstalk and non ideal effects, signal integrity, impact of packages, vias, traces, connectors, non-ideal return current paths, high frequency power delivery, methodologies for design of high speed buses, radiated emissions and minimizing system noise, Noise Analysis, Sources, Noise Figure, Gain compression, Harmonic distortion, Inter modulation, Cross-modulation, Dynamic range

Unit 2: Devices, Passive and active, Lumped passive devices (models), Active (models, low vs. high frequency).

Unit 3: RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages.

Unit 4: Mixers, Up conversion Down conversion, Conversion gain and spurious response, Oscillators Principles, PLL Transceiver architectures.

Unit 5: Printed Circuit Board Anatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards, Board Assembly, Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand significance and the areas of application of high-speed electronics circuits.
- Understand the properties of various components used in high speed electronics.
- Design High-speed electronic system using appropriate components.
- Able to design system using CAD tools for PCB design.

Text/Reference Books:
1. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE Press
2. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 2004, ISBN 0521835399.
3. Behzad Razavi, "RF Microelectronics", Prentice-Hall 1998, ISBN 0-13-887571-5.
4. Guillermo Gonzalez, "Microwave Transistor Amplifiers", 2nd Edition, Prentice Hall
5. Kai Chang, "RF and Microwave Wireless systems", Wiley.
6. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

ECEL703   **Wavelets**

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objectives:
- To study the concept of Time analysis resolution problem associated with STFT.
- To study the concept of origins of wavelets.
- To study the concept of continuous wavelet & discrete wavelet transform.
- To study the concept of Biorthogonal wavelets and application of wavelets.

Syllabus

Unit 1: Short Time Fourier Transform (STFT): Signal representation with continuous and discrete STFT, concept of time-frequency resolution, Resolution problem associated with STFT, Heisenberg's Uncertainty principle and time frequency tiling, Why wavelet transform?

Unit 2: Introduction to Wavelet Transform: The origins of wavelets, Wavelets and other wavelet like transforms, History of wavelet from Morlet to Daubechies via Mallat, Different communities and family of wavelets, Different families of wavelets within wavelet communities

Unit 3: Continuous Wavelet Transform: Wavelet transform-A first level introduction, Continuous time-frequency representation of signals, Properties of wavelets used in continuous wavelet transform, Continuous versus discrete wavelet transform.

Unit 4: Discrete Wavelet Transform: Haar scaling functions and function spaces, Translation and scaling of $\phi(t)$, Orthogonality of translates of $\phi(t)$, Function space V_0, Finer Haar scaling functions, Concepts of nested vector spaces, Haar wavelet function, Scaled and translated Haar wavelet functions, Orthogonality of $\phi(t)$ and $\psi(t)$, Normalization of Haar bases at different scales, Refinement relation with respect to normalized bases, Support of a wavelet system, Daubechies wavelets, Plotting the Daubechies wavelets,

Unit 5: Biorthogonal Wavelets: Biorthogonality in vector space, Introduction to Biorthoeonal Wavelet Systems, Signal Representation Using Biorthogonal Wavelet System,

Unit 6: Applications of Wavelets: Application of wavelet theory to signal denoising, image and video compression, multi-tone digital communication, transient detection**.**

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand time-frequency nature of the signals.
- Apply the concept of wavelets to practical problems.
- Mathematically analyze the systems or process the signals using appropriate wavelet functions.
- To understand the Biorthogonal wavelets & application of wavelets.

Text/Reference Books:
1. K. P. Soman, K. I. Rmachandran, N. G. Resmi, "Insight into Wavelets: From Theory to Practice, (Third Edition)", PHI Learning Pvt. Ltd., 2010.
2. A.N. Akansu and R.A. Haddad, "Multiresolution signal Decomposition: Transforms, Subbands and Wavelets", Academic Press, Oranld, Florida, 1992.

3. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Prentice Hall, 2007.
4. Rafael C. Gonzalez, Richard E. Woods "Digital Image Processing (Third Edition)", Pearson International Edition, 2009.
5. C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc.

Program Elective – VI

ECEL704   **Fiber Optic Communication**

L T P CR	Theory	:	75
3 0 0 3	Class Work	:	25
	Total	:	100
	Duration of Exam	:	3 Hrs.

Course Objectives:
- Introduce the concept of optical fiber communication, different models of optics.
- Introduce the concept of optical fiber characteristics (dispersion and attenuation) and understand fabrication of fibers and measurement techniques.
- Introduce the concept of optical sources (LED and LASER), photo detector, Optical switches and Optical amplifiers.
- Introduce the basic concept of WDM, DWDM system and nonlinear effect on optical fibers.

Syllabus

Unit 1: Introduction to vector nature of light, propagation of light, propagation of light ina cylindrical dielectric rod, Ray model, wave model.

Unit 2: Different types of optical fibers, Modal analysis of a step index fiber, Signal degradation on optical fiber due to dispersion and attenuation, Fabrication of fibers and measurement techniques like OTDR.

Unit 3: Optical sources- LEDs and Lasers, Photo-detectors, pin-diodes, APDs, detector responsivity, noise, optical receivers, Optical link design, BER calculation, quantum limit, power penalties.

Unit 4: Optical switches-coupled mode analysis of directional couplers, electro-optic switches.

Unit 5: Optical amplifiers-EDFA, Raman amplifier.

Unit 6: WDM and DWDM systems, Principles of WDM networks.

Unit 7: Nonlinear effects in fiber optic links, Concept of self-phase modulation, group velocity dispersion and solition based communication.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the principles fiber-optic communication, the components and the bandwidth advantages.
- Understand the properties of the optical fibers and optical components.
- Understand operation of lasers, LEDs, and detectors.
- Analyze system performance of optical communication systems.
- Design optical networks and understand non-linear effects in optical fibers.

Text/Reference Books
1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997.
7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

ECEL705 **Adaptive Signal Processing**

L T P CR	Theory	:	75
3 0 0 3	Class Work	:	25
	Total	:	100
	Duration of Exam	:	3 Hrs.

Course Objectives:
- To introduce the concept of adaptive filtering & estimation.
- To explain the concept of LMS algorithm and excess mean square error.
- To introduce the concept of signal space concepts, orthogonality, Gram-Schmidt orthogonalization, orthogonal decomposition of vector spaces.
- To introduce recursive least squares (RLS).

Syllabus

Unit 1: General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Unit 2: Optimal FIR (Wiener) filter, Method of steepest descent, extension to complexvalued, The LMS algorithm (real, complex), convergence analysis, weight errorcorrelation matrix, excess mean square error and mis-adjustment

Unit 3: Variants of the LMS algorithm, the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering, Signal space concepts, introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.

Unit 4: Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Unit 5: Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the concept of adaptive filtering & estimation.
- Understand the concept of LMS algorithm and excess mean square error.
- Understand the concept of signal space concepts.
- Understand the recursive least squares(RLS).

Text/Reference Books:
1. S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

ECEL706   **Mixed Signal Design**

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objectives:
- To familiarize the concept of signal processing of analog & digital signals.
- To introduce the concept of switched capacitor filters & its application in various areas.
- To familiarize the various conversion techniques.
- To introduce the concept of data transmission on integrated circuits.

Unit 1: Analog and discrete-time signal processing, introduction to sampling theory, Analog continuous time filters, passive and active filters, Basics of analog discrete-time filters and Z-transform.

Unit 2: Switched, capacitor filters, Nonidealities in switched-capacitor filters, Switched-capacitor filter architectures, Switched-capacitor filter applications.

Unit 3: Basics of data converters, Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

Unit 4: Mixed-signal layout, Interconnects and data transmission, Voltage-mode signalingand data transmission, Current-mode signaling and data transmission.

Unit 5: Introduction to frequency synthesizers and synchronization, Basics of PLL,Analog PLLs, Digital PLLs, DLLs.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the practical situations where mixed signal analysis is required.
- Analyze and handle the inter-conversions between signals.
- Design systems involving mixed signals.
- Design various type of high speed & low power interconnects & frequency synthesisers.

Text/Reference Books:
1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008.
2. Behzad Razavi , Design of analog CMOS integrated circuits, McGraw-Hill, 2003.
3. R. Jacob Baker, CMOS circuit design, layout and simulation, Revised second edition, IEEE press, 2008.
4. Rudy V. dePlassche, CMOS Integrated ADCs and DACs, Springer, Indian edition, 2005.
5. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill, 1981.
6. R. Schauman, Design of analog filters by, Prentice-Hall 1990 (or newer additions).
7. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford university press, first Indian edition, 2008.

Program Elective – VII

ECEL707

Basics of Satellite Communication

L T P CR		
3 0 0 3	Theory	:	75

Theory : 75
Class Work : 25
Total : 100
Duration of Exam : 3 Hrs.

Course Objectives:
- To introduce the students about basics of satellite communication and orbital mechanics.
- To study satellite subsystems and typical phenomenon in satellite communication.
- To familiarize with mathematical equations required for link designing considering clear air & rainy conditions.
- To familiarize with modulation & multiple access schemes in satellite communication.

Syllabus

Unit 1: Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

Unit 2: Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Unit 3: Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

Unit 4: Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Unit 5: Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

Unit 6: Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

Text /Reference Books:
1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009

Course Outcomes: On successful completion of this course, the students should be able to:
- Visualize the architecture of satellite systems as a means of high speed, high range communication system.
- State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
- Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

- Understand various modulation and multiple access techniques.

ECEL708   **Embedded Systems**

L T P CR	**Theory**	**:**	**75**
3 0 0 3	**Class Work**	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Syllabus

Course Objectives:
- To learn design concept and approach of embedded systems using advanced controllers.
- To learn hardware design features and memories of embedded systems.
- To learn software design features of embedded systems.
- To learn processor peripherals and their interfacing with microprocessors.

UNIT 1: Concept of Embedded Systems Design: Embedded system overview, design challenges, processor technology, design technology, and Examples of Embedded System.

UNIT 2: Custom single-purpose processors: Hardware, Basic combinational logic design, Sequential logic design, custom single purpose processor design.

UNIT 3: General purpose processors: Software, Basic architecture, operation, programmer's view, development environment, ASIC processors.

UNIT 4: Microprocessors memories: Memory write ability and storage permanence, common memory types, memory hierarchy and cache, Advanced RAM.

UNIT 5: **Standard single**: purpose processors, peripherals, Timers, counters, watchdog timers, UART, PWM, RTC, LCD controllers, keypad controllers, ADCs, Stepper motor controllers.

UNIT 6: Microprocessor Interfacing: Communication basics, I/O addressing, Interrupts, DMA, arbitration.

Text/Reference Books:
1. Frank Vahid , "Embedded System Design" Wiley India Edition, 2001.
2. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole,
3. 2000.
4. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
5. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
6. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
7. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand design concept and approach of embedded systems using advanced controllers.
- Understand hardware design features and memories of embedded systems.
- Understand software design features of embedded systems.
- Understand processor peripherals and their interfacing with microprocessors.

ECEL709	Error Correcting Codes			
L T P CR	Theory	:	75	
3 0 0 3	Class Work	:	25	
	Total	:	100	
	Duration of Exam	:	3 Hrs.	

Course Objectives:
- To study the concept of error correction and detection using Parity and hamming Codes.
- To study Linear Block Codes and Cyclic codes.
- To get knowledge about Convolution, Turbo codes and BCH codes.
- To study the performance of convolution and Linear codes and probability error limits.

Syllabus

Unit 1: Design of error detection and correction codes: Introduction of error detection and correction codes, single parity check codes, simple burst error detecting codes, encoder and decoder, hamming codes: encoding and decoding, trade off between redundancy and error detecting capability.

Unit 2: Design of Linear Block Codes: Introduction of Linear Block Codes, properties of Linear block codes, The Generator & parity check matrices, Syndrome And Error Detection, Minimum Distance of A Block Code, Error Detecting And Error Correcting Capability of A Block Code, Design of Encoder And Syndrome Decoder For Linear Block Codes.

Unit 3: Design of Cyclic Codes: Description Cyclic Codes, properties of cyclic codes, systematic cyclic codes, Generator And Parity Check Matrices of Cyclic Codes, Encoding of Cyclic Codes, Syndrome Computation And Error Detection, Decoding of Cyclic Codes, Cyclic Hamming Codes.

Unit 4: Convolutional Codes: Encoding of Convolutional Codes, convolution tree, Structural Properties of Convolutional Codes, Distance Properties of Convolutional Codes, Design of Encoder And Decoder For Convolutional Codes, maximum likelihood Decoding and Viterbi decoding algorithm, Turbo codes, Turbo decoder, Interleaver, Turbo decoder

Unit 5: BCH Codes: BCH codes, Reed Solomon Codes, Justeen Codes, MDS codes, properties of BCH codes, Galois field, generator polynomial of BCH codes, coding and decoding of BCH codes.

Unit 6: Performance of codes: Performance of codes, Performance of linear block codes & convolution codes, code incurable error probability Upper & lower bounds.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the need for error correcting codes in data communication system
- Construct parity and hamming codes capable of correcting a specified number of errors.
- Understand the operating principles of block codes, cyclic codes, convolution codes, Turbo Codes, BCH Codes.
- Understand the fundamental limits of error correction and analyse the performance measurement of different block codes.

Text/Reference Books:
1. C.B.Schlegel&L.C.Perez, "Trellis and Turbo Coding", Wiley,2004.
2. F.J. McWilliams and N.J.A. Slone, The theory of error correcting codes, 1977.

3. R.Johannaesson& K.S.Zigangirov, "Fundamentals of Convolutional Coding", Universities Press, 2001.
4. Shu Lin, Daniel J. Costello, Jr., Error Control Coding(2005).
5. R.E. Balahut, Theory and practice of error control codes, Addison Wesley, 1983.

L T P CR	Theory	:	75
3 0 0 3	Class Work	:	25
	Total	:	100
	Duration of Exam	:	3 Hrs.

Course Objective:
The primary concern of this course is
- To sensitize students to the various facts of managing people
- To create an understanding of the various policies and practices of human resource management.
- To understand contemporary issues in HRM
- To evaluate new trends in compensation management

Unit 1: Human Resource Management: concept, evolution and scope; Strategic objectives of HR management; Roles, responsibilities and competencies of HR manager; Challenges to HR professionals;Human Resource Planning & Forecasting: significance and process; Human Resource Information System.

Unit 2: Sourcing and Recruitment; Selection: process, Placement; Induction and Socialization.Job Analysis: job Description and job Specification; Job Design: approaches and methods;Job Evaluation-concept &methods;Performance Management System: appraisal and counselling.

Unit 3: Training process, training need analysis (TNA): training methods and techniques; Designing Training programs; Training evaluation; Career planning and Development; Potential Appraisal and Succession planning; Employee Compensation: basic concepts & determinants; New trends in compensation management.

Unit 4: Industrial Relations and Grievance Handling: Employee welfare; Dispute Resolution; International Human Resource Management; Contemporary Issues in HRM: knowledge Management, HR Audit &Accounting, HR in virtual organizations, ethics &corporate social responsibility. Course Outcome: a. The course will help to understand the basics of HRM with roles and responsibilities of a HR manager. b. This course enables the students to meet HR challenges in present scenario c. It will facilitate them in employing, maintaining and promoting a motivated force in an organization. d. Students will be aware about contemporary issues of human resource management.

Course Outcome:
- Students will be sensitized to the various facts of managing people
- Understanding of various policies and practices of human resource management will be developed.
- Understanding and details of contemporary issues in HRM built.
- New trends in compensation management evaluated.

TEXT/REFERENCE BOOKS
1. K. Aswathapa, "Human resource Management: Text and cases", 6th edition, Tata McGraw Hill, New Delhi.
2. Uday Kumar Haldar & Juthika Sarkar, "Human resource Management", New Delhi, Oxford University Press.
3. De Cenvo, Da & Robbins S.P., "Fundamentals of Human Resource Management", 9th edition, New York, John Wiley & Sons.

4. Gary Dessler, "Human Resource Management", 11th edition New Delhi: Pearson Prentice Hall.

5. TanujaAgarwala, "Strategic Human resource Management", Oxford University Press

OEL702   **Introduction to Power Plant Engineering**

L T P CR   **Theory**   :   **75**
3 0 0   3   **Class Work**   :   **25**
                                                 Total   :   **100**
                                                 Duration of Exam :   **3 Hrs.**

Course Objectives:
- To provide an overview of power plants and the associated energy conversion issues
- To understand basics of nuclear energy conversion
- The students will be able to understand various economic and environmental issues.

Course Contents:
Unit 1: Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Unit 2: Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit 3: Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Unit 4: Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Course Outcomes:
Upon completion of the course, the students can understand
- The principles of operation for
- The different power plants and their economics.
- Basics of nuclear energy conversion
- Various economic and environmental issues.

Text Books:
1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

PEC-CSD-602   **Soft Computing**
L T P CR   **Theory   :   75**
3 0 0   3   **Class Work :   25**
                                               Total   :   100
                                               Duration of Exam :   3 Hrs.

Course Objectives:
The primary objective of this course is to provide an introduction to the basic principles, techniques, and applications of soft computing. Upon successful completion of the course,
- Students will have an understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
- To provide the mathematical background for carrying out the optimization associated with neural network learning.
- To develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.

UNIT 1: Neural Networks: History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms- Supervised, Unsupervised and reinforcement Learning, ANN training Algorithmsperceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perception Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.

UNIT 2: Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation.

UNIT 3: Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations.

UNIT 4: Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

UNIT 5: Fuzzy Logic: Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges. Uncertainty based Information: Information & Uncertainty, Nonspecificity of Fuzzy & Crisp Sets, Fuzziness of Fuzzy Sets. Genetic Algorithms, Scope & application areas, solution of 0-1Knapsack problem using GA

Course Outcomes:
The student will be able to:
- Describe human intelligence and AI Explain how intelligent system works.
- Apply basics of Fuzzy logic and neural networks.
- Discuss the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience
- Relate with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems
- Describe with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations
- Develop some familiarity with current research problems and research methods in Soft Computing Techniques

References:
1. Fuzzy sets and Fuzzy Logic: Theory and applications‖,G.J. Klir,B.Yuan, PHI

2. Introduction to Fuzzy sets and Fuzzy Logic‖, M.Ganesh , PHI
3. An Introduction to Fuzzy Control‖, D Driankov, H Hellendoorn, M Reinfrank, Narosa Publishing Company
4. Neural Networks: A classroom approach‖, Satish Kumar , Tata McGraw Hill
5. Haykin S., ―Neural Networks-A Comprehensive Foundations‖, Prentice-Hall International, New Jersey, 1999.

OEL704   **Display Devices**

L T P CR		**Theory**	:	**75**
3 0 0 3		**Class Work**	:	**25**
		Total	:	**100**
		Duration of Exam	:	**3 Hrs.**

Course Objectives:
- To introduce about various types of displays systems.
- To introduce the various low power lighting systems.
- To introduce the operation of TFTs and LCD displays.
- To introduce various kinds of emissive displays.

Syllabus

Unit 1: Introduction to displays, Requirements of displays, Display technologies, CRT, Flat panel and advanced display technologies, Technical issues in displays.

Unit 2: Head mounted displays, Displays less than and greater than 0.5 m diagonal, Low power and light emitting displays.

Unit 3: Operation of TFTs and MIMS, LCDs, Brightness. Types of LCD displays, Emissive displays, ACTFEL, Plasma display and Field emission displays, operating principle and performance. Types of Displays: 3D, HDTV, LED, Touchscreen.

Course Outcomes: On successful completion of this course, the students should be able to:
- Appreciate the technical requirement of different types of displays systems.
- Analyze the various low power lighting systems.
- Understand the operation of TFTs and LCD displays.
- Analyze the various kinds of emissive displays and critically evaluate the recent advancements in the displays device technology.

Text Books
1. L.W. Mackonald& A.C. Lowe,Display Systems, Design and Applications, Wiley, 2003.
2. E.H. Stupp&M. S. Brennesholtz, Projection Displays, Wiley,1999.

Reference Books:
1. Peter A. Keller, Electronic Display Measurement: Concepts, Techniques, and Instrumentation, Wiley-Interscience, 1997.
2. Recent literature in Display Systems.

Financial Management

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objective:

- To develop understanding among the students regarding nature of finance and its interaction with other Management functions and the objectives of Financial Management. Detailed contents.
- To understand the usage and applications of leverages in financial decisions. The students are able to use their best knowledge in finance towards the value creation for the organization.
- To make students aware of working capital management concept.

Unit 1: Financial management: Scope finance functions and its organisation, objectives of financial management, time value of money, sources of long term finance.

Unit 2: Investment decisions importance, difficulties, determining cash flows, methods of capital budgeting with excel, risk analysis (risk adjusted discount rate method and certainty equivalent method), cost of different sources of raising capital, weighted average cost of capital.

Unit 3: Capital structure decisions: Financial and operating leverage, EBIT/EPS Analysis, capital structure theories, NI, NOI, traditional and M-M theories, determinants of dividend policy and dividend models, Walter, Gordon & M.M. models.

Unit 4: Working Capital: meaning, need, determinants, estimation of working capital need, management of cash, inventory and receivables.

Course Outcome
- It creates understanding among the students regarding the key decisions like Investment, Financing and dividend Decisions of financial Management.
- They are able to understand the usage and applications of leverages in financial decisions. The students are able to use their best knowledge in finance towards the value creation for the organization.
- The students will be made aware of working capital management concept.

TEXT/REFERENCE BOOKS

1. Pandey, I.M., "*Financial Management*", Vikas Publishing House, New Delhi
2. Khan M.Y, and Jain P.K., "*Financial Management*", Tata McGraw Hill, New Delhi
3. Keown, Arthur J., Martin, John D., Petty, J. William and Scott, David F, "*Financial Management",* Pearson Education
4. Chandra, Prasanna, "*Financial Management*", TMH, New Delhi
5. Van Horne, James C., "*Financial Management and Policy*", Prentice Hall of India
6. Brigham & Houston, "*Fundamentals of Financial Management"*, Thomson Learning, Bombay.
7. Kishore, R., "*Financial Management*", Taxman"s Publishing House, New Delhi

OEL706   **Non Linear Control System**

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objectives:
- To introduce the continuity of functions.
- To introduce about stability analysis of non linear systems.
- To introduce about feedback linearization.
- To introduce about sliding mode controller design.

Syllabus

Unit 1: Open and closed sets, compact set, dense set, Continuity of functions, Lipschitz condition, smooth functions, Vector space, norm of a vector, normed linear space, inner product space. Mathematical modeling of simple mechanical and electrical systems, concept of equilibrium points, isolated equilibrium points and limit cycles.

Unit 2: Stability analysis of nonlinear systems, Lyapunov stability, asymptotic stability, relative stability, finitetime stability and exponential stability, Lasalles invariance principle.

Unit 3: Feedback linearization, dynamic feedback linearization, flatness and back stepping controllers design.

Unit 4: Sliding mode controller design, Lyapunov redesign and energy based controller design

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the concept of non-linear system.
- Design non-linear controller for electrical system.
- Understand about feedback linearization.
- Design sliding mode controller.

Text Books:
1. Khalil H.K., 'Nonlinear Systems', Prentice Hall, 3rd Edition, 2002.
2. Vidyasagar M., 'Nonlinear System Analysis', Prentice Hall, 2nd Edition, 2002.
3. Isidori, 'Nonlinear Control Systems', Communications and Control Engineering, Springer Science & Business Media, 3 rd Edition, 2013.

Reference Books:
1. Jean - Jacques. E. Slotine and W. Li, 'Applied Nonlinear Control', Prentice Hall, Englewood Cliffs, NJ, 1991.
2. Zhihua Qu, 'Robust Control of Nonlinear Uncertain Systems', John Wiley & Sons, Interscience Division, New York, 1998.
3. H. Nijmeijer and A. J. van der Schaft, 'Nonlinear Dynamical Control Systems', Springer New York, 2016.

Course Objectives:
- To introduce the students about Different types of o.r. models.
- To introduce the students about Linear Programming problem-Formulation and graphical solution.
- To introduce the students about Dual simplex method. Sensitivity analysis.
- To introduce the students about Network minimisation, shortest route problem, Maximum flow problem and project of scheduling by PERT, CPM.
- To introduce the students about Critical path calculations.
- To introduce the students about Dynamic Programmingand examples of D.P.models.

Syllabus

Unit 1: Different types of o.r. models, their construction and general methods of solution. Linear Programming problem-Formulation and graphical solution. The standard form of the L.P.model. The simplex method, The dual of L.P.P, Primal-dual relationship, Dual simplex method, Sensitivity analysis, Transportation problem, its solution and applications, The assignment model, Travelling salesman problem.

Unit 2: Network minimization, Shortest route problem, Maximum flow problem, Project of scheduling by PERT, CPM.

Unit 3: Critical path calculations, Construction of the time chart and resource leveling, Integer programming-examples, method of and algorithms, cutting plane algorithm only.

Unit 4: Dynamic Programming, Examples of D.P.models, Bellman's Principle of optimality and method of recursive optimization, simple problems only involving upto one constraint.

Course Outcomes: On successful complete of this course, the students should be able to:
- Understand about Different types of o.r. models, LP model and Dual Simplex Method
- Understand about Network minimization, shortest route problem, Maximum flow problem and project of scheduling by PERT, CPM
- Understand about Critical path calculations
- Understand about Dynamic Programmingand examples of D.P.models

TEXT BOOKS:
1. Taha H.A Operations Research-An Introduction, PHI
2. Wanger H.M, Principles of Operation Research, PHI

OEL708   **Fundamental of Operating System**
(Operating System*- Old Name)

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objectives:
- To introduce the different types of operating system.
- To introduce about the synchronization algorithms and semaphores.
- To introduce about conditional critical regions and continuous allocation.
- To introduce about the need for file system organization and disk scheduling.

Syllabus

Unit 1: Types of operating systems, Different views of the operating system, Principles of Design and Implementation. The process and threads, System programmer's view of processes, Operating system's views of processes, Operating system services for process management, Process scheduling, Schedulers, Scheduling algorithms, Overview of Linux operating system.

Unit 2: Interprocess synchronization, Mutual exclusion algorithms, Hardware support, Semaphores, Concurrent programming using semaphores.

Unit 3: Conditional critical regions, Monitors, Interprocess communication, Messages, Pipes. Deadlocks: Characterization. Prevention, Avoidance. detection and recovery, Combined approach to deadlock handling.

Unit 4: Contiguous allocation. Static and dynamic partitioned memory allocation, Segmentation, Non- contiguous allocation, Paging, Hardware support, Virtual Memory.

Unit 5: Need for files, File abstraction, File naming, File system organization, File system optimization, Reliability, Security and protection, I/O management and disk scheduling, Recent trends and developments.

Course Outcomes: On successful completion of this course, the students should be able to:
- Understand the different types of Operating systems and scheduling algorithms.
- Understand the synchronization algorithms and semaphores.
- Appreciate the inter process communication and deadlock handling.
- Critically evaluate the different memory allocation techniques.
- Appreciate the importance of file system organization, I/O management and disk scheduling.

Text Books
1. Gary: Operating Systems- A modern Perspective, (2/e), Addison Wesley,2000.
2. M.Milenkovic: Operating systems, Concepts and Design, McGraw Hill,1992.

Reference Books
1. C. Crowley: Operating Systems, Irwin,1997.
2. J.l. Peterson & A.S. Chatz: Operating System Concepts, Addison Wesley,1985.
3. W. Stallings: Operating Systems, (2/e), Prentice Hall,1995.
4. Mattuck,A., Introduction to Analysis,Prentice-Hall,1998. 5. Recent literature in Operating Systems.

Industrial Safety Engineering

L T P CR		Theory	:	75
3 0 0 3		Class Work	:	25
		Total	:	100
		Duration of Exam	:	3 Hrs.

Course Objectives:
- To introduce about the principles of safety management.
- To introduce the factors causing accidents and their prevention.
- To impart the knowledge of material handling and realization of chemical hazards.
- To give exposure to students regarding factory act 1948.

Syllabus

Unit 1: Evolution of modern safety concept, safety policy, Safety Organization, Safety Committee, budgeting for safety.

Unit 2: Safety training, creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign

Unit 3: Concept of an accident, reportable and non reportable accidents, reporting to statutory authorities, principles of accident prevention, accident investigation and analysis, records for accidents, departmental accident reports, documentation of accidents, unsafe act and condition, domino sequence, supervisory role, cost of accident.

Unit 4: Machine Guarding, Guarding of hazards, Machine Guarding types and its application, Safety in welding and Gas cutting, Safety in Manual and Mechanical material handling, Safety in use of electricity Toxicity, TLV, Types of Chemical Hazards, Occupational diseases caused by dust, fumes, gases, smoke and solvent hazards, control measures

Unit 5: Fire triangle, Types of fire, first aid firefighting equipment, flammability limit, PG safety Overview of factories act 1948, OHSAS 18000

Course Outcomes: On successful completion of this course, the students should be able to:
- Apply principles of safety management, its functions and technique in any organization.
- Classify and categorize the factors contributing to accident.
- Apply material handling and machine guarding principles in industrial applications.
- Realize chemical hazards, toxicity, fire and explosion in the work place and involve to take various control measures to prevent hazards.
- Follow OHSAS 18000 standards.

Reference Books:
1. Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 1982
2. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973
3. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980.
4. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.
5. John Ridley, "Safety at Work", Butterworth & Co., London, 1983

OEL710 **Introduction to Cloud Computing**
(Cloud Computing*-old name)

L T P CR		
3 0 0 3		

Theory	:	**75**
Class Work	:	**25**
Total	:	**100**
Duration of Exam	:	**3 Hrs.**

Course Objectives
- To provide comprehensive knowledge of fundamental concepts and of cloud computing.
- To provide an understanding of Service models, deployment models, Virtualization.
- To get the knowledge about the programming and software environments of Cloud
- To shed light on the security issues in Cloud.

Syllabus

Unit 1: Overview of Distributed Computing, Cluster Computing and Grid Computing, Technologies for Network based systems, Software environments for Distributed Systems and Clouds, Overview of Services and Service oriented Architecture.

Unit 2: Virtual Machines and Virtualization, Implementation levels of Virtualization, Virtualization structures/tools and Mechanisms, Virtualization of CPU, Memory and I/O Devices, Storage Virtualization.

Unit 3: Cloud Computing, Properties, challenges, Service models, IaaS, PaaS and SaaS Deployment models, Service Composition and orchestration, Architecture design of Compute and Storage cloud, Public Cloud Platforms, Inter Cloud Resource Management.

Unit 4: Cloud Programming and Software Environments, Parallel and Distributed Programming paradigms, Programming on AWS, Azure and GAE, Cloud software environments Eucalyptus, Open Stack, Open Nebula.

Unit 5: Cloud Security, Infrastructure security, Data security, Identity and access management Privacy, Audit and Compliance.

Course Outcomes: On successful completion of this course, the students should be able to:
- Ability to articulate the virtualization concepts
- Ability to identify the architecture, service models and deployment models of Cloud
- Ability to master the programming aspects of Cloud
- Determine security issues in cloud

Text Book
1. Kai Hwang, Geoffrey C, Fox and Jack J, Dongarra, "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier, 2012.

Reference Books
1. Barrie Sosinsky, "Cloud Computing Bible" John Wiley & Sons, 2010.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance", O'Reilly 2009.

J.C. Bose University of Science & Technology, YMCA, Faridabad
(A Haryana State Government University)
(Established by Haryana State Legislative Act No. 21 of 2009 & Recognized by UGC Act 1956 u/s 22 to Confer Degrees)
Accredited 'A' Grade by NAAC

Implementation of Credit Transfer/Mobility Policy of online courses

Reference: Gazette of India (Extraordinary) Part-III, Section-4 No. 295, UGC **(Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016,** dated 19/07/2016.

With reference to 12th Academic Council Meeting dated 03/05/2017 (Agenda Item No. AC/11/12), wherein MOOCs were adopted in the CBCS scheme, In continuation to that, following modalities are proposed to introduce the credit transfer policy in academic curriculum for the Massive Open Online Courses (MOOC's) offered through SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds) Portal.

A. General Guidelines

1. The SWAYAM shall notify in June and November every year, the list of the online learning Courses going to be offered in the forthcoming Semester on its website https://swayam.gov.in.

2. All the UTDs/Affiliated Colleges shall, within 4 weeks from the date of notification by SWAYAM, consider through their Chairperson/Principal the online learning courses being offered through the SWAYAM platform; and keeping in view their academic requirements, decide upon the courses which it shall permit for credit transfer and keeping in view the following points:

   a) There is non-availability of suitable teaching staff for running a course in the Department.

   b) The facilities for offering the elective papers (courses), sought for by the students are not on offer/scheme in the Institution, but are available on the SWAYAM platform.

   c) The courses offered on SWAYAM would supplement the teaching-learning process in the Institution.

   d) Online courses through SWAYAM should not be more than 20% of total courses offered in a particular semester of a programme.

3. The courses offered in a particular semester will be compiled by Digital India Cell as decided and forwarded by concerned UTDs and affiliated colleges in the prescribed format to digitalindia.ymca@gmail.com and compiled set will be put up in Academic Council for approval.

4. Student can opt for 12-16 weeks course equivalent to 3-6 credits under mentorship of faculty (MHRD MOOC's guidelines 11.1(J) issued by the MHRD vide its orders dated 11/03/2016).

5. Every student being offered a particular paper (course) would be required to register for the MOOCs for that course/paper on SWAYAM through University's/Affiliated College's SWAYAM-NPTEL Local Chapter.

6. The UTD/College may designate a faculty member as course coordinator/mentor to guide the students (at least 20 students) throughout the course with 2 hours per week contribution and with mentor addition on the Local Chapter. The mentor Chairperson/Principal will ensure the provision of facilities for smooth running of the course viz. Internet facility and proper venue in the department/college.

7. Digital India Cell of the University will be the Nodal point for keeping track of MOOCs enrolments in the University and the concerned chairpersons/principals are expected to aware their students/faculty about the online courses.

8. Importance of online learning and credit transfer policy must be shared with the students at entry level by the concerned department/college. Same may be incorporated during induction program for newly admitted students.

9. The departmental/college MOOC coordinators appointed by chairpersons of concerned departments/Principals of affiliated colleges will be responsible for identification of relevant MOOCs in the UTDs/Colleges and smooth conduction during the course.

B. Credit Transfer/Mobility of MOOCs

1. The parent Institution (offering the Course) shall give the equivalent credit weightage to the students for the credits earned through online learning courses through SWAYAM platform in the credit plan of the program.

2. Following pattern will be followed for distribution of credits and will be applicable to all students from Jan 2018 onwards:

Program	Duration	Minimum Credits to be earned*
B.Tech	Semester I to VIII	3
M.Tech/MBA/M.Sc./MA	Semester I to IV	3
BBA/BCA/B.Sc./BA	Semester I to VI	3

*All students of UTDs/Affiliated colleges of all courses have to mandatorily earn minimum prescribed credits.

Note: From session 2019-20 onwards, for B.Tech program, a student has to earn at least 12 credits during the duration of the Degree subject to the passing of at least one MOOC course (carrying minimum 3 credits per year).

3. A student will be eligible to get Under-Graduate/Post-Graduate degree (B.Tech/M.Tech) with Honours if he/she completes additional credits through MOOC's. (AICTE Model Curriculum, Chapter1(B)). Following pattern will be followed for earning additional credits for the award of Honours degree:

Program	Duration	Credits to be earned*	Minimum CGPA
B.Tech	Semester I to VIII	12	8.0
M.Tech	Semester I to IV	6	8.0

*Inclusive of *Minimum credits to be earned* mentioned in clause B(2) above.

4. The earned credits shall be accepted and transferred to the total credits of the concerned students by the University for Completion of his/her degree. Credits earned through MOOCs will be incorporated in the mark sheet issued to the student by Controller of Examination.
5. Credits for MOOC's will be verified by the concerned department/college and will be forwarded to Controller of Examination for further processing.
6. The courses where model curriculum of AICTE is not applicable, pattern laid down as in B(2) will be followed.

NOTE:

1. These guidelines will be applicable to all Affiliating institutions under University along with all UTDs. Affiliating colleges will establish their own Local Chapter on SWAYAM and follow the same process.
2. For further clarifications, Notifications "Credit Framework for Online Learning Courses through SWAYAM" (UGC Regulations dated 19/07/2016) and "MHRD MOOC's guidelines" (MHRD guidelines dated 11/03/2016) may be referred.

Annexure-1

Program: B.Tech. (Electronics and Communication Engineering (2019-20))
(Program Code: 8)

Mapping of the Courses with the Employability/Entrepreneurship/Skill
Development

COURSE NAME	Course code	Employability	Entrepreneurship	Skill Development
Physics (Waves and Optics)	BSC101C			√
Mathematics-I (Calculusand Linear Algebra)	BSC103 D			√
Engineering Graphics & Design	ESC102			√
Programming for Problem solving	ESC103	√		√
Workshop- I	ESC104	√	√	√
Physics(Waves and Optics) lab	BSC104C			√
Programming for Problem solving Lab	ESC105	√		√
Mathematics-II (Calculus, Ordinary Differential Equations and Complex Variable)	BSC106 D			√
Basic Electrical Engineering	ESC101	√		
Chemistry	BSC 102			√
Workshop- II	ESC106	√	√	√
English	HSMC101			√
Basic Electrical Engineering Lab	ESC107	√		√
Chemistry Lab	BSC 105			√
English Lab	HSMC102			√
Electronics Devices	EC301	√		
Digital System Design	EC302	√		
Network Theory	EC304	√		
Engineering Mechanics	ESC01	√		√
Mathematics-III	BS301			√
Indian Constitution/ Essence of Indian Traditional Knowledge	MC01/MC02			√
Electronics Devices Lab	EC351	√		√

Subject	Code				
Digital System Design Lab	EC352	√			√
Network Theory Lab	EC353	√			√
Electronics Workshop-I	ES303	√	√		√
Analog and Digital Communication	EC401	√			
Analog Circuits	EC402	√			
Microprocessors & Microcontrollers	ECC03	√	√		
Computer Architecture	EC404	√			
Signal and Systems	ECC01	√			
EffectiveTechnical Communication	HSMC01				√
Biology	BSC01				√
Analog and Digital Communication Lab	EC451	√			√
Analog Circuits Lab	EC452	√			√
Microprocessors & Microcontrollers Lab	ECC51	√	√		
Electronics Workshop-II	ES402	√	√		√
Electromagnetic Waves	ECC02	√			
Probability Theory and Stochastic Processes	EC502	√			
Digital Signal Processing	ECC04	√			
Environmental Sciences	MC03				√
Digital Signal Processing Lab	ECC53	√			√
Electromagnetic Waves Lab	ECC52	√			√
Electronics Workshop-III	ES555	√	√		√
CMOS Design	ECEL501	√			
Nano Electronics	ECEL502	√			
Power Electronics	ECEL503	√			
Introduction to MEMS	ECEL504	√			
Smart Materials and Systems	OEL501				√
Electrical Measurement and Instrumentation	OEL502				√
Intelligent Instrumentation	OEL503				√
Electromechanical Energy Conversion	OEL504				√
Renewable Power Generation Systems	OEL505	√	√		√
Control System	EC601	√			
Computer Network	EC602	√			
Bio Medical Electronics	ECEL601	√			
Introduction to	ECEL602	√			

Subject	Code	C1	C2	C3	C4
Information Theory & Coding					
Speech and Audio Processing	ECEL603	√			
Scientific Computing	ECEL604	√			
Microwave Theory & Techniques	ECEL605	√			
Digital Image and Video Processing	ECEL606	√	√		√
Software Defined Radio	ECEL607	√			
Mobile Communication Network	ECEL608	√			
Introduction to Wireless Sensor Networks	ECEL609	√			
MIMO Wireless Communication	ECEL610	√			
Virtual Instruments Design	OEL601				√
Data Structure	OEL602				√
Cyber Laws and Security	OEL603				√
Study of Quality Management	PEC-ME-461				√
Measurement Data Analysis	OEL605				√
Computer Networks Lab	EC652	√			√
Electronics Measurement Lab	EC653	√			√
Electronics Workshop-IV	ES654	√	√		√
Microwave Lab /Digital Image Processing Lab /SDR Lab	ECEL655A /ECEL655B/ ECEL655C	√			√
Antenna and Propagation	ECEL701	√			
High Speed Electronics	ECEL702	√			
Wavelets	ECEL703	√			
Fiber Optic Communication	ECEL704	√			
Adaptive Signal Processing	ECEL705	√			
Mixed Signal Design	ECEL706	√			
Basics of Satellite Communication	ECEL707	√			
Embedded Systems	ECEL708	√	√		
Error Correcting Codes	ECEL709	√			
Human Resource Management	OEC-CS-602-I				√
Power Plant Engineering	OEL702				√
Soft Computing	PEC-CSD-602				√
Display Devices	OEL704				√
Financial Management	OEC-CS-701(I)				√
Non Linear Control System	OEL706				√
Operational Research	OEL707				√

Fundamentals of Operating System	OEL708				√
Industrial Safety Engineering	OEL709				√
Introduction to Cloud Computing	OEL710				√
Major Project	ECP701	√	√		√
Electronics Workshop-V	ES751	√	√		√
Industrial Training	EIP801	√	√		√

Chairperson
(Electronics Engineering)