CURRICULUM AND DETAILED SYLLABI

FOR

B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)

FIRST SEMESTER

FOR THE STUDENTS ADMITTED IN THE

ACADEMIC YEAR 2022-23

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided Autonomous Institution Affiliated to Anna University)
MADURAI – 625 015, TAMILNADU

Phone : 0452 – 2482240, 41
Fax : 0452 2483427
Web : www.tce.edu

Passed in Board of Studies Meeting 04.06.2022 Approved in Academic Council Meeting 25.06.2022

Vision and Mission of the Department

Vision:

To empower the Electronics and Communication Engineering students with technological excellence, professional commitment and social responsibility.

Mission:

ME1. Attaining academic excellence in Electronics and Communication Engineering through dedication to duty, innovation in learning and research, state of the art laboratories and industry driven skill development.

ME2. Establishing suitable environment for the students to develop professionalism and face life challenges with ethical integrity.

ME3. Nurturing the students to understand the societal needs and equip them with technical expertise to provide appropriate solutions.

ME4. Providing breeding ground to obtain entrepreneurial skills and leadership qualities for self and social growth.

Program Educational Objectives (PEOs):

PEO1. Graduates will be capable of developing specification and design procedures, prototyping and test methodologies for modern electronics and communication systems and gadgets that perform analog and digital processing functions.

PEO2. Graduates will be able to work and adapt to changes in allied areas of Electronics and Communication Engineering through personal success and life long learning.

PEO3. Graduates will be able to identify technological requirements for the society and provide cost effective solutions.

- These objectives will be evidenced by professional visibility (publications, presentations, inventions, patents and awards), entrepreneurial activities, international activities (participation in international conferences, collaborative research and employment abroad)

Program Outcomes:
Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and 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.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex 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 the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering 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.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes:
Engineering Graduates will be able to

PSO1. Design circuits and systems for complex engineering problems in Electronics and Communication and allied areas.
PSO2. Apply research methodologies to provide solutions for contemporary problems in the areas including RF, Signal Processing, Image Processing, VLSI, Optical Communication, Networks and Embedded Systems for given specifications.
PSO3. Actively contribute as a member or leader in diverse teams, and communicate effectively on complex engineering activities and involve in life-long learning, by applying reasoning and ethical principles.

PEO- Mission Mapping:

	ME1	ME2	ME3	ME4
PEO1	S	M	M	L
PEO2	L	S	M	M
PEO3	M	L	S	M

PEO-PO-PSO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
PEO1	■	■	■	■	■			■	■	■			■	■	
PEO2	■							■	■	■	■	■	■		■
PEO3	■	■				■	■	■					■	■	

PO-GA Mapping:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PO1	■											
PO2		■										
PO3			■									
PO4				■								
PO5					■							
PO6						■						
PO7							■					
PO8								■				
PO9									■			
PO10										■		
PO11											■	
PO12												■

TCE PROFICIENCY SCALE (CDIO Curriculum Framework)

TCE Proficiency Scale (TPS)	Proficiency	Cognitive	Affective	Psychomotor
TPS1	To have been exposed to	Remember	Receive	Perception, Set
TPS2	To be able to interpret and imitate	Understand	Respond	Guided Response
TPS3	To be skilled in the practice or implement	Apply	Value	Mechanism
TPS4	To be able to participate in and contribute	Analyse	Organise	Complex Overt Responses
TPS5	To be able to judge and adapt	Evaluate	Organise	Adaptation
TPS6	To be able to lead and innovate	Create	Characterize	Origination

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)

CREDIT DISTRIBUTION

(For the students admitted in the Academic Year 2022-23 onwards)

S.No	Category	Credits
A	**Foundation Courses (FC)**	**54-66**
	Humanities and Social Sciences including Management (HSMC)	9-12
	Basic Science (BSC)	24- 27
	Engineering Science (ESC)	21 -27
B	**Professional Core Courses (PCC)**	**55**
C	**Professional Elective Courses (PEC)**	**24 - 39**
	Programme Specific Elective (PSE)	15 - 24
	Programme Elective for Expanded Scope (PEES)	9-15
D	**Open Elective Courses (OEC)**	**6-12**
	Interdisciplinary Elective (IE)	3-6
	Basic Science Elective (BSE)	3-6
E	**Project Work (PW)**	**12**
F	**Internship and Mandatory Audit Courses prescribed by as per Regulatory Authorities (Not to be included for CGPA)**	**-**
	Minimum Credits to be earned for the award of the Degree	**160** (from A to E) and the successful completion of F

SCHEDULING OF COURSES FOR STUDENTS JOINING FROM ACADEMIC YEAR 2022-23 ONWARDS (B.E. ECE Programme) *

Sem	Theory / Theory cum Practical / Practical								CDIO courses	Audit Courses (Mandatory Non-credit}	Credit
	1	2	3	4	5	6	7	8			
I	22MA110 Calculus for Engineers (BSC-4)	22PH120 Physics (BSC-3)	22CH130 Chemistry (BSC-3)	22EG140 Technical English (HSMC-2)	22EC160 Computer Aided Engg. Graphics (TCP) (ESC-3)	22EG170 English Laboratory (HSMC-1)	22PH180 Physics Laboratory (BSC-1)	22CH190 Chemistry Laboratory (BSC-1)	22EC190 Engineering Exploration (TCP) (ESC-2)		20
II	22EC210 Matrices and Linear Algebra (BSC-3)	22EC220 Digital Circuit Design PCC-4 (TCP)	22EC230 Field Theory and Transmission Lines (TCP) PCC-3	22EC240 Electric and Magnetic Circuits (TCP) (PCC-4)	22EC250 Electronic Devices (ESC-3)	22EF260 Problem Solving using Computers (TCP) (ESC-3)				22YYXX0 Audit Course	20
III	22EC310 Probability and Statistics BSC-3	22EC320 Analog Circuit Design (TCP) (PCC-4)	22EC330 Network-Analysis and Synthesis (BSC-3)	22EC340 Computer Organization and Microprocessor (TCP) (PCC-4)	22EC350 Signals and Systems (TCP) (PCC-4)	22EC360 Object-Oriented Programming (ESC-3)					21
IV	22EC410 Optimization BSC-3	22EC420 Mixed Signal Circuit Design (TCP) (PCC-3)	22EC430 RF Circuit Design (TCP) (PCC-4)	22EC440 Microcontrollers and Embedded Systems (TCP) (PCC-4)	22EC450 Discrete-Time Signal Processing (TCP) (PCC-4)	22EC460 Introduction to Data Science (ESC-2)			22ES490 Design Thinking (ESC-3)	22YYXX0 Audit Course	23

Passed in Board of Studies Meeting 04.06.2022 Academic Council Meeting 25.06.2022

V	22EC510 Data Communication Networks (TCP) (PCC-4)	22EC520 VLSI Circuits and Systems PCC-3	22EC530 Antennas and Wave Propagation (TCP) (PCC-3)	22EC540 Sensors and Instrumentation (PCC-2)	22EC550 Analog and Digital Communication (TCP) (PCC-4)		22YYGX0 Interdisciplinary Elective (OE-3)		22EC590 Electronics - Design Project (PW-3)		22
VI	22EC610 Accounting and Finance (HSMC-3)	22EC620 Image Processing (TCP) (PCC-3)	22ECPX0 (PSE – 3)		22EC630 Optical and Wireless Communication (TCP) (PCC-4)	22EC640 Systems Software (ESC-2)	22YYFX0 Basic Science Elective (OE-3)	22EG650 Professional Communication (HSMC-3)	22EC690 Communications - Design Project – (PW-3)		24
VII	22ECPX0 (PSE – 3)	22ECPX0 (PSE – 3)	22ECRX0 (PEES – 3)	22ECRX0 (PEES – 3)	22ECRX0 (PEES – 3)				22EC790 Secure Communication or Data Engg. Design Project (PW-3)		18
VIII	22ECPX0 (PSE – 3)	22ECPX0 (PSE – 3)	22ECPX0 (PSE – 3)						22EC890 Final Project (PW-3)		12

This schedule shows an optimal way of completing the B.E. Degree programme successfully in 4 Years ***Total Credits for Curricular Activities: 160***

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)

COURSES OF STUDY
(For the students admitted in the Academic Year 2022-23 onwards)

FIRST SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
22MA110	Calculus for Engineers	BSC	3	1	-	4
22PH120	Physics	BSC	3	-	-	3
22CH130	Chemistry	BSC	3	-	-	3
22EG140	Technical English	HSMC	2	-	-	2
THEORY CUM PRACTICAL						
22EC160	Computer Aided Engineering Graphics	ESC	2	-	2	3
22EC190	Engineering Exploration	ESC	1	-	2	2
PRACTICAL						
22EG170	English Laboratory	HSMC	-	-	2	1
22PH180	Physics Laboratory	BSC	-	-	2	1
22CH190	Chemistry Laboratory	BSC	-	-	2	1
Total			**14**	**1**	**10**	**20**

BSC : Basic Science Courses
HSMC : Humanities and Social Science including Management Courses
ESC : Engineering Science Courses

L : Lecture
T : Tutorial
P : Practical

Note:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)

SCHEME OF EXAMINATIONS
(For the Students admitted in the academic year 2022-23 onwards)

FIRST SEMESTER

.#	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	22MA110	Calculus for Engineers	3	40	60	100	27	50
2	22PH120	Physics	3	40	60	100	27	50
3	22CH130	Chemistry	3	40	60	100	27	50
4	22EG140	Technical English	3	40	60	100	27	50
THEORY CUM PRACTICAL								
5	22EC160	Computer Aided Engineering Graphics	3	50	50	100	25	50
6	22EC190	Engineering Exploration	3	50	50	100	25	50
PRACTICAL								
7	22EG170	English Laboratory	3	60	40	100	18	50
8	22PH180	Physics Laboratory	3	60	40	100	18	50
9	22CH190	Chemistry Laboratory	3	60	40	100	18	50

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

22MA110	CALCULUS FOR ENGINEERS

Category	L	T	P	Credit
BSC	3	1	0	4

Preamble

This course aims to provide technical competence of modeling engineering problems using calculus. In this course, the calculus concepts are taught geometrically, numerically, algebraically and verbally. Students will apply the main tools for analyzing and describing the behavior of functions of single and multi-variables: limits, derivatives, integrals of single and multi-variables to model and solve complex engineering problems using analytical methods and MATLAB.

Prerequisite

NIL

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Cognize the concept of functions, limits and continuity	TPS2	75	70
CO2	Compute derivatives and apply them in solving engineering problems	TPS3	70	65
CO3	Employ partial derivatives to find maxima minima of functions of multi variables	TPS3	70	65
CO4	Demonstrate the techniques of integration to find the surface area of revolution of a curve.	TPS3	70	65
CO5	Utilize double integrals to evaluate area enclosed between two curves.	TPS3	70	65
CO6	Apply triple integrals to find volume enclosed between surfaces	TPS3	70	65

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L							L		L	
CO2	S	M	L						L		L	
CO3	S	M	L						L		L	
CO4	S	M	L						L		L	
CO5	S	M	L						L		L	
CO6	S	M	L						L		L	

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	Assessment 1						Assessment 2						Terminal (%)			
	Written Test 1 (%)			Assignment 1 (%)			Written Test 2 (%)			Assignment 2 (%)						
TPS	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**TOTAL (%)**
CO1	20%			50%			-			-			-	10%	-	10%
CO2	32%						-			-			-	-	16%	16%
CO3	36%						-			-			-	-	18%	18%
CO4	12%			-			39%			50%			-	-	25%	25%
CO5	-			-			35%						-	-	17%	17%
CO6	-			-			26%						-	-	14%	14%
MATLAB	-			50%			-			50%						
TOTAL	**100%**			**100%**			**100%**			**100%**			**-**	**10%**	**90%**	**100 %**

* Assignment 1: (i)Application Problems in CO1, CO2 and CO3 (50%).
(ii) MATLAB Onramp & Introduction to symbolic Math with MATLAB (50%).

**Assignment 2: (i) Application Problems in CO4, CO5 and CO6 (50%).
(ii) Application problems using MATLAB. (50%).

Syllabus

DIFFERENTIAL CALCULUS

Functions - New functions from old functions - Limit of a function - Continuity - Limits at infinity - Derivative as a function - Maxima and Minima of functions of one variable – Mean value theorem - Effect of derivatives on the shape of a graph- Application problems in engineering using MATLAB.

FUNCTIONS OF SEVERAL VARIABLES:

Function of several variables- Level curves and level surfaces - Partial derivatives – Chain rule - Maxima and minima of functions of two variables –Method of Lagrange's Multipliers - Application problems in engineering using MATLAB.

INTEGRAL CALCULUS:

The definite integral – Fundamental theorem of Calculus – Indefinite integrals and the Net Change Theorem – Improper integrals – Area of surface of revolution - Volume of solid of revolution -Application problems in engineering using MATLAB.

MULTIPLE INTEGRALS:

Iterated integrals-Double integrals over general regions-Double integrals in polar coordinates-Applications of double integrals (density, mass, moments & moments of inertia problems only)-triple integrals- triple integrals in cylindrical coordinates- triple integrals in spherical coordinates-change of variables in multiple integrals - Application problems in engineering using MATLAB.

Text Book

1) James Stewart, "Calculus Early Transcendentals", 9th Edition, Cengage Learning, New Delhi, 2019.
    a. **DIFFERENTIAL CALCULUS:** [Sections: 1.3, 2.2, 2.5, 2,6,2.8, 4.1, 4.2 and 4.3.]
    b. **FUNCTIONS OF SEVERAL VARIABLES:** [Sections: 14.1,14.3,14.5,14.7 and 14.8.]
    c. **INTEGRAL CALCULUS:** [Sections: 5.2, 5.3, 5.4, 7.8, 8.2 and 6.2.]
    d. **MULTIPLE INTEGRAL:** [Sections: 15.1-15.4, 15.6-15.9]
2) Lecture Notes on Calculus Through Engineering Application Problems and Solutions, Department of Mathematics, Thiagarajar College of Engineering, Madurai.

Reference Books& web resources

1) George B. Thomas, "Thomas Calculus: early Transcendentals", 14th edition, Pearson, New Delhi, 2018.
2) Howard Anton, Irl Bivens and Stephen Davis, “Calculus: Early Transcendentals”, 12th e, John Wiley & Sons, 2021.
3) Kuldeep Singh, "Engineering Mathematics Through Applications", 2nd edition, Blooms berry publishing, 2019.
4) Kuldip S. Rattan, Nathan W. Klingbeil, Introductory Mathematics for Engineering Applications, 2nd e John Wiley& Sons , 2021.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**DIFFERENTIAL CALCULUS**	
1.1	Functions and New functions from old functions	2
1.2	Limit of a function &Continuity of a function	1
	Tutorial	**1**
1.3	Limits at infinity	1
1.4	Derivative as a function	2
	Tutorial	**1**
1.5	Maxima and Minima of functions of single variable	2
1.6	The Mean value theorem and effect of derivatives on the shape of a graph of a function	1
	Tutorial	**1**
1.7	Application problems in engineering using MATLAB	1
2	**FUNCTIONS OF SEVERAL VARIABLES**	
2.1	Level curves and level surfaces	2
2.2	Partial derivatives – Chain rule	1
	Tutorial	**1**
2.3	Maxima and minima of functions of two variables	2
2.4	Method of Lagrange’s Multipliers	1
	Tutorial	**1**
2.5	Application problems in engineering using MATLAB	1
3	**INTEGRAL CALCULUS**	
3.1	The definite integral	1
3.2	Fundamental theorem of Calculus	2
	Tutorial	**1**
3.3	Indefinite integrals and the Net Change Theorem	1
3.4	Improper integrals	2
	Tutorial	**1**
3.5	Area of surface of revolution	1
3.6	Volume of solid of revolution.	2
3.7	Application problems in engineering using MATLAB	1
4	**MULTIPLE INTEGRALS**	
4.1	Iterated integrals	1
4.2	Double integrals over general regions	2

Module No.	Topic	No. of Periods
	Tutorial	**1**
4.3	Double integrals in polar coordinates	1
4.4	Applications of double integrals (density, mass, moments & moments of inertia problems only)	2
	Tutorial	**1**
4.5	Triple integrals	1
4.6	Triple integrals in cylindrical coordinates	1
4.7	Triple integrals in spherical coordinates	1
	Tutorial	**1**
4.8	Change of variables in multiple integrals	1
4.9	Application problems in engineering using MATLAB	1
	Total	**48**

Course Designer(s):

1. Dr.B.Vellaikannan, bvkmat@tce.edu
2. Dr.C.S.Senthilkumar, kumarstays@tce.edu
3. Dr.S.P.Suriya Prabha, suriyaprabha@tce.edu
4. Dr.S.Saravanakumar, sskmat@tce.edu
5. Dr.M.Sundar, msrmat@tce.edu

22PH120	PHYSICS

Category	L	T	P	Credit
BSC	3	0	0	3

Preamble

The course work aims in imparting fundamental knowledge of mechanics, oscillations and waves and optics, electromagnetism and quantum mechanics which are essential in understanding and explaining engineering devices.

Prerequisite

None

Course Outcomes

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

	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Apply the vector calculus approach and Newton's law in polar coordinates to solve problems in mechanics	TPS3	85	80
CO2	Solve for the solutions and describe the behaviour of a damped harmonic oscillator and waves.	TPS3	85	80
CO3	Introduce Schrodinger equation to arrive at the energy values of particle in a box and linear harmonic oscillator	TPS3	85	80
CO4	Use the principle of quantum mechanics for quantum mechanical tunnelling, quantum confinement and quantum computation	TPS2	85	80
CO5	Use the laws of electrostatics and magnetostatics to explain electromagnetic wave propagation	TPS3	85	80
CO6	Explain the fundamentals of optical phenomena and its applications	TPS2	85	80

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	-	-	-	-	-	L	L	-	-
CO2	S	M	L	-	-	-	-	-	L	L	-	-
CO3	S	M	L	-	-	-	-	-	L	L	-	-
CO4	M	L		-	-	-	-	-	L	L	-	-
CO5	S	M	L	-	-	-	-	-	L	L	-	-
CO6	M	L										

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I * (%)			CAT – II (%)			Assg. II * (%)					
TPS Scale / CO	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
CO1	8	15	22	100									6	6	10
CO2	8	10	15										4	3	10
CO3	4	5	13				-	-	15	100			-	2	15
CO4							4	15	-				4	6	-
CO5							-	-	35				-	3	15
CO6							16	15	-				6	10	-
Total	**20**	**30**	**50**	**100**			**20**	**30**	**50**	**100**			**20**	**30**	**50**

*Assignment I, II –Quiz/ Puzzle/ Case analysis/ Problem-solving/ Presentation/ Writing tasks

Syllabus

Mechanics of Particles:

Scalars and vectors under rotation transformation - Coordinate system - Cartesian, Polar, Spherical, Cylindrical - Newton's second law of motion - Forces in nature - Central forces - Conservative and non-conservative forces - Work - Energy theorem - Conservation of angular momentum - Satellite manoeuvres

Oscillations and Waves:

Simple harmonic oscillators - Energy decay in a Damped harmonic oscillator - Q factor- Impedance matching- Wave groups and group velocity - Non dispersive Transverse and Longitudinal waves - Waves with dispersion - Water waves - Acoustic waves - Earthquake and Tsunami waves

Quantum Mechanics:

Wave nature of particles - wave function - probability current density and expectation values - Schrodinger wave equation - Uncertainty principle - Particle in a box in 1D - Linear harmonic oscillator - Quantum tunnelling – Quantum confinement in 0D, 1D, 2D systems - Scanning tunnelling microscope - Quantum Cascade lasers - Quantum computation (qubit) - Entanglement - Teleportation

Electromagnetic Fields and Waves:

Electric potential and Electric field of a charged disc - Magnetic Vector potential - Maxwell's equation - Equation of continuity – Poynting Vector - Energy and momentum of EM waves - CT/MRI scan

Optics:

Ray paths in inhomogeneous medium and its solutions – Applications - Fibre optics - Numerical Aperture& Acceptance angle - Fibre optic sensors - Liquid Level & Medical Applications - Interference in non-reflecting films - Fabry-Perot interferometer - Diffraction - Fraunhofer diffraction due to double slit.

Text Books

1. Principles of Physics, Halliday, Resnick and Jearl Walker, 9th Edition, Wiley, 2011.
2. Paul A. Tipler and G. Mosca, Physics for Scientists and Engineers, 6th Edition, Freeman, 2008.

Reference Books & web resources

MECHANICS OF PARTICLES

Paul A. Tipler and Gene Mosca, Physics for Scientists and Engineers, 6th Edition, Freeman, 2008 (Chapters – 4, 9 & 10).

Manoj K. Harbola, Engineering Mechanics, 2nd Edition, Cengage, 2018.

OSCILLATIONS AND WAVES
1. Paul A. Tipler and Gene Mosca, Physics for Scientists and Engineers, 6th Edition, Freeman, 2008 (Chapters – 14 & 15).
2. H. J. Pain, The Physics of Vibrations and Waves, 6th Edition, John Wiley, 2005 (Chapters 2, 5 & 6).

ELECTROMAGNETIC FIELDS AND WAVES
1. Principles of Physics, Halliday, Resnick and Jearl Walker, 9th Edition, Wiley, 2011 (Chapters - 23, 24, 32 & 33)
2. Paul M. Fishbane, Stephen G. Gasiorowicz and Stephen T. Thornton, Physics for Scientists and Engineers with Modern Physics, 3rd Edition, Pearson, 2005 (Chapters - 26, 28, 31 & 34).

OPTICS
1. Paul A. Tipler and Gene Mosca, Physics for Scientists and Engineers, 6th Edition, Freeman, 2008 (Chapters – 31 & 33).
2. Ajoy Ghatak, Optics, 5th Edition, Tata McGraw Hill, 2012 (Chapters – 3, 18, 20)

QUANTUM MECHANICS
1. Paul A. Tipler and Gene Mosca, Physics for Scientists and Engineers, 6th Edition, Freeman, 2008 (Chapters – 34 & 35).
2. Stephen T. Thornton and Andrew Rex, Modern Physics for Scientists and Engineers, 4th Edition, Cengage, 2013. (Chapters - 5 & 6).
3. R. Shankar, Fundamentals of Physics – I, II, Yale University Press, 2014, 2016.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Mechanics of Particles**	**8**
1.1	Scalars and vectors under rotation transformation	2
1.2	Coordinate system - Cartesian, Polar, Spherical, Cylindrical	2
1.3	Newton's second law of motion - Forces in nature - Central forces	2
1.4	Conservative and non-conservative forces - Work - Energy theorem - Conservation of angular momentum - Satellite manoeuvres	2
2	**Oscillations and Waves**	**6**
2.1	Simple harmonic oscillators - Energy decay in a Damped harmonic oscillator	2
2.2	Q factor- Impedance matching – Wave groups and group velocity	2
	CAT-I after 12 contact hours	
2.3	Non-dispersive transverse and Longitudinal waves	1
2.4	Waves with dispersion- Water waves -Acoustic waves – Earthquake and Tsunami waves	1
3	**Quantum Mechanics**	**10**
3.1	Wave nature of particles - wave function -probability current density and expectation values - Schrodinger wave equation	3
3.2	Uncertainty principle - Particle in a box in 1D – Linear harmonic oscillator	3
3.3	Quantum tunnelling – Quantum confinement in 0D, 1D, 2D systems -	4

	Scanning tunnelling microscope – Quantum Cascade lasers – Quantum computation (qubit) – Entanglement - Teleportation	
	CAT-II after 12 contact hours	
4	**Electromagnetic Fields and Waves**	**6**
4.1	Electric potential and Electric field of a charged disc	1
4.2	Magnetic Vector potential – Maxwell's Equations	2
4.3	Equation of continuity-Poynting Vector-Energy and momentum of EM waves	2
4.4	CT/MRI scan	1
5	**Optics**	**6**
5.1	Ray paths in inhomogeneous medium & its solutions–Applications – Fiber optics	2
5.2	Numerical Aperture& Acceptance angle - Fiber optic sensors - Liquid Level & Medical Applications	2
5.3	Interference in non-reflecting films - Fabry- Perot interferometer - Diffraction - Two slit Fraunhofer diffraction	2
	CAT-III after 12 contact hours	
	Total	**36**

Course Designer(s):

1. Dr. M. Mahendran, Professor, manickam-mahendran@tce.edu
2. Mr. V. Veeraganesh, Assistant Professor, vvgphy@tce.edu
3. Dr. A L. Subramaniyan, Assistant Professor, alsphy@tce.edu
4. Dr. A. Karuppusamy, Assistant Professor, akphy@ce.edu

22CH130	CHEMISTRY

Category	L	T	P	Credit
BSC	3	0	0	3

Preamble

The objective of this course is to bestow basic concepts of chemistry and its applications in engineering domain. It imparts knowledge on properties and treatment methods of water, spectroscopic techniques and their applications. This course provides exposure on electrochemical techniques for corrosion control, surface coatings and energy storage devices and also emphasis the properties and applications of engineering materials.

Prerequisite

Nil

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Explain the essential water quality parameters of water	TPS2	70	70
CO2	Determine hardness of water and identify suitable water treatment method	TPS3	70	70
CO3	Explain the electrochemical process involved in energy storage devices and corrosion of metals	TPS2	70	70
CO4	Interpret the electrochemical principles in modern energy storage devices and corrosion control methods	TPS3	70	70
CO5	Identify the appropriate spectroscopic technique for various applications	TPS3	70	70
CO6	Select the materials based on the properties for Engineering applications	TPS3	70	70

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1.	M	L	-	-	-	-	-	-	-	-	-	-
CO2.	S	M	L	-	-	-	L	-	-	-	-	-
CO3.	M	L	-	-	-	-	-	-	-	-	-	-
CO4.	S	M	L	-	-	-	-	-	L	-	-	-
CO5.	S	M	L	-	-	-	L	-	L	-	-	-
CO6.	S	M	L	-	-	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	CAT1						CAT2						Terminal					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
CO1	4	20	0										2	8				
CO2	4	0	20										2	4	10			
CO3	4	20	0										2	8				
CO4	8	0	20										2	4	10			
CO5							12	20	20				6	8	10			
CO6							8	20	20				6	8	10			

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

CO	Assignment 1*						Assignment 2*					
TPS Scale	1	2	3	4	5	6	1	2	3	4	5	6
CO1												
CO2			20									
CO3												
CO4			20									
CO5									20			
CO6									20			

*Assessment type: Quiz / Test /Presentation

Syllabus

Water: Water-sources- physical - characteristics - alkalinity - hardness of water – types - determination of hardness by EDTA method. Boiler trouble-Softening of water: Internal and External treatment methods. Waste water treatment process. **Electrochemical technologies for energy storage and surface engineering:** Electrochemistry and Energy storage: Basics of electrochemistry. Batteries **-** Primary and Secondary batteries. Fuel cells. Hydrogen generation and storage. Corrosion and Surface Engineering–Basics –Corrosion - causes-factors- types - corrosion of metal and computer components- Corrosion control. Electroplating - Electroless process. **Spectroscopic technique and applications:** Principle, instrumentation, and applications: X-ray-diffraction - UV–Visible spectroscopy- Atomic Absorption Spectroscopy - Fluorescence spectroscopy - Inductively Coupled Plasma - Optical Emission Spectroscopy- Infra-red spectroscopy - Nuclear magnetic resonance spectroscopy**. Engineering materials:** Bonding and their influences on the property of materials - melting point - brittleness, ductility – thermal, electrical, and ionic conductivity - optical – magnetic properties, hydrophobic, hydrophilic. **Polymer composites** - structure and properties-applications. **Ceramics and advanced ceramics** - types-properties-applications-**Nano-materials** – Synthesis, structure, and properties –applications.

Text Book

1. P.C. Jain and Monica Jain, A Textbook of Engineering Chemistry, Dhanpat Rai publications, New Delhi, 16thedition, 2015.

Reference Books& web resources

1. S.S. Dara and S.S. Umare, “A Textbook of Engineering Chemistry”, S.Chand & Company, 12thEdition, Reprint, 2013.

2. Shashi Chawla, " A text book of Engineering Chemistry", Dhanpat Rai & Co.(pvt) ltd, 3rd edition, reprint 2011.
3. C. N. Banwell and E.M. McCash, "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill (India), 5thEdition, 2013.
4. W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008.
5. V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.
6. M. Akay, 2015, An introduction to polymer matrix composites," from: https://www.academia.edu/37778336/An_introduction_to_polymer_matrix_composites

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Water**	
1.1	Importance of water, sources, standards for drinking water, (WHO, BIS & ICMR standards) physical, chemical & biological characteristics, Alkalinity (principle only)	1
1.2	Hardness of water - types, units. Determination of hardness by EDTA method and numerical problems	2
1.3	**boiler trouble:** Scale and sludge formation, boiler corrosion, priming and foaming, caustic embrittlement	1
1.4	**Internal treatment methods:** Carbonate, Phosphate, Colloidal, Calgon conditioning	1
1.5	**softening of water:** External treatment methods: Lime-soda process (concept only), zeolite process, ion exchange process	2
1.6	Desalination- reverse osmosis, electro dialysis, solar and multistage flash distillation, nano-filtration	1
1.7	Waste water treatment – primary, secondary, and tertiary treatment	1
2	**Electrochemical technologies for energy storage and surface engineering**	
2.1	**Electrochemistry and Energy storage**: Introduction**–** Basics of electrochemistry – Redox process, EMF	1
2.2	**Energy storage** – Batteries, Battery quality parameters	1
2.3	Primary battery – Dry cell and Alkaline cell	1
2.4	Secondary battery – Lead-acid battery, Lithium-ion battery	1
2.5	Fuel cells – Fundamentals, types and applications. Hydrogen generation and storage	1
2.6	**Corrosion and Surface Engineering**- Basics –Corrosion - causes- factors- types	1
2.7	chemical, electrochemical corrosion (galvanic, differential aeration), corrosion of metal and computer components-	1

Module No.	Topic	No. of Periods
2.8	Corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method	1
2.9	Electroplating –Introduction, Process, Applications (Gold and nickel plating). Electroless plating – Principle, process, Applications (PCB manufacturing)	1
3	**Spectroscopic technique and applications**	
3.1	Introduction to Electromagnetic Radiation, Types of atomic and molecular spectra	1
3.2	***Principle, Instrumentation and Applications:*** X-ray-diffraction	1
3.3	UV–Visible spectroscopy, Atomic Absorption Spectroscopy	2
3.4	Fluorescence spectroscopy, Inductively Coupled Plasma - Optical Emission Spectroscopy	2
3.5	Infra-red spectroscopy	2
3.6	Nuclear magnetic resonance spectroscopy – Magnetic resonance imaging	1
4	**Engineering materials**	
4.1	Bonding and its influence on the property of materials	1
4.2	Properties of materials- melting point - brittleness, ductility - thermal, electrical and ionic conductivity	1
4.3	optical – magnetic properties, hydrophobic, hydrophilic	1
4.4	**Polymer composites** - structure and properties	1
4.5	applications -automotive, aerospace, marine, biomedical, and defense	1
4.6	**Ceramics and advanced ceramics** - types-properties	1
4.7	applications- medicine, electrical, electronics, space	1
4.8	**Nano-materials** – Synthesis, structure and properties	1
4.9	applications - sensors, drug delivery, photo and electro-catalysis, and pollution control	1
	Total	36

Course Designer(s):

1. Dr.M.Kottaisamy hodchem@tce.edu
2. Dr.V.Velkannan velkannan@tce.edu
3. Dr S. Sivailango drssilango@tce.edu
4. Dr.M.Velayudham mvchem@tce.edu
5. Dr.R.KodiPandyan rkp@tce.edu
6. Dr. A. Ramalinga Chandrasekar arcchem@tce.edu
7. Dr. B. Shankar bsrchem@tce.edu

22CH140	TECHNICAL ENGLISH

Category	L	T	P	Credit
HSMC	2	0	0	2

Preamble

The course aims at fostering the students' ability to communicate effectively in various academic, professional, and social settings through oral and written forms. Besides imparting the basic skills namely Listening, Speaking, Reading and Writing (LSRW), significant emphasis is placed on enriching their analytical, descriptive, and creative skills, enabling them to develop and demonstrate a holistic English language proficiency.

Prerequisite

NIL

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	**Relate** the fundamentals of language in terms of vocabulary, grammar and pronunciation in technical communication.	Understand	70%	80%
CO2	**Infer** ideas from technical and general contexts by identifying main ideas, specific details, predicting and note making	Understand	70%	80%
CO3	**Make use of** language in professional and social contexts with clarity and conciseness.	Apply	60%	70%
CO4	**Identify** specific contexts in technical writing, where appropriate lexical and grammatical functions are applied	Apply	60%	70%
CO5	**Develop** the skills such as understanding, evaluating, analysing and summarising the text and graphical representations.	Apply	60%	70%
CO6	**Organise** ideas with coherence, cohesion and precision in formal written communication	Apply	70%	80%

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									M	S		S
CO2									M	S		S
CO3								L	M	S		S
CO4									M	S		S
CO5									M	S		S
CO6								L	M	S		S

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	Assessment 1						Assessment 2						Terminal (%)		
	Written Test 1 (%)			Assignment 1 (%)			Written Test 2 (%)			Assignment 2 (%)					
TPS	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
CO1		24%		100%						-			-	10%	-
CO2		34%								-			-	20%	
CO3			14%						24%	-			-	-	20%
CO4			14%	-					34%	100%			-	-	10%
CO5			14%	-									-	-	20%
CO6				-					42%				-	-	20%
TOTAL	**100%**			**100%**			**100%**			**100%**			**100%**		

* Assignment 1: Speaking activities in CO1, CO2, and CO3 (100%).
**Assignment 2: Writing activities in CO4, CO5, and CO6 (100%).
***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

Syllabus:

MODULE- I - Basics of Language (CO1)
Vocabulary - Word Building, Prefix, Suffix and Root Words, Basics of Grammar – Parts of Speech, Tenses, Phonetics - Phonemes, Syllables and Stress.

MODULE- II– Reading (CO2)
Reading- Skimming and Scanning of Short Comprehension Passages and Answering Questions or Cloze exercises based on the text prescribed for extensive reading, Note-Making.

MODULE- III–Functional English (CO3)
Framing Questions (WH and Yes/No), Modals, Manual Writing, Recommendations Writing, Agenda and Minutes of Meeting.

MODULE-IV – Technical Notions (CO4)
Technical Notions - Subject-Verb Agreement, Relative Clause, Phrasal Verbs, Impersonal Passive Voice, Noun Compounds, Classifications and Definitions, Cause and Effect, Purpose and Function, Numerical Adjectives.

MODULE-V – Analytical Writing and Business Correspondence (CO5 & CO6)
Summary Writing, Interpretation of Graphics, Jumbled Sentences, Paragraph Writing, Formal Letters (Seeking Permission for Industrial Visit / internship / Bonafide), E-mail Writing (BEC Vantage Writing Task I)

Suggested Reading:

Books:

1. Murphy, Raymond, English Grammar in Use with Answers; Reference and Practice for Intermediate Students, Cambridge: CUP, 2004
2. Jones, Daniel. An English Pronouncing Dictionary, Cambridge: CUP, 2006
3. Brook-Hart, Guy. Cambridge English- Business Benchmark-Upper Intermediate, CUP,2013.
4. Dhanavel, S.P. English and Communication Skills for Students of Science & Engineering, Orient BlackSwan, Chennai: 2016.
5. Swan, Michael. Practical English Usage.4th Edn. OUP. 2017.

6. Elbow, Peter. Writing with Power: Techniques for Mastering the Writing Process. New York, Oxford University Press, 1998.

Extensive Reading:

1. Anthology of Select Five Short Stories
2. Tagore, Rabindranath. *Chitra, a Play in One Act.* London, Macmillan and Co., 1914.

Websites:

1. www.englishclub.com
2. owl.english.purdue.edu
3. www.oxfordonlineenglish.com
4. www.bbclearningenglish.com
5. tcesrenglish.blogspot.com

Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.	Word Building, Prefix, Suffix and Root Words	1
2.	Parts of Speech	1
3.	Tenses	1
4.	Skimming and Scanning of Short Comprehension Passages	1
5.	Manual Writing	1
6.	Recommendations	1
7.	Note-Making	1
8.	Subject-Verb Agreement	1
9.	Phonemes	1
10.	Syllables and Stress	1
11.	Answering Questions or Cloze exercises based on the text prescribed for extensive reading	1
12.	Noun Compounds, Classifications and Definitions	1
13.	Cause and Effect, Purpose and Function	1
14.	Summary Writing	1
15.	Interpretation of Graphics	1
16.	Jumbled Sentences	1
17.	Formal Letters (Seeking Permission for Industrial Visit/internship/ Bonafide)	1
18.	Phrasal Verbs and Impersonal Passive Voice	1
19.	Numerical Adjectives	1
20.	Framing Questions (WH and Yes/No) and Modals	1
21.	Agenda and Minutes of Meeting	1
22.	Relative Clause	1
23.	E-mail Writing (BEC Vantage Writing Task I)	1
24.	Paragraph Writing	1
Total		**24**

Course Designers:

1. Dr.A.Tamilselvi tamilselvi@tce.edu
2. Dr. S. Rajaram sreng@tce.edu
3. Dr.G. JeyaJeevakani gjjeng@tce.edu
4. Dr. R. TamilSelvi rtseng@tce.edu

22EC160	COMPUTER AIDED ENGINEERING GRAPHICS

Category	L	T	P	Credit
ESC	2	0	2	3

Preamble

Engineering Graphics is referred as language of engineers. An engineer needs to understand the geometry of any object through its orthographic or pictorial projections. The knowledge on engineering graphics is essential in proposing new product designs through drawings and in reading or understanding the existing drawings. This course covers manual drawing of points, straight lines and Computer aided Drawing of orthographic projection of planes & solids and isometric projection of simple and combined solids.

Prerequisite

Basic knowledge about geometry of objects.

Course Outcomes

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

CO#	Course Outcomes	TPS Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Draw Geometric constructions and projections of points (in all quadrants) and projection of Straight lines (in first quadrant) inclined to one reference plane. (Manual Drawing).	TPS 3	70	70
CO2	Draw the orthographic views (Front view, Top view and side view) of objects from the given isometric view. (Manual Drawing).	TPS 3	70	70
CO3	Draw the orthographic projections (Elevation and Plan) of plane surfaces inclined to any one reference plane using CAD software.	TPS 3	70	70
CO4	Draw the orthographic projections (Elevation and Plan) of regular solids (Prisms, Pyramids, Cylinder and Cone) with axis inclined to any one reference plane using CAD software.	TPS 3	70	70
CO5	Draw the isometric views of regular solids and combined solids (Prisms, Pyramids, Cylinder, Cone, frustum of pyramid, frustum of cone) using CAD software, by 3-D modelling.	TPS 3	70	70
CO6	Draw the isometric views of irregular solids from orthographic views using CAD software, by 3-D modelling.	TPS 3	70	70

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12
CO1	S	M	S	M	M	-	-	-	M	M	-	-
CO2	S	M	S	M	M	-	-	-	M	M	-	-
CO3	S	M	S	M	M	-	-	-	M	M	-	-
CO4	S	M	S	M	M	-	-	-	M	M	-	-
CO5	S	M	S	M	M	-	-	-	M	M	-	-
CO6	S	M	S	M	M	-	-	-	M	M	-	-
Overall	3	2	3	2	2	0	0	0	2	2	0	0
	S	M	S	M	M	-	-	-	M	M	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

Bloom's Category /TPS Scale	Continuous Assessment Test	Terminal Examination
Remember / 1		
Understand / 2		
Apply / 3	100	100
Analyse / 4		
Evaluate / 5		
Create / 6		

Marks Allocation for Internal Assessment:

Sl. No	Description	Marks
1	Submission of Drawing sheets	60
2	Test	40
	Total	**100***

* The total marks secured out of 100 will be converted to 50 marks.

Syllabus

Introduction - Significance of engineering graphics, Use of drawing instruments, Standards, Lettering and dimensioning, Scales. Orthographic Projection- Principles of orthographic projections, First angle projection, Orthographic projection of objects from pictorial views.

Geometric constructions and projections of points (in all quadrants) and projections of straight lines (in first quadrant) inclined to one reference plane. (Manual Drawing).

Drawing orthographic views (Front view, Top view and side view) of objects from the given isometric view (Manual Drawing).

Projections (Elevation and Plan) of plane surfaces in first quadrant, inclined to any one reference plane by rotating object method using Computer Aided Drafting software.

Projection (Elevation and Plan) of regular solids (Prisms, Pyramids, Cylinder and Cone) in first quadrant, by rotating object method when the axis is inclined to one of the reference planes using Computer Aided Drafting software.

Isometric views of regular solids and combined solids (Prisms, Pyramids, Cylinder, Cone, frustum of pyramid, frustum of cone in vertical positions only) using CAD software, by 3-D modelling.

Isometric views of irregular solids from orthographic views by 3-D modelling using Computer Aided Drafting software.

Text Book

1. Bhatt N.D., Panchal V.M. and Ingle P.R., (2014) "Engineering Drawing", Charotar Publishing House.
2. CAD Software Theory and User Manuals (Technical Drawing with AutoCAD).

Reference Books

1. Shah M.B, and Rana B.C (2009) "Engineering Drawing and Computer Graphics",

Pearson Education.
2. B.V.R. Gupta and M. Raja Roy, Engineering Drawing with AutoCAD, 3rd Edition, I.K.International Publications, 2009.
3. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2012.
4. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2019.
5. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2011.
6. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 2017.

Course Contents and Lecture Schedule

#	Topic	Lecture Hours	Practice Hours
1	**Introduction**- Significance of engineering graphics, Use of drawing instruments –Standards, Lettering and dimensioning, Scales, Orthographic Projection-Principles of orthographic projections,	1	1
2	Geometric constructions, Projection (Elevation and Plan) of points located in all quadrants, Projection (Elevation and Plan) of straight lines (in first quadrant) inclined to one reference plane (HP / VP). (Manual Drawing).	3	3
3	Drawing orthographic views (Front view, Top view and side view) of objects from the given isometric view (Manual Drawing).	2	2
4	Projection (Elevation and Plan) of plane surfaces in first quadrant, inclined to HP by rotating object method using Computer Aided Drafting software.	3	3
5	Projection (Elevation and Plan) of plane surfaces in first quadrant, inclined to VP by rotating object method using Computer Aided Drafting software.	3	3
6	Projection (Elevation and Plan) of regular solids (Prisms, Pyramids, Cylinder and cone) in first quadrant, by rotating object method when the axis is inclined to HP using CAD software.	3	3
7	Projection (Elevation and Plan) of regular solids (Prisms, Pyramids, Cylinder and cone) in first quadrant, by rotating object method when the axis is inclined to VP using CAD software.	3	3
8	Isometric projection – Principle, isometric scale, Isometric views and Isometric views of single simple solids and combined solids (Prisms, Pyramids, Cylinder, Cone, frustum of pyramid, frustum of cone in vertical positions only) using CAD software.	3	3
9	Isometric views of irregular solids from orthographic views by 3-D modelling using Computer Aided Drafting software.	3	3
	TOTAL	**24**	**24**

Marks Allocation for Continuous Assessment:

Sl. No	Description	Marks
1	Manual Drawing sheets (A4) submission	15
2	Computer Aided Drafting (CAD) Exercises	20
3	Continuous Assessment Test (CAT) using CAD software	15
Total		**50**

Question Pattern for Terminal Examination (Using CAD software only):

Question Number	Description	Type	Marks
1	Projection (Elevation and Plan) of points in all quadrants and straight lines (in first quadrant) inclined to any one reference plane.	Either or type	10
2	Orthographic views (Front view, Top view and side view) of objects from the given isometric view.	Either or type	10
3	Projection (Elevation and Plan) of plane surfaces (in first quadrant) inclined to any one reference plane.	Either or type	20
4	Projection (Elevation and Plan) of solids (in first quadrant) inclined to any one reference plane.	Either or type	20
5	3-D modelling of combined solids (Prisms, Pyramids, Cylinder, Cone, frustum of pyramid, frustum of cone in vertical positions only) and their isometric view.	Either or type	20
6	3-D modelling of irregular solids from orthographic views and their isometric view.	Either or type	20
Total			**100**

Note:

1. **One test or two tests will be conducted locally by respective Faculty In - charges during regular class hours to account for continuous assessment test (CAT) marks.**
2. **Terminal Practical examination (3 hrs) will be conducted centrally by the office of Controller of Examinations.**

Course Designers:

1. Dr. M.Balamurali, balacim82@tce.edu
2. Dr. A.Samuel Raja, samuel1973@tce.edu
3. Dr. B.Yogameena, ymece@tce.edu
4. Dr. B.Sathyabama, sbece@tce.edu

22EC190	ENGINEERING EXPLORATION

Category	L	T	P	Credit
ESC	1	0	2	2

Preamble

The Course Electronics and Communication Engineering Exploration provide an introduction to Engineering and specifically to Electronics and Communication Engineering fields. It is designed to help the student to learn about engineering and how it affects our everyday lives. The students develop their fundamental understanding of critical concepts of Electronic controls in Consumer products and about Telecommunication through practical sessions.

Prerequisite

Nil

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Explain technological & engineering development, change and impacts of engineering	TPS2	70	70
CO2	Demonstrate the basic concepts of Electronics and functional blocks of communication system	TPS3	70	70
CO3	Interpret the role of Electronic controls in Domestic appliances	TPS3	70	70
CO4	Apply the concept of Electronics and Communication Engineering Design Process for building an electronic hardware	TPS3	70	70

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1.	M	L	-	-	-	-	-	-	-	-	-	-
CO2.	S	M	L	-	L	L	L	-	L	L	-	-
CO3.	M	L	-	-	-	-	-	-	-	-	-	-
CO4.	M	L	-	-	-	-	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assesment-1						Assesment-2			Terminal Examination		
	THEORY						PRACTICAL			PRACTICAL		
CO	Case study			CAT-1								
TPS Scale	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
CO1		50			50							
CO2			50			50						
CO3									40			40
CO4									60			60

Syllabus

What is Engineering: Engineering Requirement, Engineering disciplines, Engineering advancements. **Electronics and Communication Engineering**: Evolution, Theme areas, Concepts in Electronics**-** Active and Passive Components, Signals and EM spectrum– Functional blocks of Wired and Wireless Communication, Communication systems/devices – PSTN, Mobile phone. **Consumer Electronics-** Electrical and Electronic aspects, Electronic controls in Domestic appliances, Audio and Video systems; **Engineering Design:** Problem definition, idea generation through brainstorming and researching, solution creation through evaluating and communicating, test/analysis, final solution and design improvement.

List of Experiments:

1. Identification of components, sources and measuring instruments - experimenting with active and passive components: resistor (voltage division/current division), capacitors and inductors
2. Domestic electrical wiring
3. Practicing soldering and de-soldering
4. Schematic and Layout preparation using CAD tool
5. Practicing PCB fabrication
6. Mini project based on Engineering Design Process demonstrating electronic controls in Domestic appliances

Reference Books

- Ryan A.Brown, Joshua W.Brown and Michael Berkihiser: “Engineering Fundamentals: Design, Principles, and Careers”, Goodheart-Willcox Publisher, Second Edition, 2014.
- Saeed Moaveni, “Engineering Fundamentals: An Introduction to Engineering”, Cengage learning, Fourth Edition, 2011.
- Lynford L. Goddard, Young Mo Kang, Steven J. McKeown, Alexandra Haser, Cori C. Johnson, Madison N. Wilson, “A Project-Based Exploration of Electrical and Computer Engineering” Goddard Independent Publishing, Second Edition, 2020.
- Bali S.P, “Consumer Electronics”, Pearson Education, 2017.
- William D.Stanley amd John.M. Jeffords, “ Electronic Communications Principles and Systems”, Cengage Learning, 2009 (India Edition).

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Engineering**	
1.1	Engineering Requirement, Engineering disciplines, Engineering advancements	1
1.2	**Electronics and Communication –** Evolution, Theme areas	1
1.3	Active and Passive Components	1
2	**Tele Communication System**	
2.1	Functional blocks of Wired and Wireless Communication	1
2.2	Communication System/devices – PSTN, Mobile phone	2
3	**Consumer Electronics**	
3.1	Electrical and Electronic aspects in Domestic appliances	1
3.2	Electronic controls in Domestic appliances	1
3.3	Audio and Video systems	1
4	**Engineering Design Process**	
4.1	Problem definition	1
4.2	Idea generation through brainstorming and researching	
4.3	Solution creation through evaluating and	1

Module No.	Topic	No. of Periods
	communicating	
4.4	Test/Analysis	1
4.5	Final solution and design improvement	
	Theory	12
	Practical	24
	Total	**36**

Course Designers:

- Dr M N Suresh, mns@tce.edu
- Dr V Vinoth Thyagarajan, vvkece@tce.edu
- Dr N Ayyanar, naece@tce.edu
- Dr M Senthilarasi, msiece@tce.edu

22EG170	ENGLISH LABORATORY	Category	L	T	P	Credit
		HSMC	0	0	2	1

Preamble

This practical course enables the students to develop and evaluate their basic English language skills through individualized learning process at the Language Lab, using English Software and online resources. In addition, it facilitates students with the need-based student-centric presentation sessions in a multi-media driven classroom environment.

Prerequisite

NIL

Course Outcomes

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

COs	Course Outcomes	TCE Proficiency Scale
CO1	Interpret words correctly through listening and watching general and technical online contents	TPS1
CO2	Develop appropriate pronunciation skills through listening and speaking practices	TPS3
CO3	Build and apply a wide range of lexicons in general and technical presentations	TPS3
CO4	Identify and apply the key ideas and spoken English features learnt through auditory and visual listening tools	TPS3
CO5	Experiment with inventiveness by creating a blog, vlog, or YouTube channel.	TPS3
CO6	Prepare and deliver oral and written presentations using digital tools.	TPS3

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									**M**	**S**		**S**
CO2									**M**	**S**		**M**
CO3								**L**	**M**	**S**		**S**
CO4								**L**	**M**	**S**		**M**
CO5								**L**	**M**	**S**		**S**
CO6								**L**	**S**	**S**		**S**

Assessment Pattern

Students' performance will be assessed in the language lab/ classroom as given below:

- Spoken Task - General / Technical Presentation / Picture Description :20 Marks
- Listening Task –(MCQs, Gap Filling Exercises) :10 Marks
- Written Test - Phonetics, Grammar, Vocabulary, Reading :20 Marks

External: Online Exam- Phonetics, Grammar, Vocabulary, Reading (45 Minutes): 50 Marks

Listening Test : 20 Marks

Submission of Students' Record on Practical Tasks in the Class and Lab :10 Marks

BEC Vantage Speaking Tasks I and II : 20 Marks

List of Experiments

S.No	Topic	Hours
	LAB ACTIVITIES (12 Hours)	
1	Listening to TED Talks/ Podcasts/ Product Advertisements/ News Bulletins.	2
2	Phonetics – Tutorials through Online Repositories, English Movie Clips and Software in the Lab(S-net)	2
3	Vocabulary Development through Movies / Short Films/ Documentaries	2
4	Language Development through English software S-net and Online Content (Tens Voices, SV Agreement, Prepositions, Coherence Markers, Relative Clauses, Mod Punctuation)	2
5	Reading Comprehension – I (General / Technical, BEC Vantage Reading Task III	2
6	Creating a Blog/Vlog/YouTube Channel –Uploading MP3/MP4 – Practice (Movie/Book/ Gadget Review, General/Tech Talks, Interview with Celebrities)	1
7	Revision – Model Online Aptitude Test	1
	CLASSROOM ACTIVITIES (12 Hours)	
8	Introduction of Spoken English Features	1
9	Self-introduction and Introducing others	1
10	Video Comprehension – Brainstorming and Note-Taking	2
11	Role-Play, Picture/Movie Description	1
12	Reporting the events from Media / Newspapers – Discussion	1
13	Interactive Games for Language Development	1
14	Reading / Note Making (Extensive Reading – News Paper Reports)	1
15	Presentation – I (Book /Movie Review, Story Telling, General Presentations)	2
16	Presentation – II (Technical Presentations)	2
	Total	24

Software Used:

1. English Software S Net
2. Business English Certificate-Vantage- Practice Software

Teaching Resources and Websites:

1. Open Online Repositories from Oxford / Cambridge / British Council/ Voice of America
2. Free Video Downloads from YouTube
3. www.ted.com
4. tcesrenglish.blogspot.com

Course Designers:

1. Dr.A.Tamilselvi tamilselvi@tce.edu
2. Dr. S. Rajaram sreng@tce.edu
3. Dr.RS. Swarnalakshmi rssleng@tce.edu
4. Mrs. M. Sarpparaje mseeng@tce.edu

22PH180	PHYSICS LABORATORY

Category	L	T	P	Credit
BSC	0	0	2	1

Preamble

This course ensures that students are able to apply the basic physics concepts and carry out the experiments to determine the various physical parameters related to the material

- Learn the necessary theory to understand the concept involved in the experiment.
- Acquire the skills to carry out the experiment.
- Tabulate the observed data and use the formula to evaluate the required quantities.
- Plot the data in a graph and use it for calculation.

Prerequisite

NIL

Course Outcomes

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

	Course Outcome	TCE Proficiency Scale	Expected Proficiency (%)	Expected Attainment Level (%)
CO1	Analyze the mechanical & electrical oscillations and determine their resonance frequency	TPS3	85	90
CO2	Analyse the interference and diffraction patterns for micron sized objects	TPS3	85	90
CO3	Investigate the V-I characteristics of photodiode, phototransistor under dark and bright illumination conditions	TPS3	85	90
CO4	Determine the Planck's constant using LEDs	TPS3	85	90
CO5	Plot the VI characteristics of solar cell and find the fill factor	TPS3	85	90
CO6	Determine the reversibility of classical and quantum logic gates	TPS3	85	90
CO7	Identify the variation of magnetic field with distance for circular coils	TPS3	85	90

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1.	S	M	L	-	M	-	-	-	S	-	-	L
CO2.	S	M	L	-	M	-	-	-	S	-	-	L
CO3	S	M	L	-	M	-	-	-	S	-	-	L
CO4	S	M	L	-	M	-	-	-	S	-	-	L
CO5	S	M	L	-	M	-	-	-	S	-	-	L
CO6	S	M	L	-	M	-	-	-	S	-	-	L
CO7	S	M	L	-	M	-	-	-	S	-	-	L

S- Strong; M-Medium; L-Low

List of Experiments

1. Quantum Logic Gate-Toffoli gate
2. Study of Optoelectronic Devices- Photodiode, Phototransistor.

3. Solar cell VI characteristics, fill factor & Optical Fibre - Determination of numerical aperture.
4. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of regular objects.
5. Laser Diffraction - Determination of wave length of the laser using grating and determination of micro particle size. (Observing diffraction pattern due to single and double slit)
6. Air wedge – Determination of thickness of a thin sheet/wire.
7. Determination of Planck's constant through V-I characteristics of LED.
8. Determination of magnetic field-Stewart and Gees.
9. LCR Circuit – Determination of resonant frequency

Course Designer(s):

1. Dr N. Sankarasubramanian, Professor, nssphy@tce.edu
2. Dr A. L . Subramaniyan, Assistant Professor, alsphy@tce.edu
3. Dr P.K. Kannan, Assistant Professor, akphy@ce.edu

22CH190	CHEMISTRY LABORATORY

Category	L	T	P	Credit
BSC	0	0	2	1

Preamble

This course aims to provide the students, a basic practical knowledge in chemistry. The objective of this course is to develop intellectual and psychomotor skills of the students by providing hands on experience in quantitative, electrochemical and photo-chemical analysis.

Prerequisite

Nil

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale
CO1	Estimate the chemical water quality parameters of sample water / effluent	TPS3
CO2	Demonstrate presence of calcium ions in milk sample	TPS3
CO3	Determine the surface tension of solvent mixtures	TPS3
CO4	Estimate pH and acid content of samples using pH metric and conductometric titrations	TPS3
CO5	Illustrate the strength of oxidisable materials present in given sample by potentiometric method	TPS3
CO6	Determine Fe^{2+} ion in effluent using colorimetric method	TPS3
CO7	Calculate the efficiency of electroplating	TPS3
CO8	Determine the rate of corrosion of metal & alloy using potentio-dynamic polarisation method	TPS3

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1.	S	M	L	-	M	-	-	-	L	-	-	-
CO2.	S	M	L	-	M	-	-	-	L	-	-	-
CO3.	S	M	L	-	M	-	-	-	L	-	-	-
CO4.	S	M	L	-	M	-	-	-	L	-	-	-
CO5.	S	M	L	-	M	-	-	-	L	-	-	-
CO6.	S	M	L	-	M	-	-	-	L	-	-	-
CO7.	S	M	L	-	M	-	-	-	L	-	-	-
CO8.	S	M	L	-	M	-	-	-	L	-	-	-

S- Strong; M-Medium; L-Low

List of Experiments/Activities with CO Mapping

Experimental List	CO
Quantitative Analysis	
Estimation of total hardness of water sample	CO1

Estimation of COD of industrial effluent	CO1
Determination of calciumion inmilk sample	CO2
Determination of surface tension of solvent mixture	CO3
Electrochemical and Photochemical Analysis	
Determination of the Phosphoric acid content in soft drinks using conductometric titration	CO4
Determination of pH of soil by pH metric titration	CO4
Potentiometric redox titration ($K_2Cr_2O_7$vs FAS, $KMnO_4$vs FAS)	CO5
Estimation of iron content in water sample using colorimeter	CO6
Estimation of current density of electroplating process using Hull cell	CO7
Determination of rate of corrosion of metal and alloy using potentiodynamic polarisation technique (TAFEL)	CO8

Learning Resources

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH}edition, 2014)
2. LaboratoryManual – Department of Chemistry, Thiagarajar College of Engineering (2022)

Course Designers:

1. Dr.M.Kottaisamy hodchem@tce.edu
2. Dr.V.Velkannan velkannan@tce.edu
3. Dr. S. Sivailango drssilango@tce.edu
4. Dr.M.Velayudham mvchem@tce.edu
5. Dr.R.Kodi Pandyan rkp@tce.edu
6. Dr.A.Ramalinga chandrasekar arcchem@tce.edu
7. Dr. B. Shankar bsrchem@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

SECOND SEMESTER

and

22EC310 Probability and Statistics for third semester
22EC410 Optimization for fourth semester

B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2022-23

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided Autonomous Institution Affiliated to Anna University)
MADURAI – 625 015, TAMILNADU

Phone : 0452 – 2482240, 41
Fax : 0452 2483427
Web : www.tce.edu

Passed in BoS Meeting 03.12.2022 Approved in 64th Academic council Meeting 11.01.2023

Vision and Mission of the Department

Vision:

To empower the Electronics and Communication Engineering students with technological excellence, professional commitment and social responsibility.

Mission:

ME1. Attaining academic excellence in Electronics and Communication Engineering through dedication to duty, innovation in learning and research, state of the art laboratories and industry driven skill development.

ME2. Establishing suitable environment for the students to develop professionalism and face life challenges with ethical integrity.

ME3. Nurturing the students to understand the societal needs and equip them with technical expertise to provide appropriate solutions.

ME4. Providing breeding ground to obtain entrepreneurial skills and leadership qualities for self and social growth.

Program Educational Objectives (PEOs):

PEO1. Graduates will be capable of developing specification and design procedures, prototyping and test methodologies for modern electronics and communication systems and gadgets that perform analog and digital processing functions.

PEO2. Graduates will be able to work and adapt to changes in allied areas of Electronics and Communication Engineering through personal success and life long learning.

PEO3. Graduates will be able to identify technological requirements for the society and provide cost effective solutions.

- These objectives will be evidenced by professional visibility (publications, presentations, inventions, patents and awards), entrepreneurial activities, international activities (participation in international conferences, collaborative research and employment abroad)

Program Outcomes:
Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and 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.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex 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 the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering 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.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes:
Engineering Graduates will be able to

PSO1. Design circuits and systems for complex engineering problems in Electronics and Communication and allied areas.
PSO2. Apply research methodologies to provide solutions for contemporary problems in the areas including RF, Signal Processing, Image Processing, VLSI, Optical Communication, Networks and Embedded Systems for given specifications.
PSO3. Actively contribute as a member or leader in diverse teams, and communicate effectively on complex engineering activities and involve in life-long learning, by applying reasoning and ethical principles.

PEO- Mission Mapping:

	ME1	ME2	ME3	ME4
PEO1	S	M	M	L
PEO2	L	S	M	M
PEO3	M	L	S	M

PEO-PO-PSO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
PEO 1															
PEO 2															
PEO 3															

PO-GA Mapping:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PO1												
PO2												
PO3												
PO4												
PO5												
PO6												
PO7												
PO8												
PO9												
PO10												
PO11												
PO12												

TCE PROFICIENCY SCALE (CDIO Curriculum Framework)

TCE Proficiency Scale (TPS)	Proficiency	Cognitive	Affective	Psychomotor
TPS1	To have been exposed to	Remember	Receive	Perception, Set
TPS2	To be able to interpret and imitate	Understand	Respond	Guided Response
TPS3	To be skilled in the practice or implement	Apply	Value	Mechanism
TPS4	To be able to participate in and contribute	Analyse	Organise	Complex Overt Responses
TPS5	To be able to judge and adapt	Evaluate	Organise	Adaptation
TPS6	To be able to lead and innovate	Create	Characterize	Origination

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)

CREDIT DISTRIBUTION
(For the students admitted in the Academic Year 2022-23 onwards)

Degree: B.E.

Sl. No.	Category		Credits
A.	**Foundation Courses (FC)**		**54 - 66**
	a.	Humanities and Social Sciences including Management Courses (HSMC)	09 - 12
	b.	Basic Science Courses (BSC)	24 - 27
	c.	Engineering Science Courses (ESC)	21 - 27
B.	**Professional Core Courses (PCC)**		**55**
C.	**Professional Elective Courses (PEC)**		**24 - 39**
	a.	Programme Specific Elective (PSE)	15 - 24
	b.	Programme Elective for Expanded Scope (PEES)	09 - 15
D.	**Open Elective Courses (OEC)**		**06 - 12**
	a.	Interdisciplinary Elective (IE)	03 - 06
	b.	Basic Science Elective (BSE)	03 - 06
E.	**Project Work (PW)**		**12**
F.	**Internship and Mandatory Audit Courses as per Regulatory authorities**		Non-Credit and not included in CGPA
Minimum Credits to be earned for the award of the Degree			**160**
			From A to E and the successful completion of F

SCHEDULING OF COURSES FOR STUDENTS JOINED FROM ACADEMIC YEAR 2022-23 ONWARDS (B.E. ECE Programme) *											
Sem	Theory / Theory cum Practical / Practical								CDIO courses	Audit Courses (Mandatory Non-credit}	Credit
	1	2	3	4	5	6	7	8			
I	22MA110 Calculus for Engineers (BSC-4)	22PH120 Physics (BSC-3)	22CH130 Chemistry (BSC-3)	22EG140 Technical English (HSMC-2)	22EC160 Computer Aided Engg. Graphics (TCP) (ESC-3)	22EG170 English Laboratory (HSMC-1)	22PH180 Physics Laboratory (BSC-1)	22CH190 Chemistry Laboratory (BSC-1)	22EC190 Engineering Exploration (TCP) (ESC-2)		20
II	22EC210 Matrices and Linear Algebra (BSC-3)	22EC220 Electronic Devices (ESC-3)	22EC230 Electric and Magnetic Circuits (PCC-4)	22EC240 Digital Circuit Design (TCP) (PCC-4)	22EC250 Field Theory and Transmission Lines (PCC-3)	22EC260 Problem Solving using Computers (TCP) (ESC-3)				22CHAA0 Environmental Science (BSC-0)	20
III	22EC310 Probability and Statistics BSC-3	22EC320 Analog Circuit Design (TCP) (PCC-4)	22EC330 Network Analysis and Synthesis (BSC-3)	22EC340 Computer Organization and Microprocessor (TCP) (PCC-4)	22EC350 Signals and Systems (TCP) (PCC-4)	22EC360 Object-Oriented Programming (ESC-3)					21
IV	22EC410 Optimization BSC-3	22EC420 Mixed Signal Circuit Design (TCP) (PCC-3)	22EC430 RF Circuit Design (TCP) (PCC-4)	22EC440 Microcontrollers and Embedded Systems (TCP) (PCC-4)	22EC450 Discrete-Time Signal Processing (TCP) (PCC-4)	22EC460 Introduction to Data Science (ESC-2)			22ES490 Design Thinking (ESC-3)	22YYXX0 Audit Course	23

V	22EC510 Data Communication Networks (TCP) (PCC-4)	22EC520 VLSI Circuits and Systems PCC-3	22EC530 Antennas and Wave Propagation (TCP) (PCC-3)	22EC540 Sensors and Instrumentation (PCC-2)	22EC550 Analog and Digital Communication (TCP) (PCC-4)		22YYGX0 Interdisciplinary Elective (OE-3)		22EC590 Electronics - Design Project (PW-3)		22
VI	22EC610 Accounting and Finance (HSMC-3)	22EC620 Image Processing (TCP) (PCC-3)	22ECPX0 (PSE – 3)		22EC630 Optical and Wireless Communication (TCP) (PCC-4)	22EC640 Systems Software (ESC-2)	22YYFX0 Basic Science Elective (OE-3)	22EG650 Professional Communication (HSMC-3)	22EC690 Communications - Design Project – (PW-3)		24
VII	22ECPX0 (PSE – 3)	22ECPX0 (PSE – 3)	22ECRX0 (PEES – 3)	22ECRX0 (PEES – 3)	22ECRX0 (PEES – 3)				22EC790 Secure Communication (or) AI in Communication., vision and health-care Design Project (PW-3)		18
VIII	22ECPX0 (PSE – 3)	22ECPX0 (PSE – 3)	22ECPX0 (PSE – 3)						22EC890 Final Project (PW-3)		12

This schedule shows an optimal way of completing the B.E. Degree programme successfully in 4 Years ***Total Credits for Curricular Activities: 160***

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)

COURSES OF STUDY
(For the students admitted in the Academic Year 2022-23 onwards)

SECOND SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
22EC210	Matrices and Linear Algebra	BSC	2	1	-	3
22EC220	Electronic Devices	ESC	2	1	-	3
22EC230	Electric and Magnetic Circuits	PCC	3	1	-	4
22EC250	Field Theory and Transmission Lines	PCC	2	1	-	3
THEORY CUM PRACTICAL						
22EC240	Digital Circuit Design	PCC	3	-	2	4
22EC260	Problem Solving using Computers	ESC	2	-	2	3
AUDIT COURSE						
22CHAA0	Environmental Science	BSC	1	-	1	0
Total			**15**	**4**	**5**	**20**

THIRD SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
22EC310	Probability and Statistics	BSC	2	1	-	3
Total			**2**	**1**	**0**	**3**

FOURTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
22EC410	Optimization	BSC	2	1	-	3
Total			**2**	**1**	**0**	**3**

BSC : Basic Science Courses
PCC : Professional Core Courses (PCC)
ESC : Engineering Science Courses

L : Lecture
T : Tutorial
P : Practical

Note:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)
SCHEME OF EXAMINATIONS
(For the Students admitted in the academic year 2022-23 onwards)

SECOND SEMESTER

Course Code	Name of the Course	Duration of TE in Hrs.	Marks			Min. Marks for Pass	
			CA*	TE	Max. Marks	TE	Total
THEORY							
22EC210	Matrices and Linear Algebra	3	40	60	100	27	50
22EC220	Electronic Devices	3	40	60	100	27	50
22EC230	Electric and Magnetic Circuits	3	40	60	100	27	50
22EC250	Field Theory and Transmission Lines	3	40	60	100	27	50
THEORY CUM PRACTICAL							
22EC240	Digital Circuit Design	3	50	50	100	25	50
22EC260	Problem Solving using Computers	3	50	50	100	25	50
AUDIT COURSE							
22CHAA0	Environmental Science	-	50	50	100	25	50

THIRD SEMESTER

Course Code	Name of the Course	Duration of TE in Hrs.	Marks			Min. Marks for Pass	
			CA*	TE	Max. Marks	TE	Total
THEORY							
22EC310	Probability and Statistics	3	40	60	100	27	50

FOURTH SEMESTER

Course Code	Name of the Course	Duration of TE in Hrs.	Marks			Min. Marks for Pass	
			CA*	TE	Max. Marks	TE	Total
THEORY							
22EC410	Optimization	3	40	60	100	27	50

TE – Terminal Examination, CA – Continuous Assessment

*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

22EC210	MATRICES AND LINEAR ALGEBRA

Category	L	T	P	Credit
BSC	2	1	0	3

Preamble

Mathematical functions can be viewed in many different ways and one way of viewing them is through vectors. Most of the algebraic manipulation of functions from an m dimensional space to an n dimensional space can be done using matrices and the tools from linear algebra. This course aims at giving through knowledge on matrices and linear algebra and enables the students to solve problems occurring in an n dimensional space.

Prerequisite

NIL

Course Outcomes

COs	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Demonstrate vector space and subspace	TPS 3	70	60
CO2	Use rank nullity theorem to determine the dimension of the range space	TPS 3	70	60
CO3	Compute the nearest possible solution to the given system of equation	TPS 3	70	60
CO4	Determine an orthonormal basis for the given basis.	TPS 3	70	60
CO5	Use properties of Eigen values to determine Eigen values for higher powers of a matrix.	TPS 3	70	60
CO6	Decompose the given matrix into a product of unitary matrix and singular matrix and determine the Eigen values numerically	TPS 3	70	60
CO7	Determine the matrix representation of a linear transformation and solve the linear system of equations numerically	TPS 3	70	60

Mapping with Programme Outcomes

COs	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	L	-	-	-	-	-	-	-	-	S	L	-	-
CO2	S	M	L	-	-	-	-	-	-	-	-	S	L	-	-
CO3	S	M	L	-	-	-	-	-	-	-	-	S	L	-	-
CO4	S	M	L	-	-	-	-	-	-	-	-	S	L	-	-
CO5	S	M	L	-	-	-	-	-	-	-	-	S	L	-	-
CO6	S	M	L	-	-	-	-	-	-	-	-	S	L	-	-
CO7	S	M	L	-	-	-	-	-	-	-	-	S	L	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

TPS / CO	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I (%)			CAT – II (%)			Assg. II (%)					
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	-	-	17	-	-	100	-	-	-	-	-	-	-	-	8
CO2	3	10	15	-	-		-	-	-	-	-	-	-	6	8
CO3	-	-	17	-	-		-	-	-	-	-	-	-	-	8
CO4	4	10	8	-	-		-	-	-	-	-	-	-	6	5
CO5	3	-	13	-	-		-	-	-	-	-	-	-	-	8
CO6	-	-	-	-	-	-	7	10	33	-	-	100	-	9	16
CO7	-	-	-	-	-	-	3	10	37	-	-		-	9	17
Total	**10**	**20**	**70**	**-**	**-**	**100**	**10**	**20**	**70**	**-**	**-**	**100**	**-**	**30**	**70**

Syllabus

Vector Spaces: Vector space, Subspaces, linear independence of vectors, basis and dimension, Row space and Column space, Rank and nullity theorem. [8 hours]

Orthogonality: Orthogonal subspaces, Least square problem, Inner product spaces, Orthonormal sets, The Gram-Schmidt orthogonalization process. [7 hours]

Matrix Eigen Value Problem: Eigen values and Eigen vectors, Properties of eigen values and eigen vectors, orthogonal matrices, Diagonalization, Quadratic forms and Canonical Form, Singular value decomposition, Jacobi method, Power method, Determining Eigen values using matlab. [12 hours]

Linear Transformations: Definition and Examples, Matrix Representations of Linear Transformations, Similarity , Gauss Elimination method, Gauss Jordan method, Solving linear system of equations using matlab [9 hours]

Text Book

- Steven.J. Leon, “Linear Algebra with Applications”, 8th edition, Pearson, 2010
- Erwin Kreszig, “Advanced Engineering Mathematics”, 9th edition, Wiley, 2017.
- Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, New Delhi, 2018.
- S. R. K. Iyengar, R. K. Jain, Mahinder Kumar Jain, “Numerical methods for Scientific and Engineering Computations”, New Age International publishers, 6th Edition, 2012.

Reference Books& web resources

- David C. Lay, “Linear Algebra and its applications”, Pearson Addison – Addison Wesley, 3 rd. edition, 2006.
- Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, New Delhi, 2012.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods	COS
1	**Vector Spaces**		
1.1	Vector space	1	CO1
1.2	Subspaces	1	CO1
	Tutorial	**1**	
1.3	Linear independence of vectors	1	CO2
1.4	Basis and dimension	1	CO2
1.5	Row space and Column space, Rank and nullity theorem	2	CO2

	Tutorial	**1**	
2	**Orthogonality**		
2.1	Orthogonal subspaces	1	CO3
2.2	Least square problem	1	CO3
	Tutorial	**1**	
2.3	Inner product spaces	1	CO4
2.4	Orthonormal sets	1	CO4
2.5	The Gram-Schmidt orthogonalization process	1	CO4
	Tutorial	**1**	
3	**Matrix Eigen Value Problem**		
3.1	Eigen values and Eigen vectors	1	CO5
3.2	Properties of Eigen values and Eigen vectors	1	CO5
	Tutorial	**1**	
3.3	Orthogonal matrices	1	CO6
3.4	Diagonalization	1	CO6
3.5	Quadratic forms and Canonical Form	1	CO6
3.6	Singular value decomposition	1	CO6
	Tutorial	**1**	
3.7	Jacobi method	1	CO6
3.8	Power method	2	CO6
	Determining Eigen values using matlab	**1**	
4	**Linear Transformations**		
4.1	Definition and Examples	1	CO7
4.2	Matrix Representations of Linear Transformations	2	CO7
4.3	Similarity	2	CO7
	Tutorial	**1**	
4.4	Gauss Elimination method	1	CO7
4.5	Gauss Jordan method	1	CO7
	Solving linear system of equations using matlab	**1**	
	Total	36	

Course Designers:

- Dr. S. P. SuriyaPrabha suriyaprabha@tce.edu
- Dr. L. Muthusubramanian lmsmat@tce.edu
- Dr. S. Suriyakala ssamat@tce.edu

22EC220	ELECTRONIC DEVICES

Category	L	T	P	Credit
ESC	2	1	0	3

Preamble

This is an introduction course to electronic devices. The course begins with a discussion on how electron energy bands are formed in semiconductors; followed by discussions on equilibrium statistics of electrons and holes, drift, diffusion currents, and generation and recombination processes. It then examines the principles and operations of essential semiconductor devices used in today's electronics: diodes, light detectors and emitters, bipolar junction transistors and MOSFETs. It includes the need for small signal model and large signal model of the devices which is the prerequisite for next level courses. The goal is to develop a solid understanding of the device concepts that will be needed in a broad range of areas from semiconductor to circuit (analog, digital and VLSI) design and engineering.

Prerequisite

NIL

Course Outcomes

CO	Course Outcome Statement	TPS Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Describe the energy band diagram of Silicon Semiconductors.	TPS 2	70	70
CO2	Examine the model parameters from the diode data Sheet	TPS 3	70	70
CO3	Interpret the model parameters from the BJT data Sheet	TPS 3	70	70
CO4	Calculate the current gain of the transistors using semiconductor parameters	TPS 3	70	70
CO5	Classify the types of FET based internal structure and operation.	TPS 3	70	70
CO6	Explain the internal structure and principle of operation of photo and power devices.	TPS 2	70	70

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	L	-	L	-	-	L	L	L	-	L	M	-	L
CO2	S	M	L	-	L	-	-	L	L	L	-	L	M	-	L
CO3	S	M	L	-	L	-	-	L	L	L	-	L	M	-	L
CO4	S	S	M	L	L	-	-	L	L	L	-	L	S	-	L
CO5	M	L	-	-	-	-	-	-	L	L	-	L	S	-	L
CO6	S	S	M	M	L	-	-	-	-	-	-	-	S	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I * (%)			CAT – II (%)			Assg. II * (%)					
TPS Scale / CO	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	-	20	-	100			-	-	-	-			-	4	12
CO2	-	10	30				-	-	-	-			-	4	10
CO3	-	10	30				-	-	-	-			-	4	10
CO4	-	-	-	-			-	10	20	100			-	4	10
CO5	-	-	-	-			-	10	30				-	4	10
CO6	-	-	-	-			-	20	20				-	4	10
Total	-	**40**	**60**	**100**			**-**	**30**	**70**	**100**			**-**	**28**	**72**

Syllabus

Semiconductors: Conductors, Semiconductors, Silicon Crystals, Intrinsic Semiconductors, Two Types of Extrinsic Semiconductors, Energy band structure, Energy Levels, Energy Hills **PN Junction Diodes:** Unbiased Diode, Forward Bias, Reverse Bias, Breakdown, Diode current, Current equation, Transition and Diffusion capacitance, Reading Diode datasheet, Rectifier circuit, Zener Diode. **Bipolar Junction Transistors**: Unbiased Transistor, Biased Transistor, Transistor Currents, CE Connection, Base Curve, Collector Curve, Transistor Approximations, Understanding BJT Data Sheet. **Field Effect Transistors**: JFETs, Drain and Transconductance Characteristics, MOSFETs, Depletion Mode MOSFET, Enhancement Mode MOSFET, Ohmic region, Understanding FET Datasheet. **Photo and Power Devices**: Photo diode, LED, LDR, SCR, DIAC, TRIAC.

Text Book

- Albert Paul Malvino and David J Bates," Electronic Principles", 8th Edition, McGraw Hills, 2020.

Reference Books & web resources

- Robert L. Boylestad, Louis Nashelsk, "Electronic Devices and Circuit Theory", 11th Edition, Pearson, 2013
- David A. Bell, "Electronic Devices and Circuits", Oxford University Press, Fifth Edition, 2008.
- Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press Seventh Edition, 2015.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**SEMICONDUCTOR**	
1.1	Conductors, Semiconductors, Silicon Crystals	1
1.2	Intrinsic Semiconductors	1
1.3	Two Types of Extrinsic Semiconductors	1
1.4	Energy band structure	1
1.5	Energy Levels, Energy Hills	3
2	**P-N JUNCTION**	
2.1	Unbiased Diode, Forward Bias, Reverse Bias,	1
2.2	Breakdown, Diode current	1
2.3	Current equation, Transition and Diffusion capacitance,	1
2.4	Reading Diode datasheet	1
2.5	Rectifier circuit	2

2.6	Zener Diode.	2
3	**BIPOLAR JUNCTION TRANSISTOR (BJT)**	
3.1	Unbiased Transistor	1
3.2	Biased Transistor	1
3.3	Transistor Currents, CE Connection	2
3.4	Base Curve, Collector Curve	2
3.5	Transistor Approximations	1
3.6	Understanding BJT Data Sheet.	1
4	**FIELD EFFECT TRANSISTORS (FET)**	
4.1	JFETs	1
4.2	Drain and Transconductance Characteristics	2
4.3	MOSFETs, Depletion Mode MOSFET	1
4.4	Enhancement Mode MOSFET	1
4.5	Ohmic region	1
4.6	Understanding FET Datasheet	1
5	**PHOTO AND POWER DEVICES**	
5.1	Photo diode, LED, LDR	3
5.2	SCR, DIAC, TRIAC	3
	Total	36

Course Designers:

- Dr.N.B.Balamurugan nbbalamurugan@tce.edu
- Dr. V.Vinoth Thyagarajan vvkece@tce.edu
- Dr.S.Rajaram rajaram_siva@tce.edu
- Dr.D.Gracia Nirmala Rani gracia@tce.edu
- Dr.V.R.Venkatasubramani venthiru@tce.edu
- Mrs J Shanthi jsiece@tce.edu

22EC230	ELECTRIC AND MAGNETIC CIRCUITS

Category	L	T	P	Credit
PCC	3	1	0	4

Preamble

This course is an introduction to electrical and magnetic circuits. It starts with the basic quantities used to characterize circuit operation (like current, voltage, and power) and then enforce several physical laws to form the basis of DC and AC electric circuit analysis. Electric circuits will be examined in time domain under transient and sinusoidal steady-state conditions. Simple magnetic circuit analysis will be done with respective Laws and the operation of transformer will also be studied.

Prerequisite

NIL

Course Outcomes

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

CO#	Course Outcomes	TPS Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Apply the knowledge of basic circuit laws to simplify DC circuits.	TPS 3	70	70
CO2	Solve DC circuits by using KVL and KCL.	TPS 3	70	70
CO3	Apply network theorems for the analysis of electrical circuits.	TPS 3	70	70
CO4	Determine Complex Impedance, Power factor of single phase and Three phase AC Circuits.	TPS 3	70	70
CO5	Obtain the transient and steady-state response of electrical circuits in Time domain.	TPS 3	70	70
CO6	Apply circuit analysis methods applicable to magnetic circuits.	TPS 3	70	70

Mapping with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	L	L	-	-	L	M	M	-	-	S	L	L
CO2	S	M	L	L	L	-	-	L	M	M	-	-	S	L	L
CO3	S	M	L	L	-	-	-	L	M	M	-	-	S	-	L
CO4	S	M	L	L	-	-	-	L	M	M	-	L	S	-	L
CO5	S	M	L	L	-	-	-	L	M	M	-	L	S	-	L
CO6	S	M	L	L	-	-	-	L	M	M	-	-	S	-	L
Over all	3	2	1	1	0	0	0	1	2	2	0	0	3	0	1
	S	M	L	L	-	-	-	L	M	M	-	-	S	-	L

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I * (%)			CAT – II (%)			Assg. II * (%)					
TPS Scale / CO	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	-	10	10	100			-						-	4	6
CO2	-	10	20				-						-	4	14
CO3	-	10	40				-						-	4	15
CO4	-						-	8	25	100			-	4	15
CO5	-						-	4	30				-	-	20
CO6	-						-	8	25				-	4	10
Total	-	**30**	**70**	**100**			**-**	**20**	**80**	**100**			**-**	**20**	**80**

Syllabus

Electric circuit Elements and Kirchhoff's laws: Charge, Voltage, Current and Power; Voltage ,current sources; series and parallel circuit, Voltage and current Divider; KCL and KVL ; **DC Circuit Analysis:** Mesh, super mesh, Node and super Node Analysis **Theorems:** Source Transformation; Superposition; Thévenin's and Norton's equivalent Circuits; Maximum power transfer Theorem; Tellegen's Theorem; Reciprocity Theorem; Δ ↔ Y conversion; **AC Components & Circuits:** Inductor; Capacitor; AC sources, Complex impedance, RL, RC & RLC series and parallel circuits and Phasors; power and Power factors; Duality in Electrical circuits; **Poly Phase circuits:** Single-Phase Three-Wire Systems; Three-Phase Y-Y Connection; The Delta Connection; **AC Steady State Analysis in Time domain :** Mesh, Node Analysis & Theorems on AC circuits ; Resonance. **Transient Analysis in Time domain :** Source Free, DC Driven RL, RC & RLC circuits; **Magnetically coupled circuits:** Self and Mutual Inductance; Dot convention, Energy considerations, Linear transformer; Ideal transformer and Impedance matching; Tuned circuits.

Text Book

- W. H Hayt, J. E Kemmerly and S.M Durbin, "Engineering Circuit Analysis" by 9th Edition (2020), McGraw Hill.

Reference Books

- A. Sudhakar and Shyammohan S. Palli, "Circuits and Networks: Analysis and Synthesis", 5th Edition (2017), McGraw Hill.
- Charles K. Alexander, Matthew N. O. Sadiku "Fundamentals of Electric Circuits" 7th Edition (2022), McGraw Hill.
- Mahmood Nahvi and Joseph Edminister, "Schaum's Outline of Electric Circuits", 7th Edition (2017) McGraw-Hill.
- NPTEL, SC Dutta Roy, Circuit Theory, IITD, http://nptel.iitm.ac.in/video.php?subjectId=10810204
- NPTEL Nagendra Krishnapura, Basic Electrical Circuits, IITM, https://onlinecourses.nptel.ac.in/noc20_ee64/preview

Course Contents and Lecture Schedule

#	Topic	Lecture Hours	Tutorial
1	**Introduction**	1	-
2	Charge, Voltage, Current and Power, Voltage ,current sources	1	-
3	Series and parallel circuit, Voltage and current Divider;	1	1
4	Mesh, super mesh, Node and super Node Analysis	4	1
	Theorems		
5	Source Transformation; Superposition Theorem	1	1
6	Thévenin's and Norton's equivalent Circuits;	2	1

7	Maximum power transfer Theorem; Tellegens Theorem; Reciprocity Theorem;	2	-
8	Δ ↔ Y conversion	1	1
	AC Components & Circuits:		
9	Inductor; Capacitor; AC sources,	1	-
10	AC sources, Complex impedance, RL, RC & RLC series and parallel circuits	2	1
11	Phasors; power and Power factors;	3	-
12	Duality in Electrical circuits;	1	-
	Poly Phase circuits:		
13	Single-Phase Three-Wire Systems;	2	
14	Three-Phase Y-Y Connection; The Delta Connection	2	2
	AC Steady State Analysis in Time domain:		
15	Mesh, Node Analysis & Theorems on AC circuits	2	1
16	Resonance	2	
	Transient Analysis in Time domain		
17	Source Free,	1	1
18	DC Driven RL, RC & RLC circuits	2	1
	Magnetically coupled circuits:		
19	Self and Mutual Inductance	1	-
20	Dot convention, Energy considerations,	1	1
21	Linear and Ideal transformer and Impedance matching	2	-
22	Tuned Circuits	1	
	TOTAL	**36**	**12**

Marks Allocation for Assignment:

Sl. No	Description	Marks
1	Assignment 1 – a) Tutorial Submission b) Experimental Verification of Kirchoff's Laws and Theorems	40
2	Assignment 2 – a) Tutorial Submission b) Power calculations of each electrical and electronic appliances at Residence	40
Total		**80**

Course Designers:

- Dr. K. Hariharan, khh@tce.edu
- Dr. B.Sathyabama, sbece@tce.edu

22EC240	DIGITAL CIRCUIT DESIGN

Category	L	T	P	Credit	TE
PCC	3	0	2	4	Theory

Preamble

The course is offered as theory cum practical course in concurrent with the course on "Electronic Devices". Cell phones and handheld devices of various kinds offer new, competing features almost daily. Underneath the attractive graphicaluser interface of all of these devices sits a digital system that processes data in a binary format. Hence, this course is to give hands on training for the students to understand the knowledge of basic combinational and sequential circuits of digital systems. This course relies on extensive use of Hardware Description Language for describing and implementing digital logic designs on standard ICs.

Prerequisite

NIL

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Explain the of Digital information Systems and number systems.	TPS2	70	70
CO2	Use Boolean algebra and graphical methods to simplify the Logic functions.	TPS3	70	70
CO3	Design a combinational circuit using logic gates.	TPS3	70	70
CO4	Design of synchronous sequential Circuits for a given specification	TPS3	70	70
CO5	Design of asynchronous sequential Circuits for a given specification	TPS3	70	70
CO6	Analyse the Sequential circuits in Moore / Mealy FSM Models	TPS4	70	70

Mapping with Programme Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O2
CO1	M	L		-	-	-	-	L	L	L	-	L	L	-	L
CO2	S	M	L	-	-	-	-	L	L	L	-	L	M	L	L
CO3	S	M	L	-	S	-	-	L	L	L	-	L	M	L	L
CO4	S	M	L	L	S	-	-	L	L	L	-	L	M	L	L
CO5	S	S	M	L	-	-	-	L	L	L	-	L	S	-	L
CO6	S	S	M	L	S	-	-	L	L	L	-	L	S	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I			Assessment - II			Terminal Exam (Theory) (%)		
	CAT – I (%)			CAT – II (%)					
TPS / CO	1	2	3	1	2	3	1	2	3
CO1	5	10					-	5	
CO2	5	10	20				-	5	20
CO3		10	40				-	5	20
CO4					-	30	-	5	20
CO5					-	30	-		10
CO6					-	40	-		10
Total	10	30	60	-	-	100		20	80

Syllabus

Theory:

Digital Information Processing: Basis of Digital System, Number systems and Codes, Methods of base conversions, Code Converters and their Applications. **Boolean Algebra and Switching Functions:** Basic postulates and fundamental theorems of Boolean algebra; Standard representation of logic functions – Sum Of Product (SOP) and Product Of Sum (POS) forms; NAND and NOR Implementation - Simplification of switching functions– Karnaugh Maps and Quine- McCluskey tabular methods. **Combinational Logic Design:** Adders/subtractors, Fast adder,Magnitude comparator, Multiplexer Demultiplexer, Encoders, Decoders, Multiplier, and Paritygenerator and Checker, Standard IC Data Sheets and its Descriptions, HDL implementation of combinational circuits. **Synchronous Sequential circuits:** Bistable elements, Latches and flip flops- S-R, JK, D and Master-Slave JK FF, Analysis and Design of Clocked Sequential Circuits, State Minimization and State Assignment, Shift Registers, Counters. HDL implementation of sequential circuits. **Asynchronous Sequential Circuits:** Design and Analysis of asynchronous sequential circuits, cycles, races, and Hazard- Static and Dynamic. Design and Analysis of Moore/Mealy FSM Models

Practical:

1. Verification of Basic and Universal Logic Gates and Boolean Laws and Theorems.
2. Introduction to HDL Coding and simulation of Logic Gates.
3. Design and Implementation of Arithmetic Circuits a. Adder b. Subtractor
4. Design and Implementation of combinational circuits – Multiplexer and Demultiplexer using MSI chips
5. Design and Simulation of Encoder and Decoder using HDL code.
6. Design and Implementation of code converters a) Gray code to Excess-3 code. b) BCD to Seven segment display
7. Design and Simulation of Latches and Flip-flips using HDL Code.
8. Design and Implementation of Shift Registers
9. Design and Implementation of Synchronous Mod counters
10. Design and HDL Implementation of Sequence Detectors using FSM Approaches.

Text Books

- Wakerly, John, Digital Design: Principles and Practice (5th edition), Pearson, 2021.
- M. Morris Mano and Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL VHDL, and System Verilog, Sixth Edition, Pearson, 2018.

Reference Books & web resources

- D. D. Givone, Digital Principles and Design, Tata Mc-Graw Hill, New Delhi, 2017.
- Charles. H. Roth, Jr., Fundamentals of Logic Design, Enhanced Seventh Edition,2020
- Thomas L. Floyd, Digital Fundamentals, 11th Edition, Pearson, 2015
- William I. Fletcher," An Engineering Approach to Digital Design,1st Edition reprint 2015.
- NPTEL course Digital Circuits: https://nptel.ac.in/courses/117106086/

Course Contents and Lecture Schedule

Module No.	Topic	No.of Lectures	CO
1	**Digital Information Processing**		
1.1	Basics of Digital Systems, Software and Electronic aspects of Digital Design, Digital ICs.	2	CO1
1.2	Number systems and Codes, Methods of base conversions	1	CO1
1.3	Code Converters and their Applications	1	CO1
2	**Boolean Algebra and Switching Functions**		
2.2	Basic postulates and fundamental theorems of Boolean algebra	1	CO2
2.3	Standard representation of logic functions - SOP and POS forms, NAND and NOR Implementation	2	CO2
2.4	Simplification of switching functions – Karnaugh Map	2	CO2
2.5	Quine-McCluskey Tabular methods	2	CO2
3	**Combinational logic Design**		
3.1	Adders/subtractors, fast adder, magnitude comparator	2	CO3
3.2	Multiplexer Demultiplexers, encoders, decoders	2	CO3
3.3	Multiplier, Parity generator and Checker	2	CO3
3.4	Standard IC Data Sheets and its Descriptions	2	CO3
4	**Synchronous Sequential Logic Design**		
4.1	Bistable elements, Latches	1	CO4
4.2	Flip-flops: - S-R, JK, D and T, Master Slave Flipflop	2	CO4
4.3	Analysis and Design of Clocked Sequential Circuits, State Minimization and State Assignment	3	CO6
4.4	Shift register, Counters**.**	3	CO4
4.5	HDL implementation of sequential circuits.	2	CO4
5	**Asynchronous Sequential Circuits**		
5.1	Design of asynchronous sequential circuits	2	CO5
5.2	Analysis of asynchronous sequential circuits	2	CO5
5.3	Cycles and races, Hazard- Static and Dynamic.	1	CO5
5.4	Design and Analysis of Moore/Mealy FSM Models	1	CO6
	Total	**36**	
Practical Sessions			
5.1	Verification of Basic and Universal Logic Gates and Boolean Laws and Theorems.	2	CO1
5.2	Introduction to HDL Coding and simulation of Logic Gates.	4	CO1
5.3	Design and Implementation of Arithmetic Circuits a. Adder	2	CO3

	b. Subtractor		
5.4	Design and Implementation of combinational circuits – Multiplexer and Demultiplexer using MSI chips	2	CO3
5.5	Design and Simulation of Encoder and Decoder using HDL code.	2	CO3
5.6	Design and Implementation of code converters a) Gray code to Excess-3 code. b) BCD to Seven segment display	4	CO3
5.7	Design and Simulation of Latches and Flip-flips using HDL Code	2	CO4
5.8	Design and Implementation of Shift Registers	2	CO4
5.9	Design and Implementation of Synchronous Mod counters	2	CO5
6	Design and HDL Implementation of Sequence Detectors using FSM Approaches.	2	CO6
	Total	**24**	

Course Designers:

- Dr.D.Gracia Nirmala Rani gracia@tce.edu
- Mrs.J.Shanthi jsiece@tce.edu
- Dr.S.Rajaram rajaram_siva@tce.edu
- Dr.N.B.Balamurugan nbbalamurugan@tce.edu
- Dr. V.Vinoth Thyagarajan vvkece@tce.edu
- Dr.V.R.Venkatasubramani venthiru@tce.edu

22EC250	FIELD THEORY AND TRANSMISSION LINES

Category	L	T	P	Credit
PCC	2	1	0	3

Preamble

The objective of this course is to provide a conceptual understanding of fundamentals of electromagnetic field theory and transmission lines with an emphasis on their applications in the design and operation of practical communication systems.

Prerequisite

NIL

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Interpret the characteristics of two-wire transmission line and determine its electrical parameters	TPS3	70	65
CO2	Calculate the transmission and reflection parameters of a transmission line	TPS3	70	65
CO3	Understand the fundamentals of vector calculus and coordinate system	TPS2	70	65
CO4	Apply the EM laws to solve the electrostatic problems	TPS3	70	65
CO5	Apply the EM laws to solve the magnetostatic problems	TPS3	70	65
CO6	Apply the maxwell's equations to solve time varying fields	TPS3	70	65

Mapping with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	-	-	M	L	-	M	M	-	-	-	M		M
CO2	S	M	-	-	M	L	-	M	M	-	-	-	M		M
CO3	M	L	-	-	-	L	-	L	L	-	-	-	M	-	L
CO4	S	M	-	-	M	L	-	M	M	-	-	-	M		M
CO5	S	M	-	-	M	L	-	M	M	-	-	-	M		M
CO6	S	M	-	-	M	L	-	M	M	-	-	-	M		M

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	Assessment 1						Assessment 2						Terminal (%)			
	CAT- 1 (%)			Assignment 1 (%)			CAT- 2 (%)			Assignment 2(%)						
TPS	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	TOTAL (%)
CO1	-	10	30	-	100		-			-			-	4	10	24
CO2	-	10	30	-			-			-			-	4	10	24
CO3	-	20		-			-			-			-	-	-	-
CO4	-	-	-	-	-	-	-	10	25	-	100		-	4	20	24
CO5	-	-	-	-	-	-	-	10	25	-			-	4	20	24
CO6	-	-	-	-	-	-	-	10	20	-			-	4	20	24
TOTAL	100			100			100			100			-	20	80	100

* Assignment 1: (i) Application based problems in CO1, CO2 and CO3
**Assignment 2: (ii) Application based problems in CO4, CO5 and CO6

Syllabus

Introduction – Transmission Lines, types, terminated lossless two-wire line – characteristic impedance, propagation constant, input impedance, VSWR, reflection and transmission co-efficients, return loss, quarter-wave transformer. **Coordinate Systems -** Fundamentals of scalars and vectors, Coordinate systems. **Electrostatics -** Charge and Current Distributions, Coulomb's Law, Gauss's Law, Electric Scalar Potential, Electric Boundary Conditions, Capacitance, Electrostatic Potential Energy. **Magnetostatic -** Magnetic Forces and Torques, Biot–Savart Law, Maxwell's Magnetostatic Equations, Vector Magnetic Potential, Magnetic Boundary Conditions, Inductance, Magnetic Energy. **Maxwell's equations and EM waves -** Equation of continuity, Maxwell's equations for time varying fields, influence of medium, boundary conditions. Wave equation, EM waves in conducting medium, Uniform plane wave equation.

Text Books

- Fawaz T. Ulaby, Umberto Ravaioli, Fundamentals of Applied Electromagnetics, Seventh Edition, Pearson Education, 2015.
- G. S. N. Raju, Electromagnetic Field Theory and Transmission Lines, Pearson education 2009.
- David M. Pozar," Microwave Engineering," John Wiley & Sons, Fourth Edition, 2015.

Reference Books & web resources

- William H. Hayt, John A. Buck, Jaleel M. Akhtar, Engineering Electromagnetics, 9th edition, McGraw-Hill Education, 2020.
- Matthew N. O. Sadiku, Elements of Electromagnetics, Seventh edition, Oxford University Press, 2018.
- Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, Sixth Edition, Pearson Prentice Hall, 2004.
- D.K. Cheng, Field and wave electromagnetics, Second edition, Pearson (India), 2002.
- John D Kraus and Daniel A Fleisch, Electromagnetics with applications, Fifth Edition, McGraw-Hill, 1999.
- NPTEL course on 'Electromagnetic Waves in Guided and Wireless Media', by Prof. Pradeep Kumar, IIT Kanpur.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Introduction**	
1.1	Transmission Lines, types, terminated lossless two-wire line – characteristic impedance, propagation constant, input impedance	3
1.2	VSWR, reflection and transmission co-efficients, return loss, quarter-wave transformer	3
	Tutorial	2
2	**Coordinate Systems**	
2.1	Fundamentals of scalars and vectors, Coordinate systems	2
	Tutorial	2
3	**Electrostatics**	
3.1	Charge and Current Distributions, Coulomb's Law, Gauss's Law,	3
3.2	Electric Scalar Potential, Electric Boundary Conditions, Capacitance, Electrostatic Potential Energy	3
	Tutorial	2
4	**Magnetostatics**	
4.1	Magnetic Forces and Torques, Biot–Savart Law, Maxwell's Magnetostatic Equations	3
4.2	Vector Magnetic Potential, Magnetic Boundary Conditions, Inductance, Magnetic Energy	3
	Tutorial	2
5	**Maxwell's equation and EM waves**	
5.1	Equation of continuity, Maxwell's equations for time varying fields, influence of medium	3
5.2	boundary conditions. Wave equation, EM waves in conducting medium, Uniform plane wave equation	3
	Tutorial	2
	Total	36

Course Designers

- Dr.B.Manimegalai naveenmegaa@tce.edu
- Dr.S.Kanthamani skmece@tce.edu
- Dr.K.Vasudevan kvasudevan@tce.edu

22EC260	PROBLEM SOLVING USING COMPUTERS

Category	L	T	P	Credit	TE
ESC	2	0	2	3	Practical

Preamble

This course aims to provide students with an understanding on the role of computation in problem solving. It focuses on problem analysis, algorithm development, top-down design, modular programming, debugging and testing. The students will learn the required background programming knowledge, including stream I/O, loops, functions, structures, arrays, pointers and memory management

Prerequisite

NIL

Course Outcomes

CO	Course Outcome Statement	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Use constructs of C programming language in problem solving.	TPS3	70%	70%
CO2	Develop algorithms to perform sorting, searching and text processing.	TPS3	70%	70%
CO3	Use function and recursion to establish modularity in programming	TPS3	70%	70%
CO4	Use pointers and derived data types like structures and union in solving complex problems.	TPS3	70%	70%
CO5	Write programs to create text and database files.	TPS3	70%	70%
CO6	Apply problem solving methodology in implementing mathematical and engineering problems.	TPS3	70%	70%

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	-	S	-	-	-	S	M	-	-	M	-	L
CO2	S	M	M	-	S	-	-	-	S	M	-	-	M	-	L
CO3	S	M	M	-	S	-	-	-	S	M	-	-	M	-	L
CO4	S	M	M	-	S	-	-	-	S	M	-	-	M	-	L
CO5	S	M	M	-	S	-	-	-	S	M	-	-	M	-	L
CO6	S	M	M	-	S	-	-	-	S	M	-	-	M	-	L

S- Strong; M-Medium; L-Low

Assessment Pattern

CO	Assessment-1						Assessment-2						Terminal - Practical					
	CAT1						CAT2											
TPS Scale	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
CO1	-	12	28	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
CO2	-	4	16	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-
CO3	-	4	36	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
CO4	-	-	-	-	-	-	-	12	28	-	-	-	-	-	20	-	-	-
CO5	-	-	-	-	-	-	-	4	16	-	-	-	-	-	10	-	-	-
CO6	-	-	-	-	-	-	-	4	36	-	-	-	-	-	20	-	-	-
Total	-	20	80	-	-	-	-	20	80	-	-	-	-	-	100	-	-	-

Syllabus

Theory:

Problem Solving Methodology: problem specification and analysis, algorithm design, flowchart, programs, program testing and verification. **Basics of Programming:** data types and its representation, variables, keywords, Operators, operator precedence, types of expression, Control Structures: Selection structure, looping Structure. **Array and string handling algorithms:** 1-D, 2-D arrays, **strings sorting:** bubble sort, searching: linear and binary search, text processing: key word search, text editing. **Modular Programming and Functions:** Function declaration, function definition, function call-call by value - call by reference, storage classes, Recursive functions, library functions. **Pointers & Memory management:** Pointers and memory addressing, Arrays and pointer, Pointers and Functions, Pointers to pointers, pointer and string arrays, Void and function pointers, use of malloc - realloc-free- heaps in memory management. **Derived data types**: structures- Arrays of Structures – Passing Structures to Functions – Structure with Pointers, enum, typedef **File Handling:** read, write and update text files

Practical:

List of Experiments

1. Programs to explore fundamental programming constructs
   a. Find the range of all primary data types.
   b. Use of different types of operators and expressions.
2. Programs using decision making, case control and looping statements
   a. Print twin prime numbers in a given range
   b. Finding greatest common divisor using Euclid's method
3. Programs using 1-D and 2-D arrays
   a. Bubble sort algorithms
   b. Matrix multiplication
   c. Histogram
4. Programs using strings
   a. Linear pattern search
   b. Text editing
5. Programs using recursive and non-recursive functions
   a. Binary search
   b. Finding n^{th} Fibonacci number
6. Programs using pointers
   a. Implement experiments 2- 5 (Selective programs) using pointers
   b. Programs using memory allocation
7. Programs to create database files using file structures
8. Solving numerical methods/engineering problems (sample)
   a. Linear convolution
   b. Bitwise operations to set specific bit fields

Text Book

- Kernighan, Brian, and Dennis Ritchie. “The C Programming Language”, 2nd ed. Upper Saddle River, NJ: Prentice Hall, 1988.

Reference Books & web resources

- Yashwanth P Kanetkar, “Let us C”, 18th ed., BPB edition, 2021.
- Schildt Herbert, “C: The Complete Reference”, 4th Edition, Mc Graw Hill, 2017.
- George S. Tselikis, Nikolaos D. Tselikas, “C: From Theory to Practice”, 2nd ed., CRC Press, 2017.
- Randal E. Bryant and David R. O'Hallaron, Computer Systems: A Programmer's Perspective, Third Edition, Pearson, 2016.
- Paul Deitel, Harvey Deitel, “C: How to program”, 7th ed., **"**, Pearson Education, 2013.
- Adam Hoover, “System Programming with C and Unix”, 1st ed., Pearson Education, 2010.
- V. Rajaraman, Computer Programming in C, PHI Learning, 2004.
- E. Balagurusamy, Programming in Ansi C, 3rd ed., Tata McGraw-Hill Publication, New Delhi, 2004.
- Paul Anderson and Gail C Anderson, “Advanced C: Tips and Techniques”, Hayden Book,1988.
- NPTEL Course on Introduction to programming in C by Prof Satyadev Nandakumar, IIT Kanpur https://nptel.ac.in/courses/106104128
- NPTEL Course on Problem Solving through Programming in C by Prof Anupam Basu, IIT Kharagpur: https://nptel.ac.in/courses/106105171

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Problem Solving Methodology**	
1.1	Problem specification and analysis, algorithm design, flowchart, programs, program testing and verification	1
2	**Basics of Programming**	
2.1	Data types and its representation, variables, keywords,	
2.2	Operators, operator precedence, types of expressions	1
2.3	**Branching and Looping**	
2.4	Conditional Expression and control structures – IF, IF-else, Switch	2
2.5	Looping Structure- While Loops, Do-While Loops, For Loops	2
2.6	Jumping statements- Break and Continue, Goto	1
3	**Arrays and Array handling algorithms**	
3.1	1-D arrays	1
3.2	Sorting: selection sort, bubble sort	1
3.3	Searching: linear and binary search	1
3.4	2-D arrays	1
3.5	Character array – Strings	1
3.6	Text processing: key word search, text editing	1
4	**Functions**	
4.1	Function declaration, function definition, function call-call by value, Using arrays as function arguments	1
4.2	Recursive functions	1
4.3	Library functions	1
4.4	Storage classes	1
5	**Pointers &Memory management**	
5.1	Pointers and memory addressing, Arrays and pointer arithmetic	1

5.2	Pointers and Functions- call by reference, Pointers to pointers	1
5.3	Pointer and string arrays, Void and function pointers	1
5.4	Memory management functions: malloc, calloc, realloc, free - use of heap in memory management	1
6	**Derived data types & File Handling**	
6.1	Structures- Union- typedef - Arrays of Structures - Passing Structures to Functions	1
6.2	Structure Pointers – Structures within Structures	1
6.3	Read, write and modify text files	1
	Theory	24
	Practical	24
	Total	48

Course Designer(s):

- Dr.R.A.Alaguraja alaguraja@tce.edu
- Dr.M.Senthilarasi msiece@tce.edu

22EC310	PROBABILITY AND STATISTICS

Category	L	T	P	Credit
BSC	2	1	0	3

Preamble

An electronics and communication engineering student needs to have some basic statistical tools and techniques to apply in diverse applications in digital signal processing communications systems and networks, radar systems, power systems that requires an understanding of Probability distributions, Joint probability distributions, covariance, correlation and Testing of Hypotheses. The course is designed to impart the knowledge and understanding of the above concepts to Electronics and Communication Engineers and apply them in their areas of specialization.

Prerequisite

NIL

Course Outcomes

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

Cos	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Apply the concept of probability and conditional probability to solve real world problems	TPS3	70	60
CO2	Use standard distributions to find the expected life time of electrical components.	TPS3	70	60
CO3	Apply the concept of Joint Probability Distributions and covariance, correlation of Joint Probability Distributions and random samples random samples.	TPS3	70	60
CO4	Apply the concepts of two functions of two random variables.	TPS3	70	60
CO5	Apply the concept of testing the hypotheses for single samples by using various tests for difference of proportions and means.	TPS3	70	60
CO6	Apply the concept of testing the hypotheses for two samples by using various tests for difference of proportions and means.	TPS3	70	60

Mapping with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	S	S	S	S	-	M	-	-	M	-	-	S	S	-	-
CO2	S	S	S	S	-	M	-	-	M	-	-	S	S	-	-
CO3	S	S	S	S	-	M	-	-	M	-	-	S	S	-	-
CO4	S	S	S	S	-	M	-	-	M	-	-	S	S	-	-
CO5	S	S	S	S	-	M	-	-	M	-	-	S	S	-	-
CO6	S	S	S	S	-	M	-	-	M	-	-	S	S	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

TPS / CO	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I (%)			CAT – II (%)			Assg. II (%)					
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	3	10	20	-	-	70	-	-	-	-	-		-	6	11
CO2	7	10	28	-	-		-	-	-	-	-		-	6	15
CO3	-	-	22	-	-		-	-	10	-	-	70	-	6	11
CO4	-	-	-	-	-		3	10	20	-	-		-	6	11
CO5	-	-	-	-	-		3	-	25	-	-		-	6	8
CO6	-	-	-	-	-		4	10	15	-	-		-	-	14
MATLAB	-	-	-	-	-	30				-	-	30	-	-	-
Total	10	20	70	-	-	100	10	20	70	-	-	100	-	30	70

Syllabus

Probability Distributions: Introduction to Probability**:** Sample space and events - Definition and axioms of probability - Conditional Probability - Baye's theorem - Independent events - Random variables - Expected Values – Discrete Probability distribution: Binomial Distribution - Poisson Distribution – Continuous Probability distribution: Normal and Exponential Distributions - Higher Order Moments - Moment generating function. [14 hours]

Joint Probability Distributions: Jointly distributed Random Variables – Two Discrete Random Variables -Two Continuous Random Variables –Independent Random Variables – Conditional Distributions – Expected Values, Covariance and Correlation: Covariance – Correlation. [6 hours]

Functions of random Variables: Functions of one random variable – Sums of independent random variables – Sum of discrete random variables – Minimum of two independent random variables - Maximum of two independent random variables – Laws of large numbers – The central limit theorem. [6 hours]

Tests of Hypothesis Based on a Single Sample: Hypotheses and Test Procedures – z-Tests for Hypotheses about a Population Mean – The One Sample t test – Test Concerning a Population Proportion. [5 hours]

Inferences Based on Two Samples: zTests and Confidence Intervals for a Difference between Two Population Means – The Two Sample t-test and Confidence Interval – Inferences Concerning a Difference Between Population Proportions [5 hours]

Text Book

- Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 9th Edition, Cengage Learning India Pvt Ltd, New Delhi, 2014.
- Oliver C. Ibe, Fundamentals of Applied Probability and Random Processes, Elsevier, 2015.
- Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, "Probability & Statistics for Engineers & Scientists", Pearson, New Delhi, 2016.

Reference Books& web resources

- Richard A. Johnson, "Miller &Freund's, Probability and Statistics for Engineers", Prentice Hall, New Delhi, 2017.
- Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", Wiley India, New Delhi,2018.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Probability Distribution**	
1.1	Introduction to Probability**:** Sample space and events, Definition and axioms of probability	1
1.2	Conditional Probability, Baye's theorem	2

Module No.	Topic	No. of Periods
	Tutorial	1
1.3	Independent events	1
1.4	Random variables, Expected Values	**1**
1.5	Discrete Probability distribution: Binomial, Poisson distributions	2
	Tutorial	1
1.6	Continuous Probability distribution: Normal Distributions Exponential Distributions	2
	Tutorial	1
1.9	Higher order moments, Moment generating function	2
2	**Joint Probability Distributions**	
2.1	Jointly distributed Random Variables – Two Discrete Random Variables	1
2.2	Two Continuous Random Variables - Independent Random Variables	1
	Tutorial	1
2.3	Conditional Distributions	1
2.4	Expected Values, Covariance	1
2.5	Correlation	1
3	**Functions of random Variables**	
3.1	Sums of independent random variables, Sum of discrete random variables	1
3.2	Minimum of two independent random variables, Maximum of two independent random variables	1
	Tutorial	**1**
3.3	Two functions of two random variable	1
3.4	Laws of large numbers – The central limit theorem.	1
	Tutorial	**1**
4	**Tests of Hypothesis Based on a Single Sample**	
4.1	Hypotheses and Test Procedures	1
4.2	z-Tests for Hypotheses about a Population Mean	1
	Tutorial	**1**
4.3	The One Sample t test	1
4.4	Test Concerning a Population Proportion.	1
5	**Inferences Based on Two Samples**	
5.1	Z Tests and Confidence Intervals for a Difference between Two Population Means	1
5.2	The Two Sample t-test and Confidence Interval	2
	Tutorial	**1**
5.3	Inferences Concerning a Difference Between Population Proportions	1
	Total	36

Course Designers:

- Dr. S. P. SuriyaPrabha suriyaprabha@tce.edu
- Dr. L. Muthusubramanian lmsmat@tce.edu
- Dr. S. Suriyakala ssamat@tce.edu

22EC410	OPTIMIZATION

Category	L	T	P	Credit
BSC	2	1	0	3

Preamble

An engineering UG student needs to have some basic mathematical tools and techniques to apply in diverse applications in Engineering. Optimization is a scientific approach to decision making that seeks to best design and operate a system, usually under conditions requiring the allocation of scarce resources. Various techniques of optimization have been dealt on the title "Optimization". Because of the complexity of most real-world optimization problems, it has been necessary to reduce the complexity of the problem by either simplifying the problem or constraining it by making reasonable assumptions. The course is designed to impart the knowledge and understanding the concepts on optimization techniques.

Prerequisite

NIL

Course Outcomes

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

Cos	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Formulate mathematical models of Linear Programming (LP),	TPS3	70	60
CO2	Solve Linear Programming Problems (LPP) by appropriate techniques and evaluate the behaviour under different range of parameters.	TPS3	70	60
CO3	Determine the optimum solutions of transportation and assignment problems	TPS3	70	60
CO4	Determine the optimum values of non-linear programming problems using search methods.	TPS3	70	60
CO5	Determine the optimum values of non-linear programming problems using descent methods	TPS3	70	60
CO6	Apply the concepts of convex optimization	TPS3	70	60

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	M	-	-	-	-	-	-	S	S	-	-
CO2	S	S	S	M	M	-	-	-	-	-	-	S	S	-	-
CO3	S	S	S	S	M	-	-	-	-	-	-	S	S	-	-
CO4	S	S	S	S	M	-	-	-	-	-	-	S	S	-	-
CO5	S	S	S	M	-	-	-	-	-	-	-	S	S	-	-
CO6	S	S	S	M	-	-	-	-	-	-	-	S	S	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

TPS / CO	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I (%)			CAT – II (%)			Assg. II (%)					
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	-	-	17	-	-	70	-	-	-	-	-	-	-	-	8
CO2	7	10	33	-	-		-	-	-	-	-	-	-	12	13
CO3	3	10	20	-	-		-	-	-	-	-	-	-	6	11
CO4	-	-	-	-	-	-	3	10	15	-	-	70	-	6	8
CO5	-	-	-	-	-	-	-	-	28	-	-		-	-	14
CO6	-	-	-	-	-	-	7	10	27	-	-		-	6	16
MATLAB	-	-	-	-	-	30	-	-	-	-	-	30	-	-	-
Total	**10**	**20**	**70**	**-**	**-**	**100**	**10**	**20**	**70**	**-**	**-**	**100**	**-**	**30**	**70**

Syllabus

Linear Programming: Formulation - Graphical Method and Simplex Method – Big-M Method – Two Phase Method - Primal-Dual Relations - Dual Simplex Method [12 hours]

Transportation problems: Transportation problems and solutions (North-West Corner Rule, Least Cost Method, Vogel's Approximation Method) – Solution using MODI Method - Assignment problems – Solution using Hungarian Method – Travelling Salesman Problems. [6 hours]

Nonlinear Programming: Unimodal Function – Fibonacci Method – Golden Section Method - Univariate Method – Steepest Descent (Cauchy) Method - Conjugate Gradient (Fletcher–Reeves) Method**.** **Convex Optimization:** Introduction to convex programming problem **-** Kuhn-Tucker Conditions – Cutting plane method - Basic Approach of the Penalty Function Method – Penalty Function Method for Problems with Mixed Equality and Inequality Constraints [18 hours]

Text Books

- Singiresu S. Rao, "Engineering Optimization Theory and Practice", 5th edition, John Wiley & Sons, Inc, 2020.
- Hamdy A. Taha, "Operations Research - An Introduction", 10th Edition, Pearson Education Limited 2017.

Reference Books & web resources

- Frederick Hillier, Gerald Lieberman, "Introduction to Operations Research" Tenth Edition, Tata McGraw Hill, 2015.
- Winston, Wayne L, and Jeffrey B. Goldberg, "Operations Research: Applications and Algorithms", 7th edition, Thomson/Brooks/Cole Belmont, CA, 2004.
- Ravindran, Don. T. Philips and James J. Solberg, "Operations Research- Principles and Practice", Second Edition, John Wiley and Sons, 2007.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Linear Programming**	
1.1	Introduction-Linear Programming, Formulation	2
	Tutorial	1
1.2	Graphical Method	1
1.3	Simplex Method	1
	Tutorial	**1**
1.4	Big-M Method	1
1.5	Two Phase Method	1
	Tutorial	1
1.6	Primal-Dual Relations	1

1.7	Dual Simplex Method	2
2	**Transportation problems**	
2.1	Introduction - Transportation problems and solutions, North-West Corner Rule	1
2.2	Least Cost Method, Vogel's Approximation Method	1
	Tutorial	1
2.3	Solution using MODI Method	1
2.4	Assignment problems - Solution using Hungarian Method	1
2.5	Travelling Salesman Problems.	1
3	**Nonlinear Programming:**	
3.1	Introduction-Nonlinear programming Unimodal Function	1
3.2	Fibonacci Method	1
	Tutorial	1
3.3	Golden Section Method	1
3.4	Univariate Method	1
3.5	Steepest Descent (Cauchy) Method	2
	Tutorial	1
3.6	Conjugate Gradient (Fletcher–Reeves) Method**.**	2
3.7	Introduction to convex programming problem, Kuhn-Tucker Conditions – -–	2
	Tutorial	1
3.8	Cutting plane method	1
3.9	Basic Approach of the Penalty Function Method	1
3.10	Penalty Function Method for Problems with Mixed Equality and Inequality Constraints	2
	Tutorial	1
	Total	36

Course Designers:

- Dr. S. P. SuriyaPrabha suriyaprabha@tce.edu
- Dr. L. Muthusubramanian lmsmat@tce.edu
- Dr. S. Suriyakala ssamat@tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

THIRD AND FOURTH SEMESTER

and

22ECL10 VECTOR SPACES, PROBABILITY AND OPTIMIZATION
(for the lateral entry students admitted from the academic year 2023-24 onwards)

B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2022-23

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided Autonomous Institution Affiliated to Anna University)
MADURAI – 625 015, TAMILNADU

Phone : 0452 – 2482240, 41
Fax : 0452 2483427
Web : www.tce.edu

Passes in BoS Meeting 29.04.2023 Approved in 65th Academic Council Meeting 27.05.2023

Vision and Mission of the Department

Vision:

To empower the Electronics and Communication Engineering students with technological excellence, professional commitment and social responsibility.

Mission:

ME1. Attaining academic excellence in Electronics and Communication Engineering through dedication to duty, innovation in learning and research, state of the art laboratories and industry driven skill development.

ME2. Establishing suitable environment for the students to develop professionalism and face life challenges with ethical integrity.

ME3. Nurturing the students to understand the societal needs and equip them with technical expertise to provide appropriate solutions.

ME4. Providing breeding ground to obtain entrepreneurial skills and leadership qualities for self and social growth.

Program Educational Objectives (PEOs):

PEO1. Graduates will be capable of developing specification and design procedures, prototyping and test methodologies for modern electronics and communication systems and gadgets that perform analog and digital processing functions.

PEO2. Graduates will be able to work and adapt to changes in allied areas of Electronics and Communication Engineering through personal success and life long learning.

PEO3. Graduates will be able to identify technological requirements for the society and provide cost effective solutions.

- These objectives will be evidenced by professional visibility (publications, presentations, inventions, patents and awards), entrepreneurial activities, international activities (participation in international conferences, collaborative research and employment abroad)

Program Outcomes:
Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and 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.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex 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 the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering 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.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes:
Engineering Graduates will be able to

PSO1. Design circuits and systems for complex engineering problems in Electronics and Communication and allied areas.
PSO2. Apply research methodologies to provide solutions for contemporary problems in the areas including RF, Signal Processing, Image Processing, VLSI, Optical Communication, Networks and Embedded Systems for given specifications.
PSO3. Actively contribute as a member or leader in diverse teams, and communicate effectively on complex engineering activities and involve in life-long learning, by applying reasoning and ethical principles.

PEO- Mission Mapping:

	ME1	ME2	ME3	ME4
PEO1	S	M	M	L
PEO2	L	S	M	M
PEO3	M	L	S	M

PEO-PO-PSO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
PEO 1	■	■	■	■	■			■	■	■			■	■	
PEO 2	■							■	■	■	■	■	■		■
PEO 3	■	■				■	■	■					■	■	

PO-GA Mapping:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PO1	■											
PO2		■										
PO3			■									
PO4				■								
PO5					■							
PO6						■						
PO7							■					
PO8								■				
PO9									■			
PO10										■		
PO11											■	
PO12												■

TCE PROFICIENCY SCALE (CDIO Curriculum Framework)

TCE Proficiency Scale (TPS)	Proficiency	Cognitive	Affective	Psychomotor
TPS1	To have been exposed to	Remember	Receive	Perception, Set
TPS2	To be able to interpret and imitate	Understand	Respond	Guided Response
TPS3	To be skilled in the practice or implement	Apply	Value	Mechanism
TPS4	To be able to participate in and contribute	Analyse	Organise	Complex Overt Responses
TPS5	To be able to judge and adapt	Evaluate	Organise	Adaptation
TPS6	To be able to lead and innovate	Create	Characterize	Origination

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)

CREDIT DISTRIBUTION
(For the students admitted in the Academic Year 2022-23 onwards)

Degree: B.E.

Sl. No.	Category		Credits	
			Regular	Lateral Entry
A.	**Foundation Courses (FC)**		**54 - 66**	**23 – 35**
	a.	Humanities and Social Sciences including Management Courses (HSMC)	09 - 12	06 - 09
	b.	Basic Science Courses (BSC)	24 - 27	09 - 11
	c.	Engineering Science Courses (ESC)	21 - 27	08 - 15
B.	**Professional Core Courses (PCC)**		**55**	**44**
C.	**Professional Elective Courses (PEC)**		**24 - 39**	**24 – 39**
	a.	Programme Specific Elective (PSE)	15 - 24	15 – 24
	b.	Programme Elective for Expanded Scope (PEES)	09 - 15	09 – 15
D.	**Open Elective Courses (OEC)**		**06 - 12**	**06 – 12**
	a.	Interdisciplinary Elective (IE)	03 - 06	03 – 06
	b.	Basic Science Elective (BSE)	03 - 06	03 – 06
E.	**Project Work (PW)**		**12**	**12**
F.	**Internship and Mandatory Audit Courses as per Regulatory authorities**		Non-Credit and not included in CGPA	Non-Credit and not included in CGPA
Minimum Credits to be earned for the award of the Degree			**160**	**120**
			From A to E and the successful completion of F	From A to E and the successful completion of F

SCHEDULING OF COURSES FOR STUDENTS JOINED FROM ACADEMIC YEAR 2022-23 ONWARDS (B.E. ECE Programme) *											
Sem	Theory / Theory cum Practical / Practical								CDIO courses	Audit Courses (Mandatory Non-credit}	Credit
	1	2	3	4	5	6	7	8			
I	22MA110 Calculus for Engineers (BSC-4)	22PH120 Physics (BSC-3)	22CH130 Chemistry (BSC-3)	22EG140 Technical English (HSMC-2)	22EC160 Computer Aided Engg. Graphics (TCP) (ESC-3)	22EG170 English Laboratory (HSMC-1)	22PH180 Physics Laboratory (BSC-1)	22CH190 Chemistry Laboratory (BSC-1)	22EC190 Engineering Exploration (TCP) (ESC-2)		20
II	22EC210 Matrices and Linear Algebra (BSC-3)	22EC220 Electronic Devices (ESC-3)	22EC230 Electric and Magnetic Circuits (PCC-4)	22EC240 Digital Circuit Design (TCP) (PCC-4)	22EC250 Field Theory and Transmission Lines (PCC-3)	22EC260 Problem Solving using Computers (TCP) (ESC-3)				22CHAA0 Environmental Science (BSC-0)	20
III	22EC310 Probability and Statistics (BSC-3)	22EC320 Analog Circuit Design (TCP) (PCC-4)	22EC330 Network Analysis and Synthesis (BSC-3)	22EC340 Computer Organization and Microprocessor (TCP) (PCC-4)	22EC350 Signals and Systems (PCC-4)	22EC360 Object Oriented Programming (ESC-3)			22ES390 Design Thinking (ESC-3)		24
IV	22EC410 Optimization (BSC-3)	22EC420 Mixed Signal Circuit Design (PCC-3)	22EC430 RF Circuit Design (TCP) (PCC-4)	22EC440 Microcontrollers and Embedded Systems (TCP) (PCC-4)	22EC450 Discrete-Time Signal Processing (TCP) (PCC-4)	22EC460 Data Science (ESC-2)				22YYXX0 Audit Course	20

V	22EC510 Data Communication Networks (TCP) (ESC-4)	22EC520 VLSI Circuits and Systems PCC-3	22EC530 Antennas and Wave Propagation (TCP) (PCC-3)	22EC540 Sensors and Instrumentation (BSC-2)	22EC550 Analog and Digital Communication (TCP) (PCC-4)		22YYGX0 Interdisciplinary Elective (IE-3)		22EC590 Project-I (PW-3)		22
VI	22EC610 Accounting and Finance (HSMC-4)	22EC620 Image Processing (TCP) (PCC-3)	22ECXY0 PEC-1 (3)		22EC630 Optical and Wireless Communication (TCP) (PCC-4)	22EC640 Systems Software (ESC-2)	22YYBX0 Basic Science Elective (BSE-3)	22EG650 Professional Communication (HSMC-2)	22EC690 Project-II (PW-3)		24
\VII	22ECXY0 PEC-2 (3)	22ECXY0 PEC-3 (3)	22ECXY0 PEC-4 (3)	22ECXY0 PEC-5 (3)	22ECXY0 PEC-6 (3)				22EC790 Project-III (PW-3)		18
VIII	22ECXY0 PEC-7 (3)	22ECXY0 PEC-8 (3)	22ECXY0 PEC-9 (3)						22EC890 Project-IV (PW-3)		12

This schedule shows an optimal way of completing the B.E. Degree programme successfully in 4 Years ***Total Credits for Curricular Activities: 160***

SCHEDULING OF COURSES FOR STUDENTS JOINED FROM ACADEMIC YEAR 2023-24 ONWARDS (B.E. ECE Programme) *											
Sem	Theory / Theory cum Practical / Practical								CDIO courses	Audit Courses (Mandatory Non-credit}	Credit
	1	2	3	4	5	6	7	8			
I	22MA110 Calculus for Engineers (BSC-4)	*23PH120* Physics (BSC-3)	22EG140 Technical English (HSMC-2)	*22EC230 Electric and Magnetic Circuits (PCC-4)*	*22EC260 Problem Solving using Computers (TCP) (ESC-3)*		22EG170 English Laboratory (HSMC-1)	22PH180 Physics Laboratory (BSC-1)	22EC190 Engineering Exploration (TCP) (ESC-2)	*22CHAA0 Environmental Science (BSC-0)*	20
II	22EC210 Matrices and Linear Algebra (BSC-3)	*22CH130 Chemistry (BSC-3)*	22EC220 Electronic Devices (ESC-3)	22EC240 Digital Circuit Design TCP (PCC-4)	22EC250 Field Theory and Transmission Lines (PCC-3)	*Python Programming and Data Structure TCP (ESC-3)*	*22CH190 Chemistry Laboratory (BSC-1)*				20
III	22EC310 Probability and Statistics (BSC-3)	22EC320 Analog Circuit Design (TCP) (PCC-4)	22EC330 Network Analysis and Synthesis (BSC-3)	22EC340 Computer Organization and Microprocessor (TCP) (PCC-4)	22EC350 Signals and Systems (PCC-4)	22EC360 Object Oriented Programming (ESC-3)			22ES390 Design Thinking (ESC-3)		24
IV	22EC410 Optimization (BSC-3)	22EC420 Mixed Signal Circuit Design (PCC-3)	22EC430 RF Circuit Design (TCP) (PCC-4)	22EC440 Microcontrollers and Embedded Systems (TCP) (PCC-4)	22EC450 Discrete-Time Signal Processing (TCP) (PCC-4)	22EC460 Data Science (ESC-2)				22YYXX0 Audit Course	20

V	22EC510 Data Communication Networks (TCP) (ESC-4)	22EC520 VLSI Circuits and Systems PCC-3	22EC530 Antennas and Wave Propagation (TCP) (PCC-3)	22EC540 Sensors and Instrumentation (BSC-2)	22EC550 Analog and Digital Communication (TCP) (PCC-4)		22YYGX0 Interdisciplinary Elective (IE-3)		22EC590 Project-I (PW-3)		22
VI	22EC610 Accounting and Finance (HSMC-4)	22EC620 Image Processing (TCP) (PCC-3)	22ECXY0 PEC-1 (3)		22EC630 Optical and Wireless Communication (TCP) (PCC-4)	22EC640 Systems Software (ESC-2)	22YYBX0 Basic Science Elective (BSE-3)	22EG650 Professional Communication (HSMC-2)	22EC690 Project-II (PW-3)		24
\VII	22ECXY0 PEC-2 (3)	22ECXY0 PEC-3 (3)	22ECXY0 PEC-4 (3)	22ECXY0 PEC-5 (3)	22ECXY0 PEC-6 (3)				22EC790 Project-III (PW-3)		18
VIII	22ECXY0 PEC-7 (3)	22ECXY0 PEC-8 (3)	22ECXY0 PEC-9 (3)						22EC890 Project-IV (PW-3)		12

This schedule shows an optimal way of completing the B.E. Degree programme successfully in 4 Years ***Total Credits for Curricular Activities: 160***

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)
COURSES OF STUDY
(For the students admitted in the Academic Year 2022-23 onwards)

THIRD SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
22EC310	Probability and Statistics	BSC	2	1	-	3
22EC330	Network Analysis and Synthesis	BSC	2	1	-	3
22EC350	Signals and Systems	PCC	3	1	-	4
22EC360	Object Oriented Programming	ESC	3	-	-	3
22ES490	Design Thinking	ESC	1	-	2	3
THEORY CUM PRACTICAL						
22EC320	Analog Circuit Design	PCC	3	-	2	4
22EC340	Computer Organization and Microprocessor	PCC	3	-	2	4
Total			**17**	**3**	**6**	**24**

FOURTH SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
22EC410	Optimization	BSC	2	1	-	3
22EC420	Mixed Signal Circuit Design	PCC	3	-	-	3
22EC460	Data Science	ESC	2	-	-	2
THEORY CUM PRACTICAL						
22EC430	RF Circuit Design	PCC	3	-	2	4
22EC440	Microcontrollers and Embedded Systems	PCC	3	-	2	4
22EC450	Discrete-Time Signal Processing	PCC	3	-	2	4
Total			**16**	**1**	**6**	**20**

Third and Fourth Semester Mathematics course for Lateral Entry Students

Course Code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
22MA310	Essentials of Matrices and Calculus	BSC	2	1	-	3
22ECL10	Vector Spaces, Probability and Optimization	BSC	2	1	-	3

BSC : Basic Science Courses
PCC : Professional Core Courses
ESC : Engineering Science Courses
L : Lecture
T : Tutorial
P : Practical

Note:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B. E. DEGREE PROGRAMME
(Electronics and Communication Engineering)
SCHEME OF EXAMINATIONS
(For the Students admitted in the academic year 2022-23 onwards)

THIRD SEMESTER

Course Code	Name of the Course	Duration of TE in Hrs.	Marks			Min. Marks for Pass	
			CA*	TE	Max. Marks	TE	Total
THEORY							
22EC310	Probability and Statistics	3	40	60	100	27	50
22MA310 (for LE students)	Essentials of Matrices and Calculus	3	40	60	100	27	50
22EC330	Network Analysis and Synthesis	3	40	60	100	27	50
22EC350	Signals and Systems	3	40	60	100	27	50
22EC360	Object-Oriented Programming	3	40	60	100	27	50
THEORY CUM PRACTICAL							
22EC320	Analog Circuit Design	3	50	50	100	22.5	50
22EC340	Computer Organization and Microprocessor	3	50	50	100	22.5	50

FOURTH SEMESTER

Course Code	Name of the Course	Duration of TE in Hrs.	Marks			Min. Marks for Pass	
			CA*	TE	Max. Marks	TE	Total
THEORY							
22EC410	Optimization	3	40	60	100	27	50
22ECL10 (for LE students)	*Vector Spaces, Probability and Optimization*	*3*	*40*	*60*	*100*	*27*	*50*
22EC420	Mixed Signal Circuit Design	3	40	60	100	27	50
22EC460	Data Science	3	40	60	100	27	50
22ES490	Design Thinking	3	40	60	100	27	50
THEORY CUM PRACTICAL							
22EC430	RF Circuit Design	3	50	50	100	22.5	50
22EC440	Microcontrollers and Embedded Systems	3	50	50	100	22.5	50
22EC450	Discrete-Time Signal Processing	3	50	50	100	22.5	50

TE – Terminal Examination, CA – Continuous Assessment

*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

22ECL10	VECTOR SPACES, PROBABILITY AND OPTIMIZATION	Category	L	T	P	Credit
		BSC	2	1	0	3

Preamble

An electronics and communication engineering student needs to have Mathematical functions can be viewed in many different ways and one way of viewing them is through vectors. Most of the algebraic manipulation of functions from an m dimensional space to an n-dimensional space can be done using matrices and the tools from linear algebra. Some basic statistical tools and techniques to apply in diverse applications in digital signal processing communications systems and networks that requires an understanding of Probability distributions. Optimization is a scientific approach to decision making that seeks to best design and operate a system, usually under conditions requiring the allocation of scarce resources. The course is designed to impart the knowledge and understanding of the above concepts and apply them in their areas of specialization.

Prerequisite

NIL

Course Outcomes

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

Cos	Course Outcomes	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Demonstrate vector space and subspace	TPS3	70	65
CO2	Determine an orthonormal basis for the given basis	TPS3	70	65
CO3	Solve the linear programming using graphical and simplex method	TPS3	70	65
CO4	Determine the optimum solutions of transportation and assignment problems	TPS3	70	65
CO5	Apply the concept of probability and conditional probability to solve real world problems	TPS3	70	65
CO6	Use standard distributions to find the expected life time of electrical components.	TPS3	70	65

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	-	-	-	-	-	-	-	S	S	L	-	-
CO2	S	M	L	-	-	-	-	-	-	-	S	S	L	-	-
CO3	S	M	L	-	-	-	-	-	-	-	S	S	L	-	-
CO4	S	M	L	-	-	-	-	-	-	-	S	S	L	-	-
CO5	S	M	L	-	-	-	-	-	-	-	S	S	L	-	-
CO6	S	M	L	-	-	-	-	-	-	-	S	S	L	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

TPS CO	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I (%)			CAT – II (%)			Assg. II (%)					
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	4	10	19	-	-	30	-	-	-	-	-	-	-	6	11
CO2	3	-	31	-	-	40	-	-	-	-	-	-	-	3	14
CO3	3	10	20	-	-	30	-	-	-	-	-	-	-	3	14
CO4	-	-	-	-	-	-	4	10	19	-	-	30	-	6	11
CO5	-	-	-	-	-	-	3	-	25	-	-	30	-	3	10
CO6	-	-	-	-	-	-	3	10	26	-	-	40	-	9	10
Total	**10**	**20**	**70**	-	-	**100**	**10**	**20**	**70**	-	-	**100**	-	**30**	**70**

Syllabus

Vector Spaces: Vector space, Subspaces, linear independence of vectors, basis and dimension **Orthogonality**: Orthonormal sets, The Gram-Schmidt orthogonalization process. [12 hours]

Linear Programming: Graphical Method and Simplex Method **Transportation problems:** Transportation problems and solutions (Vogel's Approximation Method) – Optimal Solution using MODI method - Assignment problems: Solution using Hungarian Method. [12 hours]

Probability: Introduction to Probability**:** Sample space and events - Definition and axioms of probability - Conditional Probability - Baye's theorem **Random variables and Distributions:** Random variables - Expected Values – Discrete Probability distribution: Binomial Distribution - Continuous Probability distribution: Normal distribution [12 hours]

Text Book

- Steven.J. Leon, "Linear Algebra with Applications", 9th edition, Pearson, 2015
- P.K.Gupta and D.S.Hira, "Operations Research", 7th edition, S.Chand and company Pvt Ltd, Inc, 2014
- Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 9th Edition, Cengage Learning India Pvt Ltd, New Delhi, 2014.

Reference Books & web resources

- David.C.Lay, "Linear Algebra and its applications", Pearson Addison – Addison Wesley, 3 rd edition, 2006.
- Richard A. Johnson, "Miller &Freund's, Probability and Statistics for Engineers", Prentice Hall, New Delhi, 2017.
- Singiresu S. Rao, "Engineering Optimization Theory and Practice", 5th edition, John Wiley & Sons, Inc, 2020.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
1	**Vector Spaces**	
1.1	Vector space	2
	Tutorial	1
1.2	Subspaces	1
1.3	Linear independence of vectors	1
1.4	Basis and dimension	1

Module No.	Topic	No. of Periods
1.5	**Orthogonality**: Orthonormal sets	2
	Tutorial	1
1.6	The Gram-Schmidt orthogonalization process	2
	Tutorial	1
2	**Linear Programming**	
2.1	Graphical Method	2
	Tutorial	1
2.2	Simplex Method	3
2.3	Transportation problems and solutions - Vogel's Approximation Method	1
2.4	Optimal Solution using MODI method	2
	Tutorial	1
2.5	Assignment problems: Solution using Hungarian Method	2
3	**Probability**	
3.1	Introduction to Probability**:** Sample space and events Definition and axioms of probability	1
3.2	Conditional Probability	1
	Tutorial	1
3.3	Baye's theorem	2
3.4	**Random variables and Distributions** - Random variables	1
3.5	Expected Values	2
	Tutorial	1
3.6	Discrete Probability distribution: Binomial Distribution	1
3.7	Continuous Probability distribution: Normal distribution	2
	Total	**36**

Course Designer(s):

- Dr. S. P. SuriyaPrabha suriyaprabha@tce.edu
- Dr. L. Muthusubramanian lmsmat@tce.edu
- Dr. S. Suriyakala ssamat@tce.edu

22EC320	ANALOG CIRCUIT DESIGN	Category	L	T	P	Credit	TE
		PCC	3	0	2	4	Theory

Preamble

This course is an introduction to basic knowledge about the principle of operation of semiconductor electronic devices like diodes, transistors. It will enable the students to learn about the use of transistors in analog circuits like single and multi-stage amplifier, feedback amplifier, Differential amplifier, power amplifier and oscillators. It also gives information about the current mirror circuits used for biasing in Integrated Circuits and their applications in the field of electronics industry.

Prerequisite

Basic knowledge on Electronic Devices.

Course Outcomes

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

CO#	Course Outcomes	TPS Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Compute the impedance and gain parameters of transistor amplifier circuits.	TPS 3	70	70
CO2	Understand the frequency response of transistor amplifier circuits.	TPS 2	70	70
CO3	Demonstrate the effect of negative feedback on amplifier performance parameters.	TPS 3	70	70
CO4	Use the condition for oscillation in a transistor circuit to establish sustained oscillation.	TPS 3	70	70
CO5	Calculate the power conversion efficiency of large signal amplifiers.	TPS 3	70	70
CO6	Construct the inverting and non-inverting mode applications of operational amplifier.	TPS 3	70	70
CO7	Calculate the component values for the given timing specification for multivibrator circuit using IC 555.	TPS 3	70	70

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	L	L	-	-	-	L	L	-	-	S	L	L
CO2	S	M	L	L	L	-	-	-	L	L	-	-	S	L	L
CO3	S	M	L	L	L	-	-	-	L	L	-	-	S	-	L
CO4	S	M	L	L	L	-	-	-	L	L	-	L	S	-	L
CO5	S	M	L	L	L	-	-	-	L	L	-	L	S	-	L
CO6	S	M	L	L	L	-	-	-	L	L	-	-	S	-	L
CO7	S	M	L	L	L	-	-	-	L	L	-	-	S	-	L
Overall	3	2	1	1	1	0	0	1	1	1	0	0	3	0	1
	S	M	L	L	L	-	-	L	M	M	-	-	S	-	L

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I			Assessment - II			Terminal Exam (%)		
	CAT – I (%)			CAT – II (%)					
TPS / CO	1	2	3	1	2	3	1	2	3
CO1	-	10	10	-			-	4	10
CO2	-	10	20	-			-	4	10
CO3	-	05	20	-			-	4	15
CO4	-	05	20	-			-	2	15
CO5	-			-	4	30	-	2	10
CO6	-			-	8	25	-	2	10
CO7	-			-	8	25	-	2	10
Total	-	**30**	**70**	**-**	**20**	**80**	**-**	**20**	**80**

Psychomotor Skill	Practical
Perception	-
Set	-
Guided Response	-
Mechanism	100
Complex Overt Responses	-
Adaptation	-
Origination	-

Syllabus

Small Single Amplifiers: Q- Point, Self-bias- CE and CS, h-model of BJT and MOSFET, Small signal analysis of Amplifiers, Low frequency, Midband frequency and High frequency model of Transistors. [8]

Feedback Amplifiers and Oscillators: Feedback concept, negative and Positive feedback, voltage/ current, series/shunt feedback, Bark hausen criterion, Colpitts, Hartley's, Phase shift, Wein bridge and crystal oscillators. [8]

Large Signal Amplifiers: Class A, B, AB, C, Conversion Efficiency. [4]

Operational Amplifier: Ideal OPAMP, Differential Amplifier, Constant Current Source (Current Mirror), Open and Closed loop Circuits, Inverting and Non-Inverting amplifiers, Voltage follower, Buffer circuit. [6]

Applications of Operational Amplifier: Adder, Integrator and Differentiator, Comparator, Schmitt Trigger, Instrumentation Amplifier, Log and Anti-Log Amplifiers, Voltage to current and Current to voltage converter. [5]

Multivibrators: Bistable, Astable, Monostable multivibrators using IC 555 Timer, Applications of 555 Timer. [5]

Practical:

1. Design, simulate and demonstrate a single stage amplifier.
2. Design, simulate and demonstrate a series and shunt feedback amplifier.
3. Design, simulate and demonstrate a LC oscillator.
4. Design, simulate and demonstrate a RC oscillator.
5. Design, simulate and demonstrate a class-B power amplifier.
6. Design, simulate and demonstrate a Differential Amplifier using Op-amp.
7. Design, simulate and demonstrate an inverting and non-inverting amplifier.
8. Design, simulate and demonstrate application of operational amplifier circuits.
9. Design, simulate and demonstrate Astable and Monostable multivibrators.

Text Book

- Boylested and Nashelsky, "Electronic Devices and Circuit Theory", 11th edition, Pearson Education India, 2015.

Reference Books& web resources

- Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits: Theory and Application",7th Edition, Oxford University Press, 2017.

- Serigo Franco, “Design with Operational Amplifiers & Analog Integrated Circuits”, 4th edition, McGraw Hill, 2014.
- https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/readings/.
- NPTEL video lecture on “Analog Electronic Circuits” https://nptel.ac.in/courses/108102095/.

Course Contents and Lecture Schedule

#	Topic	Lecture Hours	Practical
	Small Signal Amplifiers		-
1.	Q-Point, Self-Bias-CE and CS	2	-
2.	h-model of BJT and MOSFET	2	-
3.	Small signal analysis of Amplifiers	1	2
4.	Low frequency model of Transistor	1	2
5	Midband frequency and High frequency model of Transistor	2	-
	Feedback Amplifiers and Oscillators		
6.	Feedback concepts	1	-
7.	Negative and Positive feedback	1	-
8.	Voltage/Current feedback	1	2
9.	Series/Shunt feedback	1	-
10	Barkhausen criterion, Colpitts Oscillator	1	2
11.	Hartley Oscillator	1	-
12.	Phase shift Oscillator	1	2
13.	Wein bridge and crystal oscillator	1	-
	Large Signal Amplifiers		-
14.	Class A amplifier	1	-
15.	Class B amplifier	1	2
16.	Class AB amplifier	1	-
17.	Class C and Conversion Efficiency	1	-
	Operational Amplifiers		
18.	Ideal OPAMP	1	-
19.	Differential Amplifier	1	2
20.	Constant current source (Current mirror)	1	-
21.	Open and Closed loop circuits	1	-
22.	Inverting and Non-inverting Amplifiers	1	-
23.	Voltage follower, Buffer circuit	1	2
	Applications of Operational Amplifier		
24.	Adder, Integrator and Differentiator	1	-
25.	Comparator and Schmitt trigger	1	2
26.	Instrumentation Amplifier	1	-
27.	Log and Anti-Log Amplifiers	1	-
28.	Voltage to current and Current to voltage converter.	1	2
	Multivibrators		
29.	Bistable multivibrators using IC 555 Timer	1	-
30.	Astable and Monostable multivibrator using IC 555 Timer	2	2
31.	Application of 555 Timer	2	2
	TOTAL	**36**	**24**

Course Designers:

- Dr.N.B.Balamurugan nbbalamurugan@tce.edu
- Dr. V.Vinoth Thyagarajan vvkece@tce.edu

22EC330	NETWORK ANALYSIS AND SYNTHESIS

Category	L	T	P	Credit
BSC	2	1	0	3

Preamble

The goal of this course is to broaden the student's understanding of network analysis beyond the basic concepts. It covers sophisticated network analysis in frequency domain, understanding pole-zero concept, analysis of two-port networks, synthesis of simple networks and basics of filter design.

Prerequisite

Nil

Course Outcomes

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

CO#	Course Outcomes	TPS Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Apply Laplace transform to formulate and solve electric network problems	TPS 3	70	60
CO2	Identify the properties and characteristics of network functions with respect to pole zero plot	TPS 3	70	60
CO3	Determination of two port network Z, Y, h and ABCD parameters	TPS 3	70	60
CO4	Determine network function of Advanced Networks - Ladder, Lattice, Bridged T Networks	TPS 3	70	60
CO5	Synthesize passive one-port networks using standard Foster and Cauer forms.	TPS 3	70	60
CO6	Apply two-port network analysis in the design of filters.	TPS 3	70	60

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	L	L	-	-	L	M	M	-	-	M	L	L
CO2	S	M	L	L	L	-	-	L	M	M	-	-	M	L	L
CO3	S	M	L	L	-	-	-	L	M	M	-	-	M	-	L
CO4	S	M	L	L	-	-	-	L	M	M	-	L	M	-	L
CO5	S	M	L	L	-	-	-	L	M	M	-	L	M	-	L
CO6	S	M	L	L	-	-	-	L	M	M	-	-	M	-	L
Overall	3	2	1	1	0	0	0	1	2	2	0	0	2	0	1
	S	M	L	L	-	-	-	L	M	M	-	-	M	-	L

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I * (%)			CAT – II (%)			Assg. II *(%)					
TPS Scale / CO	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	-	10	20	100			-						-	4	10
CO2	-	10	20				-						-	4	10
CO3	-	10	30				-						-	4	15
CO4	-						-	10	20	100			-	-	15
CO5	-						-	10	30				-	4	15
CO6	-						-	10	20				-	4	15
Total	-	30	70	100			-	30	70	100			-	20	80

Syllabus

Laplace transform- Laplace transform of Electrical signals: step, Impulse and periodic functions- Initial and final value Theorem- Inverse transform- Analysis of electric DC networks. **S- Domain Analysis of AC Networks:** Interpretation of complex frequency- Network function for one-port and two-port, poles and zeros with restrictions for driving point functions and transform functions, stability by Routh-Hurwitz criterion. **Two Port Parameters:** Z-Y-h-ABCD parameters - Equivalent circuit model- Interrelationship of different parameters Interconnection of two port networks- calculation of network function for ladder and Lattice networks. **Network Synthesis**: Positive and real function (PRF), properties of PRF, testing of driving point functions, even and odd function, one terminal pair network driving point synthesis with LC, RL and RC elements, Foster and Cauer form. **Synthesis of Filters:** Low pass filters, high pass filters, band pass filters, band reject filters, constant k- and m-derived filters.

Text Book

- Van Valkenburg M.E., —Introduction to Modern Network Synthesis, Wiley Eastern, 1960 (reprint 1986).
- Van Valkenburg M.E, —Network Analysis, Prentice Hall India, 2014

Reference Books

- Ravish R. Singh, "Network Analysis and Synthesis", McGraw-Hill Education, 2013
- Abhijit Chakrabarti, “Circuit Theory Analysis and Synthesis” Dhanpat Rai & Co.; Seventh - Revised edition- 2018.
- Franklin Kuo, —Network Analysis and Synthesis||, 2nd Ed.,Wiley India,2006.
- Sudhakar, A. Shyammohan, “Circuits and Network”, 5th Edition, Tata McGraw Hill, 2015.
- S. K. Bhattacharya, —Network Analysis and Synthesis, || Pearson Education India.2015.
- “Network Analysis and Synthesis”, Wadhwa, New Age,2007.
- Dr. K.M. Soni, “Fundamentals of Network Analysis & Synthesis”, S.K. Kataria & Sons, 9th Edition,2019.

Course Contents and Lecture Schedule

#	Topic	Lecture Hours	Tutorial
	Introduction to the Course, COs POs	1	-
1	**Laplace Transform (6)**		
2	Definition of Laplace Transform	1	-
3	Basic Theorems of Laplace Transform, Laplace transform of some basic functions	1	-
4	Application of Laplace transforms in solving Integro-differential equations and simultaneous differential equations	1	
5	Application of Laplace Transform Method to DC Circuit Analysis	1	2
	S- Domain Analysis of AC Networks: (6)		
6	Interpretation of complex frequency in S-Plane	1	-
7	Network function for one-port and two-port Networks,	1	-
8	Pole -Zero Diagram, Significance of Poles and Zeros	1	-
9	Poles and zeros with restrictions for driving point functions and transform functions,	1	-
10	Stability by Routh-Hurwitz criterion	1	1
	Two Port Parameters: (6)		
11	Relationships of Two-Port Variables	1	-
12	Two Port Parameters – z,y,h and ABCD, Image Impedance Equivalent circuit Model	1	1
13	Conditions for Reciprocity and Symmetry	1	-
14	Interrelationships between Two-Port Parameters	1	-
15	Terminated Two-Port Networks	1	-
	Ladder and Lattice Networks (5)		

16	Interconnection of Two-Port Networks	1	
17	Ladder Networks, Lattice and Bridged T Networks	1	2
18	Image Parameters of Two port Networks	1	-
	Network Synthesis: **(6)**		
19	Elements of Realizability, Positive Real Functions (PRF) Properties of PRF	1	
20	Basic Realization Procedures	1	1
21	Synthesis of one port networks with two kinds of elements-RL,RC,LC & Properties of Functions	1	2
	Synthesis of Filters: (6)		
22	Classification of Filters, Filter Networks, Characteristic Impedances	1	
23	Constant K Filters	1	2
24	m-derived Filters	1	1
	TOTAL	**24**	**12**

Marks Allocation for Assignment:

Sl. No	Description	Marks
1	Assignment 1 – a) Tutorial Submission b) Identification of Real world Two port networks	40
2	Assignment 2 – a) Tutorial Submission b) Synthesis of Networks using C	40
Total		**80**

Course Designers:

- Dr K Hariharan, khh@tce.edu
- Dr. B.Sathyabama, sbece@tce.edu

22EC340	COMPUTER ORGANIZATION AND MICROPROCESSOR

Category	L	T	P	Credit	TE
PCC	3	0	2	4	Theory

Preamble

This course on Computer Organization and Microprocessor is designed as a theory and practical course that aims to provide students with a deep understanding of computer system architecture and organization. The course covers various topics, including the evolution and performance of computer systems, central processing units and computer hardware, x86 and MIPS32 processors, and multi-core architecture. Through experiments, students will gain hands-on experience in designing and implementing programs for data transfer, arithmetic operations, floating-point arithmetic, code conversion, stack implementation, array handling, recursion programs, and IO system service calls using x86 and MIPS32 architectures. Upon completion of the course, students will have a strong foundation in computer organization and microprocessor architecture and be equipped to design efficient and optimized programs for modern computer systems.

Prerequisite

Nil

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Understand the evolution, performance, organization, and architecture of computer systems.	TPS2	70	70
CO2	Understand the structure and function of CPU and computer hardware components.	TPS2	70	70
CO3	Apply the knowledge of x86 processors, to frame ASM coding for data transfer and arithmetic computations.	TPS3	70	70
CO4	Apply knowledge of MIPS32 architecture to design and optimize efficient programs for maximum performance and resource utilization.	TPS3	70	70
CO5	Apply knowledge of vector processors, multicore processors, network on chip, and Raspberry Pi SBC building blocks to design and implement efficient parallel programs	TPS3	70	70
CO6	Apply the principles of BIOS system calls and I/O system service calls to effectively communicate with and control computer hardware devices.	TPS3	70	70

Mapping with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O2
CO1	M	L	-	-	-	-	-	L	L	L	L	L	L	-	L
CO2	M	M	L	L	-	-	-	L	L	L	L	L	-	L	L
CO3	S	M	L	-	S	-	-	L	L	L	L	L	M	L	L
CO4	S	M	L	L	S	L	-	L	L	L	L	L	M	L	L
CO5	S	M	L	L	-	L	-	L	L	L	L	L	M	-	L
CO6	S	L	L	L	-	-	-	L	L	L	L	L	-	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I			Assessment - II			Terminal Exam (%)		
	CAT – I (%)			CAT – II (%)					
TPS / CO	1	2	3	1	2	3	1	2	3
CO1	-	20	-	-	-	-	-	20	-
CO2	-	20	20	-	-	-	-	-	20
CO3	-	20	20	-	-	-	-	20	-
CO4	-	-	-	-	30	15	-	-	20
CO5	-	-	-	-	30	15	-	-	15
CO6	-	-	-	-		10	-	-	5
Total	-	**60**	**40**	**-**	**60**	**40**	**-**	**40**	**60**

Psychomotor Skill	Practical
Perception	-
Set	-
Guided Response	-
Mechanism	100
Complex Overt Responses	-
Adaptation	-
Origination	-

Syllabus

Computer System: Evolution and Performance, organization and architecture. Structure and Function, Generations of computer. IAS computer Structure and operation. CISC and RISC, Evolution of the Intel x86 and ARM architecture. Performance assessment [5]

Central Processing Unit and Computer Hardware: CPU building blocks and its functions, ALU, Register organization. Instruction sets, Addressing modes and functions. Instruction Pipelining. Bus interconnection. Memory Management**:** Cache and its organization, Internal External memory and virtual memory and DMA [8]

x86 Processors: Architecture and Modes of operations, memory segments and Programming mode. Instruction sets, assembler directives. Stack, and interrupts. Memory Banking. ASM Coding for data transfer and arithmetic computations. Introduction to IA32 architecture. [6]

MIPS32 Architecture: MIPS32 instructions, programming model, CPU performance measuring. Pipelining of the Mips32 Data Path, Amadhal laws, Multi-cycle Operations in MIPS32 and exploiting Instruction Level Parallelism [9]

Multi-Core Architecture: Vector Processors, Introduction to Tiled Chip Multicore Processors, Network On Chip and Raspberry PI SBC-Buliding Blocks. [8]

Practical:

1. x86 programming for data Transferring and arithmetic operation [2]
2. x86 Floating point arithmetic operations [2]
3. x86 BIOS system call for Input/output device [2]
4. MIPS32 Integer arithmetic operation [2]
5. MIPS32 Logical operations [2]
6. MIPS32 Floating point arithmetic [2]
7. Implementing of code conversions in MIPS32 [2]
8. MIPS32 Stack implementation [2]
9. Array handling in MIPS32 [2]
10. Recursion Program [2]
11. IO System Service Calls [2]
12. Handling Interrupts in MIPS32 [2]

Note:

- Experiments 1, 2 and 3 will be carried out by EMU8086 simulator which runs on all recent computers.
- Experiments 4 to 12 will be carried out by QTSPIM simulator runs on Windows, and Linux computers.

Text Book

- William Stallings, Computer Organisation and Architecture- Designing for Performance", 9th Edition, Pearson Education series, 2014.
- Robert Britton, "MIPS Assembly Language Programming", Pearson/Prentice Hall, 2004

Reference Books& web resources

- K. Bhurchandi, A. K. Ray, Advanced Microprocessor and Peripherals, McGraw Hill Education, 3rd Edition, 2017.
- Patterson, D. A., and J. L. Hennessy. Computer Organization and Design: The Hardware/Software Interface, 5th ed. San Mateo, CA: Morgan Kaufman, 2013. ISBN: 1558606041.
- https://onlinecourses.nptel.ac.in/noc22_cs88/course.
- https://onlinecourses.nptel.ac.in/noc21_cs82/course.

Course Contents and Lecture Schedule

Module No.	Topic	No.of Lectures	CO
1	**Computer System**		
1.1	Evolution and Performance, organization and architecture. Structure and Function, Generations of computer.	2	CO1
1.2	IAS computer Structure and operation. CISC and RISC,	2	CO1
1.3	Evolution of the Intel x86 and ARM architecture. Performance assessment	1	CO1
2	**Central Processing Unit and Computer Hardware**		
2.1	CPU building blocks and its functions, ALU, Register organization.	2	CO2
2.2	Instruction sets, Addressing modes and functions.	2	CO2
2.3	Instruction Pipelining. Bus interconnection.	2	CO2
	Memory Management**:** Cache and its organization, Internal External memory and virtual memory and DMA	2	CO2
3	**x86 Processors**		
3.1	Architecture and Modes of operations, memory segments and Programming mode.	2	CO3
3.2	Instruction sets, assembler directives.	1	CO3
3.3	Stack, and interrupts. Memory Banking. ASM Coding for data transfer and arithmetic computations.	2	CO3
	Introduction to IA32 architecture.	1	CO3
4	**MIPS32 Architecture**		
4.1	MIPS32 instructions, programming model, CPU performance measuring.	3	CO4
4.2	Pipelining of the Mips32 Data Path	2	CO4
4.3	Amadhal laws, Multi-cycle Operations in MIPS32	2	CO4
4.4	exploiting Instruction Level Parallelism	2	CO6
5	**Multi-Core Architecture**		
5.1	Vector Processors	2	CO5
5.2	Introduction to Tiled Chip Multicore Processors.	2	CO5

5.3	Network On Chip	2	CO5
5.4	Raspberry PI SBC-Building Blocks	2	CO5
Total		**36**	
Practical			
6	x86 programming for data Transferring and arithmetic operation	2	CO3
7	x86 Floating point arithmetic operations	2	CO3
8	x86 BIOS system call for Input/output device	2	CO6
9	MIPS32 Integer arithmetic operation	2	CO4
10	MIPS32 Logical operations	2	CO4
11	MIPS32 Floating point arithmetic	2	CO4
12	Implementing of code conversions in MIPS32	2	CO4
13	MIPS32 Stack implementation	2	CO4
14	Array handling in MIPS32	2	CO4
15	Recursion Program	2	CO4
16	IO System Service Calls	2	CO6
17	Handling Interrupts in MIPS32	2	CO6
Total		**24**	

Course Designers:

- Dr.K.Hariharan khh@tce.edu
- Dr.G.Prabhakar gpece@tce.edu

22EC350	SIGNALS AND SYSTEMS

Category	L	T	P	Credit
PCC	3	1	0	4

Preamble

Signals and Systems arise in a wide variety of fields such as communications, aeronautics astronautics, acoustics, seismology, biomedical engineering and speech processing. Signals are functions of one or more independent variables. Signals contain information about the behaviour or nature of some phenomenon. They vary continuously in time or at discrete points in time. Systems respond to particular signals by producing other signals or some desired behaviour. Systems that respond to or process signals lead naturally to two parallel frameworks for signal and system analysis, one for phenomena and processes that are described in continuous in time and one for those that are described in discrete in time. In this course, students will be able to analyse signals and systems and design systems to enhance or restore signals that have been degraded.

Prerequisite

Nil

Course Outcomes

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

CO#	Course Outcomes	TPS Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Characterize and classify the given continuous and discrete signals and systems	TPS 3	70	70
CO2	Carry out time domain analysis of continuous time systems	TPS 3	70	70
CO3	Carry out time domain analysis of discrete time systems	TPS 3	70	70
CO4	Analyze continuous time periodic signals using Fourier Series.	TPS 4	70	70
CO5	Analyze continuous time non-periodic signals using Fourier Transform.	TPS 4	70	70
CO6	Convert a continuous time signal into discrete time sequence using Nyquist Sampling Theorem	TPS 3	70	70
CO7	Carry out discrete time analysis using z-Transform.	TPS 3	70	70

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	M	L	-	-	-	-	-	-	M	-	-	M	M	-
CO2	S	M	L	-	-	-	-	-	-	M	-	-	M	M	-
CO3	S	M	L	-	-	-	-	-	-	M	-	-	M	M	-
CO4	S	S	M	L	S	-	-	-	-	M	-	-	S	M	-
CO5	S	S	M	L	S	-	-	-	-	M	-	-	S	M	-
CO6	S	M	L	-	-	-	-	-	-	M	-	-	M	M	-
CO7	S	M	L	-	-	-	-	-	-	M	-	-	M	M	-
Overall	S	M	L	-	-	-	-	-	-	M	-	-	M	M	-

S- Strong; M-Medium; L-Low

Assessment Pattern:

	Assessment – I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assignment I (%)			CAT – II (%)			Assignment II (%)					
TPS / CO	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
CO1	10	10	-	100			-	-	-	-			2	10	-
CO2	10	20	-				-	-	-	-			2	10	-
CO3	10	20	-				-	-	-	-			2	-	10
CO4	-	-	20				-	-	-	-			4	-	10
CO5	-	-	-	-			-	10	20	100			4	10	-
CO6	-	-	-	-			10	20	-				2	20	-
CO7	-	-	-	-			10	30	-				4	10	-
Total	**30**	**50**	**20**	**100**			**20**	**60**	**20**	**100**			**20**	**60**	**20**

Syllabus

Signals and Systems: Signals, Signal Operations, Classification of Signals, Continuous time Signal Models, Systems, Classification of continuous time Systems, Signal operations on discrete time signals, Discrete Signal Models, Classification of discrete time systems, **Time-Domain Analysis of Continuous-Time Systems:** System response to internal conditions: the zero-input response, Unit impulse response, *System response to external input: zero-state response*: Convolutional Integral, Interconnected System; *System stability***:** BIBO and Asymptotic Stability**,** *Intuitive Insights into System Behaviour***:** Time Constant, Resonance Phenomenon, **Time-Domain Analysis of Discrete-Time Systems:** System response to internal conditions: the zero-input response, unit impulse response, *System response to external input: zero-state response:* Convolutional Sum, Properties of convolution sum, Interconnected Systems, *System stability:* BIBO and Asymptotic Stability**,** *Intuitive Insights into System Behaviour:* Time Constant, Resonance Phenomenon, **Continuous-Time Signal Analysis-The Fourier Series:** Periodic signal representation by trigonometric Fourier series, Existence and convergence of the Fourier series, Exponential Fourier series, LTIC response to periodic inputs, Generalized Fourier series: Signals as vectors, **Continuous-Time Signal Analysis-The Fourier Transform:** Aperiodic signal representation by Fourier integral, Fourier Transforms of useful functions, Properties of Fourier Transform, Signal transmission through LTIC systems, **Sampling:** Sampling Theorem, Signal Reconstruction, **Discrete-Time System Analysis Using the z-Transform:** Properties of z-Transform, z-Transform Solution of Linear Difference Equations, Frequency Response of Discrete-Time Systems, Frequency Response from Pole-Zero Location, Connection between the Laplace Transform and the z-Transform, The Bilateral z-Transform.

Text Book

- Principles of Linear Systems and Signals: B.P. Lathi (2nd Edition), Oxford University Press, 2009.

Reference Books& web resources

- Alan V.Oppenheim, Alan S.Willsky and S.Hamid Nawab, “Signals & Systems”, PrenticeHall of India, Second Edition, 2011.
- James H.McClellen, Ronald W.Schafer, Mark A.Yoder ,”Signal Processing First”, Pearson Education, 2003.
- Rodger E.Ziemer, William H.Tranter and D.Ronald Fannain “Signals & Systems Continuous and Discrete”, Pearson Education, 2002.
- Simon Haykin, Barry Van Veen,” Signals and Systems”, Wiely, 2nd Edition, 2002.
- Sophocles J.Orfanidis “Introduction to Signal Processing”, Prentice Hall, 1996.
- Ashok Ambardar, “Digital Signal Processing: A Modern Introduction”, Nelson Engg, 2007.
- https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/index.htm

Course Contents and Lecture Schedule

No.	Topic	Lecture/ Tutorial Hours	COs
1	Signals and Systems		
1.1	Signals, Signal Operations, Classification of Signals	1	CO1
1.2	Continuous time Signal Models, Systems	2	CO1
1.3	Classification of continuous time Systems	1	CO1
1.4	Signal operations on discrete time signals	1	CO1
1.5	Discrete Signal Models, Classification of discrete time systems	2	CO1
2	**Time-Domain Analysis of Continuous-Time Systems**		
2.1	System response to internal conditions: The zero-input response, Unit impulse response	1	CO2
2.2	System response to external input: zero-state response	1	CO2
2.3	Convolutional Integral, Interconnected System	2	CO2
2.4	System stability**:** BIBO and Asymptotic Stability	2	CO2
2.5	Intuitive Insights into System Behaviour: Time Constant, Resonance Phenomenon	2	CO2
3	**Time-Domain Analysis of Discrete-Time Systems**		
3.1	System response to internal conditions: the zero-input response unit impulse response	2	CO3
3.2	System response to external input: zero-state response-Convolutional Sum	2	CO3
3.3	Properties of convolution sum, Interconnected Systems	1	CO3
3.4	System stability**:** BIBO and Asymptotic Stability	2	CO3
3.5	Intuitive Insights into System Behaviour**:** Time Constant, Resonance Phenomenon	1	CO3
4	**Continuous-Time Signal Analysis-The Fourier Series**		
4.1	Periodic signal representation by trigonometric Fourier series	2	CO4
4.2	Existence and convergence of the Fourier series	2	CO4
4.3	Exponential Fourier series	2	CO4
4.4	LTIC response to periodic inputs, Generalized Fourier series: Signals as vectors	2	CO4
5	**Continuous-Time Signal Analysis-The Fourier Transform**		
5.1	Aperiodic signal representation by Fourier integral	2	CO5
5.2	Fourier Transforms of useful functions	2	CO5
5.3	Properties of Fourier Transform, Signal transmission through LTIC systems	3	CO5
6	**Sampling**		
6.1	Sampling Theorem, Signal Reconstruction	3	CO6
7	**Discrete-Time System Analysis Using the z-Transform**		
7.1	Properties of z-Transform, z-Transform Solution of Linear Difference Equations	2	CO7
7.2	Frequency Response of Discrete-Time Systems, Frequency Response from Pole-Zero Location	2	CO7
7.3	Connection between the Laplace Transform and the z-Transform, The Bilateral z-Transform	3	CO7
Total		**48**	

Course Designers:

- Dr.S.J.Thiruvengadam sjtece@tce.edu
- Dr.K.Rajeswari rajeswari@tce.edu
- Dr.G.Ananthi gananthi@tce.edu

22EC360	OBJECT ORIENTED PROGRAMMING

Category	L	T	P	Credit
ESC	3	0	0	3

Preamble

This course aims to provide students with broad theoretical and practical skills in object-oriented programming. This course focuses on various OOP concepts like Class, Object, Encapsulation, Inheritance and Polymorphism. It also focuses on various libraries and Swing for programming an interactive real-world application.

Prerequisite

Nil

Course Outcomes

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

CO#	Course Outcomes	TPS Scale	Expected Proficiency %	Expected Attainment %
CO1	Use programming constructs like Data types, Control structures, looping statements.	TPS 3	70	70
CO2	Construct object-oriented programs for the given scenario using object-oriented concepts like abstraction, encapsulation, polymorphism and inheritance.	TPS 3	70	70
CO3	Apply JAR, package, and exception handling mechanism for the given problem.	TPS 3	70	70
CO4	Implement various libraries like String, I/O, Collection classes and JDBC.	TPS 3	70	70
CO5	Develop interactive, user friendly software for real world applications using swing and Event Handling.	TPS 3	70	70
CO6	Construct Java based solutions with functional programming and design patterns for various domain areas	TPS 3	70	70

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	L		L			M				M	M	L	
CO2	S	M	L		L			M				M	M	L	
CO3	S	M	L		L			M				M	M	L	
CO4	S	M	L		S			M				M	M	M	M
CO5	S	M	L		S			S	S	S		S	M	M	M
CO6	S	M	L		S			S	S	S		S	M	M	M

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I * (%)			CAT – II (%)			Assg. II * (%)					
TPS / CO	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	-	10	10	100			-			100			-	4	6
CO2	-	10	20				-						-	4	14
CO3	-	10	40				-						-	4	15
CO4	-						-	10	40	100			-	4	15
CO5	-						-	10	20				-	-	20
CO6	-						-	10	40				-	4	10
Total	-	**30**	**70**	**100**			**-**	**20**	**80**	**100**			**-**	**20**	**80**

Syllabus

Programming Constructs: Data types, Arrays, Control structures- Selection, Looping and Jump statements **Object Oriented Programming Concepts:** Object Oriented Paradigms, Encapsulation Object, Class, Method, Inheritance, Polymorphism–Method overloading, Method overriding, dynamic method dispatch, Abstract class and Interfaces **Exception Handling:** JAR, Create and import packages, Exception handling, Exception hierarchy- Try and Catch, Multiple catch, Nested try, throw, Built in exceptions and User defined exceptions **Libraries:** User-defined packages, String Handling - Methods, I/O – File Reading and Writing, StringTokenizer, Collections – Arraylist, linked list, HashSet, Linked Hashset, Tree Set, JDBC **Swing & Event Handling:** Swing components, Event handling, Event ListenersInterfaces - Action Listener, Focus Listener, Item Listener, Key Listener, Mouse Listener, Text Listener, AWT components - Frame, Label, Button, TextField, CheckBox, CheckBoxGroup, Choice, List, Layout – grid, card **Design Patterns:** Creational, Structural and Behavioral Design Patterns **Functional Programming:** Lambda expressions, functional interfaces, Stream API, immutability, pure functions, higher order functions, Recursion.

Text Book

- Herbert Schildt, “Java: The Complete Reference”, McGraw-Hill. Ninth Edition, 2014.

Reference Books

- Tony Gaddis, Starting Out with Java: From Control Structures through Objects, 4/E, Addison-Wesley, 2009.
- Grady Booch, Robert Maksimchuk, Michael Engel, Bobbi Young, Jim Conallen, Kelli Houston: Object Oriented Analysis and Design with Applications, Third Edition, May 2007.
- H.M. Deitel and P.J. Deitel, C How to program Introducing C++ and Java, Fourth Edition, Pearson Prentice Hall, 2005.
- Paul Deitel and Harvey Deitel, “Java How to Program (Early Objects)”, Pearson, Eleventh Edition, 2017.
- E.Balagurusamy, “Programming with Java” , McGraw-Hill, Fifth Edition, 2014.
- Kathy Sierra, “Head First Java”, Shroff publications, Second edition, 2005.
- Cay S. Horstmann and Gary Cornell, “Core Java, Volume I - Fundamentals”, Prentice Hall, Ninth Edition, 2013.
- Cay S. Horstmann and Gary Cornell, “Core Java, Volume II – Advanced Features : 2”, Prentice
- Erich Gamma. Richard Helm, Ralph Johnson, John Vlissides, “Design Patterns- Element of Reusable Object-Oriented Software”, Pearson Education India, 2004.

Course Contents and Lecture Schedule

#	Topic	Lecture Hours
1	**Introduction**	**1**
2	**Programming Constructs:** Data types, Arrays	1
3	Control structures- Selection	1
4	Control structures- Looping and Jump statements	1
	Object Oriented Programming Concepts:	
5	Object Oriented Paradigms	1
6	Encapsulation Object, Class, Method	2
7	Inheritance	1
8	Polymorphism–Method overloading, Method overriding, dynamic method dispatch	2
9	Abstract class and Interfaces	2
	Exception Handling:	
10	JAR	1
11	Create and import packages	1

12	Exception handling, Exception hierarchy- Try and Catch	1
13	Multiple catch and Nested try	2
14	throw	1
	Built in exceptions	1
15	User defined exceptions	1
	Libraries:	
16	User-defined packages, String Handling - Methods	1
17	I/O – File Reading and Writing	1
18	String Tokenizer	
19	Collections – Array list, linked list Hash Set, Linked Hash set, Tree Set	1
20	JDBC	1
	Swing & Event Handling:	
21	Swing components, Event handling, Event Listeners Interfaces - Action Listener, Focus Listener, Item Listener, Key Listener, Mouse Listener, Text Listener	2
22	AWT components - Frame, Label, Button, TextField, CheckBox, CheckBoxGroup, Choice, List, Layout – grid, card	2
	Design Patterns:	
23	Creational Design Patterns	2
24	Structural and Behavioral Design Patterns	2
	Functional Programming:	
25	Lambda expressions, functional interfaces	2
26	Stream API, immutability, pure functions	1
27	Higher order functions, Recursion.	1
	TOTAL	**36**

Course Designers:

- Dr. M.Senthilarasi, msiece@tce.edu
- Dr.R.A.Alaguraja, alaguraja@tce.edu

22EC420	MIXED SIGNAL CIRCUIT DESIGN

Category	L	T	P	Credit
PCC	3	0	0	3

Preamble

This course is to knowledge of link between analog world and digital world as in the name of mixed signal circuit. It is performed by sampling and hold circuit, DAC and ADC. The course mainly presents state-of-the-art Sample and hold circuits, digital-to-analog converters, a range of analog-to-digital converters, and phase locked loop concepts.

Prerequisite

Nil

Course Outcomes

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

CO#	Course Outcomes	TPS Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Demonstrate the performance parameters of Sample and Hold Circuits	TPS 3	70	70
CO2	Demonstrate the performance parameters of comparators	TPS 3	70	70
CO3	Interpret Data Converter Specifications	TPS 3	70	70
CO4	Design Digital-to-analog converters	TPS 3	70	70
CO5	Design Analog-to-digital converters	TPS 3	70	70
CO6	Understand the Phase locked loop concepts	TPS 2	70	70

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	L	L	-	-	-	-	-	M	-	-	M	-	-
CO2	S	M	L	L	-	-	-	-	-	M	-	-	M	-	-
CO3	S	M	L	L	-	-	-	-	-	M	-	-	M	-	-
CO4	S	M	L	L	-	-	-	-	-	M	-	-	M	-	-
CO5	S	M	L	L	-	-	-	-	-	M	-	-	M	-	-
CO6	S	M	L	L	-	-	-	-	-	M	-	-	M	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Assg. I * (%)			CAT – II (%)			Assg. II * (%)					
TPS / CO	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	-	10	20	100			-						-	4	10
CO2	-	10	20				-						-	4	10
CO3	-	10	30				-						-	4	15
CO4	-						-	10	20	100			-	4	15
CO5	-						-	10	30				-	4	15
CO6	-						-	30	-				-	15	-
Total	-	**30**	**70**	**100**			**-**	**50**	**50**	**100**			**-**	**35**	**65**

Syllabus

Sample and Hold Circuits: Performance of sample-and-hold circuits – Testing of sample and holds, MOS sample-and-hold basics, CMOS sample and hold circuits, Switch capacitor amplifiers, Switch capacitor power amplifiers, Switch capacitor filters. [8]

Comparators: Comparator specifications – input offset and noise, hysteresis. Opamp as a comparator – input-offset voltage errors, charge-injection errors, making charge-injection signal independent, minimizing errors due to charge-injections. [6]

Data Converter Specifications: Ideal D/A converter, ideal A/D converter, quantization noise, deterministic approach, stochastic approach, signed codes, performance limitations, resolution, offset and gain error, accuracy and linearity [5]

Digital-to-analog converters (DAC): Decoder-based converters – resistor string converters, folded resistor-string converters, binary-weighted resistor converters, R-2R-based converters, Thermometer-code converters [5]

Analog-to-digital converters (ADC): Integrating converters, flash converters, Successive-approximation converters, Pipelined A/D converters and Sigma Delta Converters [6]

Phase locked loop: Basic phase-locked loop architecture, voltage-controlled oscillator, divider, phase detector, loop filer, the PLL in lock [6]

Text Book

- Tony Chan Carusone, D avid A. Johns, Kenneth W. Martin “Analog Integrated Circuit Design”, Wiley, 2nd Edition, 2011.
- David A. Johns and Ken Martin: Analog Integrated Circuit Design, Wiley India, 2008.
-

Reference Books & web resources

- Phillip Allen and Douglas R. Holberg “CMOS Analog Circuit Design” Elsevier, 2011.
- Willy M. C. Sansen “Analog Design Essentials” Springer, 2006.
- Behzad Razavi “Design of Analog CMOS Integrated Circuits” McGraw Hill, 2nd Edition, 2015.

Course Contents and Lecture Schedule

#	Topic	Lecture Hours
	Sample and Hold Circuits	
1	Performance of sample-and-hold circuits	2
2	Testing of sample and holds	1
3	MOS sample-and-hold basics, CMOS sample and hold circuits,	2
4	Switch capacitor amplifiers, Switch capacitor power amplifiers.	2
5	Switch capacitor filters	1
	Comparators	
6	Comparator specifications	1
7	Input offset and noise	1
8	Hysteresis	1
9	Opamp as a comparator – input-offset voltage errors	1
10	Charge-injection errors, making charge-injection signal independent, minimizing errors due to charge-injections	2
	Data Converters Specifications	
11	Ideal D/A converter	1
12	Ideal A/D converter	1
13	Quantization noise, deterministic approach, stochastic approach	1
14	Signed codes, performance limitations	1
15	Resolution, offset and gain error, accuracy and linearity	1
	Digital-to-Analog Converters (DAC)	
16	Decoder-based converters – resistor string converters	1
17	Folded resistor-string converters, binary-weighted resistor converters	2

18	R-2R-based converters, Thermometer-code converters	2
	Analog-to-Digital Converters (ADC)	
19	Integrating converters	2
20	Flash converters, Successive-approximation converters	2
21	Pipelined A/D converters and Sigma Delta Converters	2
	Phase Locked Loop	
22	Basic phase-locked loop architecture	2
23	Voltage-controlled oscillator, divider	2
24	Phase detector, loop filer, the PLL in lock	2
	TOTAL	**36**

Course Designers:

- Dr K Hariharan, khh@tce.edu
- Dr V R Venkatasubramani, venthiru@tce.edu

22EC430	RF CIRCUIT DESIGN	Category	L	T	P	Credit	TE
		PCC	3	0	2	4	Theory

Preamble

The subject begins with the introduction of basic building blocks of the RF front-end and their functionalities from the perspective of mobile phone architecture. The microwave network analysis and its application were introduced in the second module. The third module covers the impedance matching between the interconnects and the terminating components/devices. The scattering parameter-based design and analysis of RF passive devices were given in fourth module. The final module provides stability criteria, design and analysis of active devices such as amplifiers and oscillators. The design theory is validated with the CAD simulation, fabrication and measurements in the laboratory.

Prerequisite

Nil

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Understand the RF front-end blocks in a GSM cellular phone and the component behaviour at RF/Microwave frequencies	TPS2	70	70
CO2	Design and validate the lumped and distributed matching networks	TPS3	70	70
CO3	Design and validate Power divider and Coupler	TPS3	70	70
CO4	Design and validate Filters for GSM frequencies	TPS3	70	70
CO5	Design and develop linear amplifier for the GSM applications	TPS3	70	70
CO6	Design an oscillator for the given specifications	TPS3	70	70

Mapping with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	M	L		-	-	-	-	L	L	L	-	L	L	-	L
CO2	S	M	L	-	M	-	-	L	L	L	-	L	M	L	L
CO3	S	M	L	-	M	-	-	L	L	L	-	L	M	L	L
CO4	S	M	L	-	M	-	-	L	L	L	-	L	M	L	L
CO5	S	M	L	-	M	-	-	L	L	L	-	L	M	L	L
CO6	S	M	L	-	M	-	-	L	L	L	-	L	M	L	L

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I			Assessment – II			Terminal Exam (%)		
	CAT – I (%)			CAT – II (%)					
TPS / CO	1	2	3	1	2	3	1	2	3
CO1	-	20	-	-	-	-	-	6	-
CO2	-	10	30	-	-	-	-	2	16
CO3	-	10	30	-	-	-	-	4	16
CO4	-	-	-	-	10	20	-	2	16
CO5	-	-	-	-	15	20	-	4	16
CO6	-	-	-	-	15	20	-	2	16
Total	-	**40**	**60**	**-**	**40**	**60**	-	**20**	**80**

Psychomotor Skill	Practical
Perception	-
Set	-
Guided Response	-
Mechanism	100
Complex Overt Responses	-
Adaptation	-
Origination	-

Syllabus

Introduction: RF front-end blocks and functionalities in mobile phone, microwave sources and waveguides, EM Spectrum, RF/Microwaves versus DC and Low AC signals, behaviour of electronic components at microwave frequencies. [5]

Microwave Network Analysis: S-parameters, ABCD parameters – examples. [3]

Matching Networks: Lumped and Single stub matching – LC matching, Stub matching - Series and Shunt type. [6]

RF Passive Devices: Power dividers: Properties of dividers, Design of equal and un-equal power divider. Couplers: Properties of couplers, Design of Quadrature hybrid couplers and Rat-race coupler. Filters: Filter parameters and types, Filter design by insertion loss method, Butterworth filter transformations - Design of lumped and stepped impedance filters. [12]

RF Active Devices: RF/Microwave Linear Amplifiers: Amplifier parameters, transistor topologies, Stability criterion, Design of maximum gain amplifier (MGA) design, Gain-bandwidth product, Gain and Power budget analysis. **Oscillators:** Oscillator versus amplifier design, Condition of stable oscillations, One-port negative resistance oscillator design. [10]

Practical:

- Design and synthesis of planar transmission lines [2 Hours]
- Design & Simulation of L-section matching [2 Hours]
- Design & Simulation of Single-Stub matching [2 Hours]
- Design & Simulation of equal and un-equal power divider [2 Hours]
- Design & Simulation of Quadrature hybrid couplers and Rat-race coupler [4 Hours]
- Design & Simulation of Lumped and Distributed low pass filter [4 Hours]
- Design & Simulation of a linear amplifier [2 Hours]
- Study of Spectrum and Network analysers [2 Hours]
- PCB prototype fabrication and measurement of RF passive devices for GSM applications [4 Hours]

Text Book

- David M. Pozar, “Microwave Engineering”, John Wiley & Sons, Fourth Edition, 2015.
- Les Besser and Rowan Gilmore, “Practical RF circuit Design for Modern Wireless Systems- Passive circuits and Systems”, Vol.1, Artech House Publishers, Boston, London 2008.

Reference Books& web resources

- Matthew M. Radmanesh, "Radio frequency and Microwave Electronics Illustrated", Pearson Education Asia, 2001.
- G L Matthaei, L Young, and E M T Jones, “Microwave filters, impedance matching networks and coupling structures”, Artech House, 1985.
- Dr. Grish Kumar, Microwave theory and techniques, NPTEL.

Course Contents and Lecture Schedule

Module No.	Topic	No.of Lectures	CO
1	**INTRODUCTION**		
1.1	RF front-end blocks and functionalities in mobile phone	1	CO1
1.2	microwave sources and waveguides, EM Spectrum, RF/Microwaves versus DC and Low AC signals	2	CO1
1.3	Behaviour of electronic components at microwave frequencies	2	CO1
2	**MICROWAVE NETWORK ANALYSIS**		
2.1	S-parameters, ABCD parameters – examples	3	CO2
3	**MATCHING NETWORKS**		
3.1	Lumped and Single stub matching – LC matching	3	CO2
3.2	Stub matching - Series and Shunt type	3	CO2
4	**RF PASSIVE DEVICES**		
4.1	Power dividers: Properties of dividers	1	CO3
4.2	Design of equal and un-equal power divider	3	CO3
4.3	Couplers: Properties of couplers, Design of Quadrature hybrid couplers and Rat-race coupler.	4	CO3
4.4	Filters: Filter parameters and types, Filter design by insertion loss method	1	CO4
4.5	Butterworth filter transformations - Design of lumped and stepped impedance filters	3	CO4
5	**RF ACTIVE DEVICES**		
5.1	RF/Microwave Linear Amplifiers: Amplifier parameters, transistor topologies, Stability criterion	3	CO5
5.2	Design of maximum gain amplifier (MGA) design, Gain-bandwidth product, Gain and Power budget analysis	3	CO5
5.3	Oscillators: Oscillator versus amplifier design, Condition of stable oscillations	2	CO6
5.4	One-port negative resistance oscillator design	2	CO6
	Total	**36**	

Practical Sessions			
3.1	Design and synthesis of planar transmission lines	2	CO2
3.2	Design & Simulation of L-section matching	2	CO2
3.3	Design & Simulation of Single-Stub matching	2	CO2
4.1	Design & Simulation of equal and un-equal power divider	2	CO3
4.2	Design & Simulation of Quadrature hybrid couplers and Rat-race coupler	4	CO3
4.3	Design & Simulation of Lumped and Distributed low pass filter	4	CO4
5.1	Design & Simulation of a linear amplifier	2	CO5
5.2	Study of Spectrum and Network analysers	2	CO2,CO3,CO4,CO5
5.3	PCB prototype fabrication and measurement of RF passive devices for GSM applications	4	CO2,CO3,CO4
Total		**24**	

Course Designers:

- Dr.B.Manimegalai naveenmegaa@tce.edu
- Dr.S.Kanthamani skmece@tce.edu
- Dr.K.Vasudevan kvasudevan@tce.edu

22EC440	MICROCONTROLLER AND EMBEDDED SYSTEM

Category	L	T	P	Credit	TE
PCC	3	0	2	4	Theory

Preamble

This course on Microcontrollers and Embedded Systems provides an in-depth understanding of the architecture, programming, and interfacing of microcontrollers and embedded systems. Students will learn the fundamental concepts of microcontroller-based system design, including the basics of assembler, compilers, and interpreters, data types, syntax, preprocessors, and debugging techniques. The course also covers the organization and mapping of memory in ARM-based embedded systems, communication protocols, GPIOs, timers, and ADC and DAC peripherals. Practical programming skills in developing and debugging programs for embedded systems using 8051 and ARM microcontrollers will be emphasized. By the end of the course, students will be equipped with the knowledge and skills to design and develop efficient and effective embedded systems.

Prerequisite

Nil

Course Outcomes

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

CO	Course Outcome	TCE Proficiency Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Understand the architecture of microcontrollers, including internal and external memory, registers, and instruction sets.	TPS2	70	70
CO2	Apply the basics of assemblers, compilers, interpreters, and debugging techniques, and apply this knowledge to write efficient and effective code in C for embedded systems.	TPS3	70	70
CO3	Understand the architecture of ARM microcontrollers, including general purpose and special registers, exceptions, interrupts, and stack operations.	TPS2	70	70
CO4	Apply the knowledge of ARM system design to develop programs for ARM-based embedded systems and interface with peripherals such as GPIOs, timers, ADC, and DAC.	TPS3	70	70
CO5	Apply knowledge of synchronous and asynchronous communication, as well as UART, SPI, I2C, and CAN, to develop programs for embedded systems that involve communication peripherals.	TPS3	70	70
CO6	Apply interrupt handling and embedded system programming for reliable and efficient firmware development in microcontroller-based systems.	TPS3	70	70

Mapping with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O2
CO1	M	L		-	-	-	-	M	M	L	L	L	L	-	L
CO2	S	M	L	L	-	L	-	M	M	L	L	L	M	L	L
CO3	M	L	L	-	S	-	-	M	M	L	L	L	L	L	L
CO4	S	M	L	L	S	L	-	M	M	L	L	L	M	L	L
CO5	S	M	L	L	-	L	-	M	M	L	L	L	M	-	L
CO6	S	M	L	L	-	L	-	M	M	L	L	L	M	-	L

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I			Assessment - II			Terminal Exam (%)		
	CAT – I (%)			CAT – II (%)					
TPS / CO	1	2	3	1	2	3	1	2	3
CO1	-	20	-	-	-	-	-	20	-
CO2	-	20	20	-	-	-	-	-	20
CO3	-	20	20	-	-	-	-	20	-
CO4	-	-	-	-	30	15	-	-	20
CO5	-	-	-	-	30	15	-	-	15
CO6	-	-	-	-		10	-	-	5
Total	-	**60**	**40**	**-**	**60**	**40**	**-**	**40**	**60**

Psychomotor Skill	Practical
Perception	-
Set	-
Guided Response	-
Mechanism	100
Complex Overt Responses	-
Adaptation	-
Origination	-

Syllabus

8051 Microcontroller Architecture: Introduction and Overview of microprocessor and microcontrollers. Internal architecture and registers. Internal and External memory. Instructions sets and Addressing modes. Interrupts and Peripherals: GPIOs, Timers. UART. Applications of microcontrollers. Interface Programming [10]

Embedded C programming: Assembler, Compilers and interpreter. Data types and its syntax, preprocessors. IDE and refereeing to its manuals. Startup code. Continuous while loop. Accessing of internal, external memory of code and data memory. Look up tables. Debugging techniques. Build system [4]

ARM-Microcontroller: Thumb-technology and applications of ARM, Architecture of ARM Evolution of ARM. General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence. Instruction set and CMSIS and HAL Library. Programming concepts [7]

ARM Embedded system and Interfacing: ARM system design, Memory organization and memory mapping. AMBA Bus architecture protocols. Peripherals GPIOs, Timers with various modes of operation. Accessing ADC and DAC [8]

Communication Peripherals: Introduction to synchronous and Asynchronous communication. UART with RS232 and RS485 signal scheme, SPI, I2C and CAN. Interrupt handling and Embedded system programming [7]

Practical:

1. Programming in cross compiler Keil for 8051microcontroller (CO2)
   - Assembling and simulating an ASM code for accessing GPIO and external memory
   - Develop the user define a function to a switch connected in PORT1 and outputting the data to the LEDs connected in PORT0 using appropriate argument and return type
   - Methods to invoke breakpoints and step-by-step execution of the code
   - Calculating the delay for the given clock frequency
2. Embedded C programming in cross-compiler Keil for 8051 microcontrollers (CO2)
   - Compiling and simulating the embedded C code for performing the computation like root of the equation, and performing convolution operation.
   - An arithmetic computation
   - Methods to invoke break points and step by step execution of the C code
   - Calculating the delay for the given clock frequency
3. Developing the C program for accessing GPIO and Timer peripherals in 8051 boards (CO2)
   - Develop a user function for a software delay “SoftDelay_ms(no of milli-seconds)” and use this function for blinking the LEDs in Port 0
   - Plot the error in the delay function when the argument changes from 1 to 1000 in the order of 100
   - Develop a user function for a hardware delay “HardDelay_ms(no of milli-seconds)” and use this function for blinking the LEDs in Port 0
   - Plot the error in the delay function when the argument changes from 1 to 1000 in the order of 100
4. Invoking interrupt services in the Embedded C programming and to realize it in 8051/ARM target board (CO6)
   - Control the LEDs in PORT-0 by the external interrupts INT0 and INT1
   - Blink the LEDs using a Timer peripheral interrupt which runs periodic time of intervals
5. Establishing serial communication between target board and computer (CO4)
   - Develop a user function in the C code for serial transmission with a defined baud rate to transmit a character and a string as an argument. Use interrupt-driven and polling methods
   - Develop a user function in the C code for serial reception with a defined baud rate to transmit a character and a string as an argument. Use interrupt-driven method
6. Accessing analog signal into the 8051/ARM system through ADC (CO4)
   - Develop the C code for accessing external ADC through parallel or serial communication and show the result in LEDs or in serial transmission
   - Access the ADC and display the sent data to LEDs
   - Show the analog input data in CRO
7. Design a setup for a display system to display the data in 7 segment LED (CO5)
   - Develop the LUT for 7 segment pattern to display the list of characters including blank
   - The Number X is displayed and incremented up to 9 for every period of time and it is updated in a single display
   - The number X range from 0 to 9999 is displayed for every period of time and it is updated in a single display. BCD conversion is done before displaying
   - For all the above objective\, user defined function is required
8. Design a display system to display the numbers and characters in LCD module (CO5)
   - Develop a function to display the array of stored alpha numeric string in LCD module
   - The arguments are needed to control the display position and clear the LCD
   - The text sent by PC is displayed in LCD module in 8051 target board

Text Book

- "The 8051 Microcontroller and Embedded Systems Using Assembly and C" by Muhammad Ali Mazidi, Rolin D. McKinlay, and Janice G. Mazidi
- ARM System Developer's Guide Designing and Optimizing System Software Andrew N. Sloss Dominic Symes Chris Wright. ELSEVIER inc 2005.

Reference Books& web resources

- https://www.nxp.com/docs/en/data-sheet/LPC1769_68_67_66_65_64_63.pdf
- NPTEL Video Lecture on "Microprocessor and Microcontroller", weblink: https://onlinecourses.nptel.ac.in/noc19_ee11/course
- Virtual Lab on "Real Time Embedded System", weblink: https://nptel.ac.in/courses/108102045/24

Course Contents and Lecture Schedule

#	Topic	No. of Lectures	CO
1	**8051 Microcontroller Architecture**		
1.1	Introduction and Overview of microprocessor and microcontrollers.	2	CO1
1.2	Internal architecture and registers. Internal and External memory.	2	CO1
1.3	Instructions sets and Addressing modes.	2	CO1
1.4	Interrupts and Peripherals: GPIOs, Timers. UART.	2	CO1
1.5	Applications of microcontrollers. Interface Programming	2	CO1
2	**Embedded C programming**		
2.1	Assembler, Compilers and interpreter. Data types and its syntax, preprocessors.	1	CO2
2.2	IDE and refereeing to its manuals. Startup code. Continuous while loop.	1	CO2
2.3	Accessing of internal, external memory of code and data memory. Look up tables. Debugging techniques. Build system	2	CO2
3	**ARM-Microcontroller**		
3.1	Thumb-technology and applications of ARM, Architecture of ARM Evolution of ARM.	2	CO3
3.2	General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence.	2	CO3
3.3	Instruction set and CMSIS and HAL Library.	2	CO3
3.4	Programming concepts	1	CO3
4	**ARM Embedded system and Interfacing**		
4.1	ARM system design, Memory organization and memory mapping.	2	CO4
4.2	AMBA Bus architecture protocols.	2	CO4
4.3	Peripherals GPIOs, Timers with various modes of operation.	2	CO4
4.4	Accessing ADC and DAC	2	CO4
5	**Communication Peripherals**		
5.1	Introduction to synchronous and Asynchronous communication.	2	CO5
5.2	UART with RS232 and RS485 signal scheme programming	2	CO5
5.3	SPI, I2C and CAN	2	CO5
5.4	Interrupt handling and Embedded system	1	CO6
	Total	**36**	
Practical			
6	Programming in cross compiler Keil for 8051microcontroller	**3**	CO2
7	Embedded C programming in cross-compiler Keil for 8051 microcontrollers	**3**	CO2
8	Developing the C program for accessing GPIO and Timer peripherals in 8051 boards	**3**	CO2
9	Invoking interrupt services in the Embedded C programming and to realize it in 8051/ARM target board	**3**	CO6

10	Establishing serial communication between target board and computer	**3**	CO5
11	Accessing analog signal into the 8051 system through ADC	**3**	CO4
12	Design a setup for a display system to display the data in 7 segment LED	**3**	CO5
13	Design a setup for a display system to display the numbers and characters in LCD module	**3**	CO5
Total		**24**	

Course Designers:

- Dr.K.Hariharan khh@tce.edu
- Dr.G.Prabhakar gpece@tce.edu

22EC450	DISCRETE TIME SIGNAL PROCESSING	Category	L	T	P	Credit	TE
		PCC	3	0	2	4	Theory

Preamble

Signal Processing is the field that deals with use of digital computers and processors to perform a wide variety of operations to alter and process digitally recorded signals. In this course, both an in-depth and an intuitive understanding of the theory behind modern discrete-time signal processing systems and applications are provided. This course lays down foundation to be able to gain understanding of specialized courses like speech signal processing, image processing, radar signal processing and data analysis. Further, in practical session, hands on training are given to the students in understanding the theory of signals and systems and practicing the algorithms used in discrete time signal processing.

Prerequisite

Nil

Course Outcomes

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

CO#	Course Outcomes	TPS Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Determine the frequency domain representation of aperiodic discrete time signals.	TPS 3	70	70
CO2	Compute DFT and IDFT coefficients of a given discrete time sequence using Fast Fourier Transform algorithms	TPS 3	70	70
CO3	Design FIR and IIR filters for the given specifications using Window method and bilinear transformation & impulse invariant techniques respectively	TPS 3	70	70
CO4	Design FIR and IIR filters based on pole-zero placements in z-domain	TPS 3	70	70
CO5	Draw the implementation structure of FIR and IIR discrete time systems using block diagram and signal flow graph representation.	TPS 3	70	70
CO6	Compute statistical parameters like mean, correlation and power spectral density of a given random variable or random processes at the output of LTI system	TPS 3	70	70
CO7	Apply sampling rate conversion and multi-rate signal processing in the digital domain based on the given application.	TPS 3	70	70

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	S	M	L	-	S	-	-	M	M	-	-	-	M	L	-
CO2	S	M	L	-	S	-	-	M	M	-	-	-	M	L	-
CO3	S	M	L	-	S	-	-	M	M	-	-	-	M	L	-
CO4	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-
CO5	S	M	L	-	S	-	-	M	M	-	-	-	M	L	-
CO6	S	M	L	-	S	-	-	M	M	-	-	-	M	L	-
CO7	S	M	L	-	S	-	-	M	M	-	-	-	M	L	-
Overall	S	M	L	-	S	-	-	M	M	-	-	-	M	L	-

S- Strong; M-Medium; L-Low

Assessment Pattern:

	Assessment - I			Assessment - II			Terminal Exam (%)		
	CAT – I (%)			CAT – II (%)					
TPS / CO	1	2	3	1	2	3	1	2	3
CO1	-	10	20	-	-	-	-	2	10
CO2	-	20	20	-	-	-	-	4	10
CO3	-	10	20	-	-	-	-	4	15
CO4	-	-	-	-	5	20	-	2	10
CO5	-	-	-	-	5	20	-	2	10
CO6	-	-	-	-	5	20	-	4	15
CO7	-	-	-	-	5	20	-	2	10
Total	-	**40**	**60**	**-**	**20**	**80**	**-**	**20**	**80**

Psychomotor Skill	Practical
Perception	-
Set	-
Guided Response	-
Mechanism	100
Complex Overt Responses	-
Adaptation	-
Origination	-

Syllabus

Fourier Analysis of Discrete-Time Signals: Discrete-time Fourier Transform (DTFT), Properties of DTFT, LTI discrete-time system analysis by DTFT **Discrete Fourier Transform (DFT):** Fourier representation of Finite duration sequences, Properties of DFT, Linear Convolution using DFT, Direct computation of the DFT, Decimation-in Time and Decimation in frequency FFT algorithms. **Discrete Time Filters:** Filter specifications, LTI Systems as frequency selective filters, Design of FIR filters by Windowing, Design of Discrete-Time IIR Filters from Continuous-Time Filters, Filter Design by Impulse Invariance, Bilinear Transformation, Design of Discrete-Time Butterworth Filter, Filter design based on Pole/zero: Linear Phase filter, Averaging filters, Comb Filters, Notch Filters, Resonators. **Structures for Discrete Time Systems** Basic Structures for IIR Systems: Direct Forms, Cascade Form, Parallel Form, Basic Network Structures for FIR Systems: Direct Form, Structures for Linear-Phase FIR Systems. **Random Signal Processing:** Random process: definition, stationary process, mean, correlation and covariance functions, ergodic process, transmission of random process through LTI systems, power spectral density, Gaussian process, noise, narrow band noise, noise reduction and signal enhancement, Optimum Linear filters: Wiener filter and linear prediction. **Multirate Signal Processing:** Review of Sampling theorem, Decimation, Interpolation, Sampling rate conversion by a rational factor I/D, Quadrature Mirror Filter, Polyphase Filter Structures.

Practical:

1. Time Domain response of LTI System (Convolution, Correlation)
2. Frequency response of LTI System (DTFT, z-Transform)
3. Fourier Analysis of Signals Using the Discrete Fourier Transform (DFT, FFT)
4. FIR Filter Design using windowing and frequency sampling methods
5. IIR Filter Design: Butterworth and Chebyshev filters
6. Filter design based on Pole-zero: Average Filter, Comb, Notch, Resonators
7. Random Signal Processing: Wiener filters, Linear Prediction

8. Random Signal Processing: Noise reduction and signal enhancement filter
9. Multirate Signal Processing: Decimation, Interpolation, Sampling rate conversion by I/D
10. Real Time Signal Processing Applications: Data acquisition using ADALM 1000
11. Real Time Signal Processing Applications: Filtering using DSP processor

Text Book

- Alan V.Oppenheim, Ronald W. Schafer, "Discrete time signal processing", Prentice Hall, Third Edition, 2010.
- John G.Proakis and Dimitris G.Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Prentice-Hall of India, Fourth Edition, 2006.

Reference Books& web resources

- Buck, Daniel, Singer, "Computer Explorations in Signals and Systems Using MATLAB", Prentice Hall, 2nd Ed., 2001.
- Vinay K. Ingle, John G.Proakis, "Digital Signal Processing using MATLAB" Cengage Learning, Third Edition, 2012.
- Woon-Seng Gan, Sen.M.Kuo, Embedded Signal Processing with Micro Signal Architecture, John Wiley Sons, 2007
- Richard Newbold, "Practical applications in Digital Signal Processing, Pearson Prentice Hall, 2012.
- https://archive.nptel.ac.in/courses/117/105/117105134/

Course Contents and Lecture Schedule

No.	Topic	Lecture Hours	COs
1	**Fourier Analysis of Discrete-Time Signals**		
1.1	Discrete-time Fourier Transform (DTFT)	1	CO1
1.2	Properties of DTFT	2	CO1
1.3	LTI discrete-time system analysis by DTFT	1	CO1
2	**Discrete Fourier Transform (DFT)**		
2.1	Fourier representation of Finite duration sequences	1	CO2
2.2	Properties of DFT	2	CO2
2.3	Linear Convolution using DFT, Direct computation of the DFT	1	CO2
2.4	Decimation-in Time and Decimation in frequency FFT algorithms.	2	CO2
3	**Discrete Time Filters**		
3.1	Filter specifications, LTI Systems as frequency selective filters	1	CO3
3.2	Design of FIR filters by Windowing	1	CO3
3.3	Design of Discrete-Time IIR Filters from Continuous-Time Filters	1	CO3
3.4	Filter Design by Impulse Invariance, Bilinear Transformation,	1	CO3
3.5	Design of Discrete-Time Butterworth Filter	1	CO3
3.6	Filter design based on Pole/zero: Linear Phase filter	2	CO4
3.7	Averaging filters, Comb Filters	2	CO4
3.8	Notch Filters, Resonators	1	CO4
4	**Structures for Discrete Time Systems**		
4.1	Basic Structures for IIR Systems: Direct Forms	1	CO5
4.2	Cascade Form, Parallel Form	1	CO5
4.3	Basic Network Structures for FIR Systems:	1	CO5
4.4	Direct Form, Structures for Linear-Phase FIR Systems	1	CO5
5	**Random Signal Processing**		
5.1	Random process: definition, stationary process, mean	1	CO6
5.2	correlation and covariance functions ergodic process	1	CO6

5.3	transmission of random process through LTI systems, power spectral density	1	CO6
5.4	Gaussian process, noise, narrow band noise	2	CO6
5.5	noise reduction and signal enhancement	1	CO6
5.6	Optimum Linear filters: Wiener filter and linear prediction.	2	CO6
6	**Multirate Signal Processing**		
6.1	Review of Sampling theorem, Decimation	1	CO7
6.2	Interpolation, Sampling rate conversion by a rational factor I/D	1	CO7
6.3	Quadrature Mirror Filter	1	CO7
6.4	Polyphase Filter Structures	1	CO7
	Total Hours	**36**	
Practical Sessions			
1	Time Domain response of LTI System (Convolution, Correlation)	2	CO1
2	Frequency response of LTI System (DTFT, z-Transform)	2	CO1
3	Fourier Analysis of Signals Using the Discrete Fourier Transform (DFT, FFT)	2	CO2
4	FIR Filter Design using windowing and frequency sampling methods	2	CO3
5	IIR Filter Design: Butterworth and Chebyshev filters	2	CO3
6	Filter design based on Pole-zero: Average Filter, Comb, Notch, Resonators	2	CO4
7	Random Signal Processing: Wiener filters, Linear Prediction	2	CO6
8	Random Signal Processing: Noise reduction and signal enhancement filter	2	CO6
9	Multirate Signal Processing: Decimation, Interpolation, Sampling rate conversion by I/D	2	CO7
10	Real Time Signal Processing Applications: Data acquisition using ADALM 1000	2	CO7
11	Real Time Signal Processing Applications: Filtering using DSP processor	4	CO7
	Total Hours	**24**	

Course Designers:

1. Dr.S.J.Thiruvengadam sjtece@tce.edu
2. Dr.M.N.Suresh mnsece@tce.edu
3. Dr.P.G.S.Velmurugan pgsvels@tce.edu

22EC460	DATA SCIENCE

Category	L	T	P	Credit
ESC	2	0	0	2

Preamble

Data science is an interdisciplinary field that draws on skills from mathematics, computer science, and statistics. This course will enable students to learn the fundamental concepts circumventing data science, and its applications.

Prerequisite

NIL

Course Outcomes

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

CO#	Course Outcomes	TPS Scale	Expected Proficiency in %	Expected Attainment Level %
CO1	Describe the taxonomy of Data	TPS 2	70	70
CO2	Explore the current practices in Data Analytics	TPS 2	70	70
CO3	Identify the key roles for the Data Ecosystem	TPS 2	70	70
CO4	Identify the Key roles for a successful analytics project	TPS 2	70	70
CO5	Apply the Data Analytics Life Cycle components to data science projects.	TPS 3	70	70
CO6	Apply data preparation and modelling techniques to data science related problem specifications.	TPS 3	70	70

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	-	-	-	-	-	-	-	-	-	-	L	-	-
CO2	M	L	-	-	-	-	-	-	-	-	-	-	L	-	-
CO3	M	L	-	-	-	-	-	-	-	-	-	-	L	-	-
CO4	M	L	L	-	-	-	-	-	-	-		-	L		-
CO5	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-
CO6	S	M	L	-	-	-	-	-	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern

	Assessment - I						Assessment - II						Terminal Exam (%)		
	CAT – I (%)			Ass. I * (%)			CAT – II (%)			Ass. II * (%)					
TPS / CO	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
CO1	5	20		100			-	-	-	-			4	5	-
CO2	10	25					-	-	-	-			4	5	-
CO3	15	25					-	-	-	-			4	5	-
CO4	-	-	-				10	10		100			4	5	-
CO5	-	-	-	-			5	10	20				2	5	20
CO6	-	-	-	-			5	10	30				2	5	30
Total	30	70	-	100			20	30	50	100			20	30	50

Syllabus

Taxonomy of Data: Basics of Data Structures **-** Overview of Big Data –Introduction to analytics - Data Repositories. **Data Analytics**- Overview - Analytics in a Data Science Project - Key roles for a successful analytics project. **Data Analytics Life Cycle (DALC) –** Overview- Different phases in a DALC**. Phase I Discovery**- Learning the Business Domain, Resources, Framing the Problem, identifying key stakeholders, Interviewing the Analytics Sponsor, Developing initial hypotheses, Identifying potential data Sources. **Phase II-Data Preparation**- Preparing the analytic Sandbox, Performing ETLT, Learning about the data, Data conditioning,

Survey and Visualize data using common tools for the Data Visualization Phase. **Phase III-Model Planning-** Data exploration and variable selection, Model selection, Common tools for the model planning phase. **Phase IV-Model Building**- Common tools for the model building phase, **Phase V-Communicate Results, Phase VI-Operationalize.**

Reference Books

- Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data. Wiley., Dietrich, D., Heller, B., & Yang, B, Wiley, First Edition, 2015. (Chapters 1.0, 1.1, 1.2, 2.0, 2.1 - 2.7)
- Big Data: A Beginner's Guide to Using Data Science for Business, Eliot P. Reznor, CreateSpace Independent Publishing Platform, 2017.
- Data Analytics: A Practical Guide to Data Analytics for Business, Beginner to Expert, Fahl, J, CreateSpace Independent Publishing Platform, 2017.

Course Contents and Lecture Schedule

Module No.	Topic	Lecture Hours
1	**Taxonomy of Data**	
1.1	Basics of Data Structures	1
1.2	Overview of Big Data	1
1.3	Introduction to analytics	1
1.4	Data Repositories	1
2	**Data Analytics**	
2.1	Overview	1
2.2	Analytics in a Data Science Project	1
2.3	Key roles for a successful analytics project	1
3	**Data Analytics Life Cycle (DALC)**	
3.1	Overview	1
3.2	Different phases in a DALC	1
4	**Phase I Discovery**	1
4.1	Resources, Framing the Problem	1
4.2	Identifying key stakeholders	1
4.3	Interviewing the Analytics Sponsor	1
4.4	Developing initial hypotheses	1
4.5	Identifying potential data Sources	1
5	**Phase II-Data Preparation**	
5.1	Preparing the analytic Sandbox	1
5.2	Performing ETLT	1
5.3	Learning about the data, Data conditioning	1
5.4	Survey and Visualize data using common tools for the Data Visualization Phase.	1
6	**Phase III-Model Planning**	
6.1	Data exploration and variable selection	1
6.2	Model selection	1
6.3	Common tools for the model planning phase	1
7	**Phase IV-Model Building**	1
8	**Phase V-Communicate Results**	1
9	**Phase VI-Operationalize**	1
	Total	**25**

Course Designers:

- Dr S T Padmapriya stpca@tce.edu