Department of
Electronics and Computer Science

R21

Curriculum Structure & Syllabus

1st Semester to 8th Semester

(Effective from 2021-22 Admission Batch)

Curriculum Structure of ECS

Curriculum for B. Tech
Under Autonomy
Electronics & Computer Science
L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

First Year First Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science course	PH101	Physics-I	3	0	0	3	3
2	Basic Science course	M101	Mathematics –I	4	0	0	4	4
3	Humanities and Social Sciences including Management courses	HSMC101	Professional Communication	2	0	0	**2**	2
	B. PRACTICAL							
4	Basic Science course	PH191	Physics-I Lab	0	0	3	3	1.5
5	Engineering Science Courses	ME191	Workshop and Manufacturing Practices Lab	0	0	3	3	1.5
6	PROJECT	PR191	Theme based Project I	0	0	1	1	0.5
7	PROJECT	PR192	Skill Development I: Soft Skill	0	0	1	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
8	Mandatory Course	MC181	Induction Program	0	0	2	2	0
	TOTAL CREDIT							13.0

First Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science courses	CH201	Chemistry-I	3	0	0	3	3
2	Basic Science courses	M201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	EE201	Basic Electrical Engineering	3	0	0	3	3
4	Engineering Science Courses	CS201	Programming for Problem Solving	3	0	0	3	3
	B. PRACTICAL							
5	Basic Science course	CH291	Chemistry-I Lab	0	0	3	3	1.5
6	Humanities and Social Sciences including Management courses	HSMC291	Professional Communication LAB	0	0	2	2	1.0
7	Engineering Science Courses	EE291	Basic Electrical Engineering Lab	0	0	3	3	1.5
8	Engineering Science Courses	ME292	Engineering Graphics and Design Lab	0	0	3	3	1.5
9	Engineering Science Courses	CS 291	Programming for Problem Solving Lab	0	0	3	3	1.5
10	PROJECT	PR291	Theme based Project II	0	0	1	1	0.5
11	PROJECT	PR292	Skill Development II: Life Skill	1	0	0	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
12	Mandatory Course	MC281	NSS/Physical Activities / Meditation and Yoga / Photography	0	0	2	2	0
	TOTAL CREDIT							21

2nd Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Basic Science course	M(ECS) 301	Mathematics III	4	0	0	4	4
2	Engineering Science Courses	ECS301	Circuit Theory and Networks	3	0	0	3	3
3	Engineering Science Courses	ECS302	Analog and Digital Electronics	3	0	0	3	3
4	Program Core Course	ECS303	Computer Organization and Architecture	3	0	0	3	3
5	Program Core Course	ECS304	Optoelectronics	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC303	Universal Human Values 2: Understanding Harmony	3	0	0	3	3
B. PRACTICAL								
7	Engineering Science Courses	ES391	Numerical Method lab	0	0	3	3	1.5
8	Engineering Science Courses	ECS391	Circuits and Networks Lab	0	0	3	3	1.5
9	Engineering Science Courses	ECS392	Analog and Digital Electronics Lab	0	0	3	3	1.5
10	Program Core Course	ECS393	Computer Organization and Architecture Lab	0	0	3	3	1.5
11	PROJECT	PR391	Theme based Project III	0	0	1	1	0.5
12	PROJECT	PR392	Skill Development III: Technical Seminar Presentation	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC301	Environmental Science	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							26
D.MOOCS COURSES**								
14	MOOCS COURSES	HM301	MOOCS COURSE-I	1	3	1	4	4
TOTAL CREDIT WITH MOOCS COURSES								30

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

2nd Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Basic Science course	PH(ECS)401	Physics-II	3	0	0	3	3
2	PC	ECS401	Microprocessors and Microcontrollers	3	0	0	3	3
3	PC	ECS402	Operating System	3	0	0	3	3
4	PC	ECS403	Data Base Management System	3	0	0	3	3
5	PC	ECS404	Data structure and Algorithm	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC402	Gender Culture and Development	2	0	0	2	2
B. PRACTICAL								
7	Basic Science course	PH(ECS)491	Physics-II lab	0	0	2	2	1
8	PC	ECS491	Microprocessors and Microcontrollers Lab	0	0	3	3	1.5
9	PC	ECS492	Operating System Lab	0	0	3	3	1.5
10	PC	ECS493	Data Base Management System Lab	0	0	3	3	1.5
11	PC	ECS494	Data structure and Algorithm Lab	0	0	3	3	1.5
12	PROJECT	PR491	Theme based Project IV	0	0	1	1	0.5
13	PROJECT	PR492	Skill Development IV: Soft Skill and Aptitude-I	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
14	MC	MC481	Learning an Art Form [vocal or instrumental, dance, painting, clay modeling, etc.] OR Environmental Protection Initiatives	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							25.0
D.MOOCS COURSES								
15	MOOCS COURSES	HM401	MOOCS COURSE-II	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**29.0**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

3rd Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC505	Principles of Management	2	0	0	2	2
2	PC	ECS501	Communication Engineering	3	0	0	3	3
3	PC	ECS502	Formal Language and Automata theory	3	0	0	3	3
4	PC	ECS503	Internet of Things and its Applications	3	0	0	3	3
5	PE	ECS504A	Object Oriented Programming with JAVA	3	0	0	3	3
		ECS504B	Information Theory and Coding					
		ECS504C	Sensors and Applications					
B. PRACTICAL								
7	PC	ECS591	Communication Engineering Lab	0	0	3	3	1.5
8	PC	ECS592	Compiler Design	0	0	3	3	1.5
9	PC	ECS593	Internet of Things Lab	0	0	3	3	1.5
10	PE	ECS594 A	Object Oriented Programming with JAVA	0	0	3	3	1.5
		ECS594B	Information Theory and Coding Lab					
		ECS594C	Sensors and Applications Lab					
11	PROJECT	PR591	Minor Project I	0	0	3	3	1
12	PROJECT	PR592	Skill Development V: Soft Skill and Aptitude-II	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
14	MC	MC501	Constitution of India	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							21.5
D. MOOCS COURSES**								
15	MOOCS COURSES	HM501	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**25.5**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

3rd Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC604	Economics for Engineers	2	0	0	2	2
2	PC	ECS601	Computer Networking	3	0	0	3	3
3	PC	ECS602	Control System Engineering	3	0	0	3	3
4	PE	ECS603A	Industrial Automation	3	0	0	3	3
		ECS603B	Software Engineering					
		ECS603C	Python Programming					
5	PE	ECS604A	Machine Learning	3	0	0	3	3
		ECS604B	Optical and Satellite communication					
		ECS604C	Digital Signal Processing					
6	OE	ECS605A	Introduction to Data Science	3	0	0	3	3
		ECS605B	Introduction to Robotics					
		ECS605C	Soft Computing					
B. PRACTICAL								
7	PC	ECS691	Computer Networking Lab	0	0	3	3	1.5
9	PC	ECS692	Control System Engineering Lab	0	0	3	3	1.5
10	PE	ECS693A	Industrial automation Lab	0	0	2	2	1
		ECS693B	Software Engineering					
		ECS693C	Python Programming Lab					
11	PROJECT	PR691	Minor Project II	0	0	3	2	1
12	PROJECT	PR692	Skill Development VI: Soft Skill and Aptitude-III	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC601	Intellectual Property Right	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							22.5
D.MOOCS COURSES**								
14	MOOCS COURSES	HM601	MOOCS COURSE-IV	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**26.5**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

4th Year 1st Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours/Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PE	ECS701A	Embedded System Design	3	0	0	3	3
		ECS701B	Digital Image Processing					
		ECS701C	Cloud Computing					
2	PE	ECS702A	Quantum Computing	3	0	0	3	3
		ECS702B	Information theory and Coding					
		ECS702C	Wireless Sensor Network					
3	OE	ECS703A	Power Electronics	3	0	0	3	3
		ECS703B	Virtual Instrumentation					
		ECS703C	Artificial Intelligence					
4	OE	ECS704A	Electromagnetic Wave	3	0	0	3	3
		ECS704B	Cyber Law and Ethics					
		ECS704C	Cryptography and Network Security					
B. PRACTICAL								
5	PE	ECS791A	Embedded System Design Lab	0	0	0	3	1.5
		ECS791B	Digital Image Processing Lab					
		ECS791C	Cloud Computing Lab					
6	OE	ECS793A	Power Electronics Lab	0	0	2	2	1
		ECS793B	Virtual Instrumentation Lab					
		ECS793C	Artificial Intelligence Lab					
7	PROJECT	PR791	Major Project-I	0	0	0	4	2
8	PROJECT	PR792*	Industrial Training / Internship	0	0	0	0	1
9	PROJECT	PR793	Skill Development VII: Seminar and Group Discussion	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC781	Entrepreneurship and Innovation Skill	2	0	0	2	0
TOTAL CREDIT WITHOUT MOOCS COURSES								18
D.MOOCS COURSES**								
11	MOOCS COURSES	HM701	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**22**

***Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

4th Year 2nd Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PE	ECS801A	Real Time System	3	0	0	3	3
		ECS801B	Low power VLSI Design					
		ECS801C	Multimedia and Virtual Reality					
2	OE	ECS802A	MEMS Technology	3	0	0	3	3
		ECS802B	Simulation and Modelling					
		ECS802C	Biomedical Electronics					
3	OE	ECS803A	Mobile Communication	3	0	0	3	3
		ECS803B	Big Data Analytics					
		ECS802C	Nanoelectronics					
B. PRACTICAL								
4	PROJECT	PR891	Major Project-II	0	0	0	12	6
5	PROJECT	PR892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
8	MC	MC881	Essence of Indian Knowledge Tradition	2	0	0	2	0
TOTAL CREDIT								16

Total:

Total for ECS	
Without MOOCS	**With MOOCS**
34.0	**34.0**
26.0	**30.0**
25.0	**29.0**
21.5	**25.5**
22.5	**26.5**
18.0	**22.0**
16.0	**16.0**
163	**183 (for honors/minor)**

Credit Distribution

Subject Category	Subjects	Credit Distribution as per AICTE (%)	Suggested Breakup of Credits (Total 160) as per AICTE	
Humanities and Social Sciences including Management courses (HSMC)	**Humanities & Social Science:** (i)English (ii)Language / English Lab **Management courses** (i) Universal Human Values 2: Understanding Harmony (ii) Gender Culture and Development (iii) Principle of Management, (iv) Economics for Engineers	5 to 10%	**12**	**9+3** **5.63%**

Basic Sciences (BS)	**Physics** (i)Introduction to Electromagnetic Theory (ii)Introduction to Mechanics (iii)Quantum Mechanics for Engineers (iv)Oscillation, Waves and Optics (v)Semiconductor Optoelectronics (vi)Semiconductor Physics	**15 to 20%**	**25**	**25** **15.00%**
	Chemistry & Biology (i)Chemistry – I (Concepts in chemistry for engineering) (ii)Chemistry Laboratory **Elective Courses** (i)Chemistry-II (Chemical Applications) (ii)Polymer Chemistry (iii)Experiments in Polymer Chemistry **Biology**			
	Mathematics **(i)Mathematics (Option 1)** Mathematics 1 Mathematics 2 Mathematics 3			
Engineering Sciences and Skills (ES)	(i)Workshop / Manufacturing Practice (ii)Drawing / Engineering Graphics & Design, (iii)Basics of Electrical (iv)Computer / Programming for Problem Solving (v)Numerical Methods (vi)Circuit theory	15 to 20%	**24**	**22.5** **14.06%**
Professional core courses (PC)	Courses relevant to chosen branch	30 to 40%	**48**	**48.0** **30.37%**
Professional Elective (PE)	Elective courses relevant to chosen specialization/branch	10 to 15%	**18**	**22** **13.80%**
Open Elective(OE)	Elective Courses from other technical programs and /or emerging subjects:	5 to 10%	**18**	**16** **10.00%**

	1. Artificial Intelligence 2.Introduction to Data Science 3. Introduction to Robotics 4. MEMS Technology 5. Simulation and Modelling 6. Biomedical Electronics 7. Mobile Communication 8. Big Data Analytics 9. Nanoelectronics 10. Power Electronics 11. Virtual Instrumentation 12. Electromagnetic Wave 13. Cyber Law and Ethics 14. Cryptography and Network Security 15.Soft Computing			
Project work, seminar and internship in industry or elsewhere	(i)PROJECT (PR….91): Project work (ii)PROJECT (PR….92): (iii) PROJECT (PR …93): (iv)Grand Viva - 1	10 to 15%	**15**	**17.5** **10.94%**
Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]	**MC Courses:** (i)Environmental Science, (ii)Foreign language, (iii)Constitution of India (iv)Behavioral & Interpersonal skills (v)Essence of Indian Knowledge Tradition **& Others as mentioned in AICTE guidelines** **MC Activities:** (i)Induction Programming (ii)NSS/NCC/Yoga (iii)Technical Lecture Presentation **& Others as mentioned in AICTE guidelines**	**No Credit Course**	Minimum 2 units per semester min. Max: 28 Units/Program	

Summary

Sub	Credit	%	AICTE %
HSMC	9	5.63	5to10
BSHU	25	15.62	15to20
ES	22.5	14.06	15to20
PC	48	30.00	30to40
PE	22	13.75	10to15
OE	16	10.00	5to10
Project	17.5	10.94	10to15
	160	100.00	

Professional Electives (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)			
	Option 1	**Option 2**	**Option 3**
Professional Elective I	Object Oriented Programming with JAVA	Information Theory and Coding	Sensors and Applications
Professional Elective II	Industrial Automation	Introduction to IoT	Python Programming
Professional Elective III	Artificial Intelligence	Optical and Satellite communicatio n	Digital Signal Processing
Professional Elective IV	Embedded System Design	Digital Image Processing	Cloud Computing
Professional Elective V	Quantum Computing	Information theory and Coding	Wireless Sensor Network
Professional Elective VI	Real Tme System	Low power VLSI Design	Multimedia and Virtual Reality

Open Electives (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)			
	Option 1	**Option 2**	**Option 3**
Open Elective I	Introduction to Data Science	Introduction to Robotics	Soft Computing
Open Elective II	Power Electronics	Virtual Instrumentation	Artificial Intelligence
Open Elective III	Electromagnetic Wave	Cyber Law and Ethics	Cryptography and Network Security
Open Elective IV	MEMS Technology	Simulation and Modelling	Biomedical Electronics
Open Elective V	Mobile Communication	Big Data Analytics	Nanoelectronics

Proposed Honors courses:

Sl. No.	Option 1
1.	Artificial Intelligence and Machine Learning
2.	Internet of Things (IoT)

Proposed minor Courses:

Sl. No.	Option 1
1.	VLSI Design
2.	Data Science

MOOCs (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)						
	Sem	Credit	Option 1	Option 2	Option 3	Option 4
MOOCS COURSE-I	III	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-II	IV	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-III	V	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-IV	VI	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-V	VII	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors

**Please define your Honors/Minor programme credit point of 20 to be earned by the student. Related BOS would endorse the selection of these courses followed by the necessary intimation at the Academic Council of the Institute.

Syllabus of ECS

First Year First Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	D. THEORY			L	T	P	Total	
1	Basic Science course	PH101	Physics-I	3	0	0	3	3
2	Basic Science course	M101	Mathematics –I	4	0	0	4	4
3	Humanities and Social Sciences including Management courses	HSMC101	Professional Communication	2	0	0	**2**	2
	E. PRACTICAL							
4	Basic Science course	PH191	Physics-I Lab	0	0	3	3	1.5
5	Engineering Science Courses	ME191	Workshop and Manufacturing Practices Lab	0	0	3	3	1.5
6	PROJECT	PR191	Theme based Project I	0	0	1	1	0.5
7	PROJECT	PR192	Skill Development I: Soft Skill	0	0	1	1	0.5
	F. MANDATORY ACTIVITIES / COURSES							
8	Mandatory Course	MC181	Induction Program	0	0	0	2	0
	TOTAL CREDIT							13.0

PAPER NAME: PHYSICS –I
PAPER CODE: PH101
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisites: Knowledge of Physics up to 12th standard.

Course Outcomes (COs):

After attending the course students' should be able to

CO1: describe various types of mechanical resonance and its electrical equivalence

CO2: explain basic principles of Laser, Optical fibers and Polarization of light

CO3: apply superposition principle to explain interference and diffraction

CO4: analyze different crystallographic structures according to their co-ordination number and packing factors

CO5: justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics

Course Content:

Module 1 (5L) :-
Waves & Oscillations:-
Simple Harmonic Motion (Recap), superposition of waves, damped harmonic motion-over damped, critically damped and under damped motion, energy decay, logarithmic decrement, force vibration and resonance (amplitude, velocity resonance), sharpness of resonance, quality factor, related numerical problems. 5L

Module 2 (12L):-
Classical Optics:
2.01- Interference of light: Huygens's principle, conditions of sustained interference, classification of interference, Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, related numerical problems. 4L

2.02- Diffraction of light: Fresnel and Fraunhofer class, Fraunhoffer diffraction of a single slit, double slit, multiple slits, intensity distributions, missing order, Rayleigh criterion (no deduction) and resolving power of grating and microscope (no deduction), related numerical problems.

4L

2.03- Polarization: Definition, Plane of polarization, Plane of vibration, Malus Law, Fundamental concepts of plane, circular & elliptical polarizations (only qualitative idea) with examples, Brewster's law, Double refraction: Ordinary & Extra ordinary rays, positive and negative crystal, Nicol's prism, Numerical problems 4L

Module 3 (8L):-
Quantum Mechanics-I
3.01 Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment. 4L

3.02 Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions; uncertainty principle, relevant numerical problems. Introduction of Schrödinger wave equation (only statement). 4L

Module 4 (3L):-
Solid State Physics-I:
4.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems. 3L

Module 5 (8L):
Modern Optics-I:
5.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems. 5L

5.02-Fibre optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle, Basic concept of losses in optical fiber, related numerical problems. 3L

Recommended Text Books for Physics I (PH 101):

Waves & Oscillations:

1. Sound-N. K. Bajaj (TMH)
2. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
3. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
4. A text book of sound-M. Ghosh (S. Chand publishers)
5. A text book of Light- K.G. Mazumder & B.Ghoshs, (Book & Allied Publisher)
6. Physics of Oscillations and Waves- R.P. Singh
7. College Physics Vol. II - A.B. Gupta
8. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:

1. A text book of Light- K.G. Mazumder & B.Ghoshs (Book & Allied Publisher)
2. A text book of Light-Brijlal & Subhramanium, (S. Chand publishers)
3. Modern Optics-A. B. Gupta (Book & Allied Publisher)
4. Optics-Ajay Ghatak (TMH)
5. Optics-Hecht
6. Optics-R. Kar, Books Applied Publishers
7. Physical Optics Möler

8. Optics -F.A. Jenkins and H.E White

Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
2. Quantum Mechanics-Bagde and Singh (S. Chand Publishers)
3. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)
4. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
5. Quantum Mechanics-Bransden (Pearson Education Ltd.)
6. Perspective of Modern Physics-A. Beiser (TMH)
7. Quantum mechanics -A.K. Ghatak and S Lokenathan
8. Modern Physics -E.E. Anderson
9. Physics Volume 2 -Haliday, Resnick & Krane, Published by Wiley India

Solid State Physics-I:

1. Solid state physics-Puri & Babbar (S. Chand publishers)
2. Materials Science & Engineering-Kakani Kakani
3. Solid state physics- S. O. Pillai
4. Introduction to solid state physics-Kittel (TMH)
5. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)
6. Problem in Solid state physics -S.O. Pillai (a. b.)

Text Books:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.
5. Basic Engineering Physics-Sujoy Bhattacharya, Saumen Pal (MG)
6. Engineering Physics (Vol. 1, Vol. 2)-S.P. Kuila (S. Chand Publishers)
7. Engineering Physics-A. S. Vasudeva

**Total marks of the questions set from each module should be in proportion to the number of lectures allotted.

Project Domains

1. Study of Superposition of waves: Lissajous figures.

2. Electrical analogue of mechanical vibrations: application to electrical circuit (LC and LCR circuits), Electrical and mechanical impedance, quality factor, complex representation and phasor diagram.

3. Study of N-slit diffractions

4. Optical Fiber & its applications: Study of losses, estimation of numerical aperture in practical problems.

5. Photonic nature of electromagnetic waves

6. Optical Rotation

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2
CO4	2	3	-	-	-	-	-	-	-	-	-	2
CO5	2	3	-	-	-	-	-	-	-	-	-	2

COURSE NAME: MATHEMATICS-I
COURSE CODE: M101
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48
CREDITS: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra, calculus, and vector algebra.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to

CO1: Recall the properties and formula related to matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series.

CO2: Determine the solutions of the problems related to matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series.

CO3: Apply the appropriate mathematical tools of matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series for the solutions of the problems.

CO4: Analyze different engineering problems linked with matrix algebra, differential calculus, multivariable calculus, vector calculus.

Course Content:

Module I: Matrix Algebra **11L**

Echelon form and Normal (Canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton theorem.

Module II: Differential Calculus and Infinite Series **10L**

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Tests for convergence of infinite series: Comparison test, D'Alembert's ratio

test, Raabe's test, Cauchy's root test, Leibnitz's Test, Power series; Taylor's series, Series for exponential, trigonometric and logarithm functions.

Module III: Multivariable Calculus (Differentiation) 13L

Function of several variables, Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; Chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function, Jacobian. Maxima and minima of functions of two variables, Method of Lagrange multipliers.

Module IV: Multivariable Calculus (Integration) 6L

Line Integral, Double Integral, Triple Integral,Change of order in multiple integrals, Change of variables in multiple integrals.

Module V: Vector Calculus 8L

Gradient, Directional derivatives, Divergence, Curl, vector line integrals, vector surface integrals, vector volume integrals, Green's theorem, Gauss divergence theorem and Stokes' theorem.

Project Domain:

1. Study on eigenvalues and eigenvectors.
2. Study on convergence of infinite series.
3. Application of partial derivatives.
4. Application of vector calculus
5. Application of integral calculus.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
6. Samanta Guruprasad, A text book of Engineering Mathematics-I, New age International Publishers

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
3. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
4. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
6. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	-	-	-	-	-	-	-	-	2
CO4	2	3	2	2	-	-	-	-	-	-	-	2

COURSE NAME: PROFESSIONAL COMMUNICATION
COURSE CODE: HSMC101
CONTACT: 2:0:0
TOTAL CONTACT HOURS: 24
CREDITS: 2

Pre-requisites: Basic (10+2) level of knowledge of English grammar, vocabulary reading and writing skills.

Course Outcomes (COs):

After attending the course students' should be able to

CO1: apply the modalities and nuances of communication in a workplace context.

CO2: analyze communication across cultures and societies.

CO3: apply the basic formats, templates of business and official communication.

CO4: employ formal communication modes in meetings and reports.

CO5: justify importance of culturally neutral language in interpersonal and business communication.

Course Content:

Module- 1: Verbal and Non-verbal communication **4L**

1.1: Definition, Relevance and Effective Usage
1.2: Components of Verbal Communication: Written and Oral Communication
1.3: Components of Non-verbal Communication: Kinesics, Proxemics, Chronemics, Haptics Paralanguage
1.4: Barriers to Effective Communication

Module- 2: Social Communication Essentials and Cross-Cultural Communication **6L**

2.1: Communication in Society and the Workplace
2.2: Greetings, Courtesies and Socially Useful Language
2.3: Cultural Contexts: High Context and Low Context Cultures
2.4: Understanding Cultural Nuances and Stereotyping
2.5: Achieving Culturally Neutral Communication in Speech and Writing

Module- 3: Meetings **4L**

3.1: Meetings: Nature and Types
3.2: Conducting Meetings: Organization and Procedures
3.3: Meeting Coordination: Roles of Chairpersons and Members
3.4: Notice and Agenda for a Meeting
3.5: Preparing the Minutes of a Meeting (MOM)

Module- 4: Report Writing **4L**

4.1: Nature and Function of Reports
4.2: Types of Reports
4.3: Researching for a Business Report
4.4: Format, Language and Style
4.5: Report Documentation

Module 5: Employment Communication **6L**

5.1: Writing Business Letters- (Enquiry, Order, Sales, Complaint, Adjustment, Job Application, Offer)
5.2: Preparing a CV or Rẽsumẽ
5.3: Creating a Digital/Online Profile – LinkedIn (Résumé/Video Profile)
5.4: Writing E-mails: types, convention, and etiquette
5.5: Memo, Notices and Circulars
5.6: Writing Technicalities—Paragraphing, Sentence Structure and Punctuation

Text Books &Reference Books:

1. Meenakshi Raman and Sangeetha Sharma. *Technical Communication*. 3rd edition. New Delhi: Oxford University Press, 2015.
2. Mark Ibbotson. *Cambridge English for Engineering*. Cambridge: Cambridge University Press, 2008.
3. Mark Ibbotson. *Professional English in Use: Engineering*. Cambridge: Cambridge UP, 2009.
4. Lesikar et al. *Business Communication: Connecting in a Digital World*. New Delhi: Tata McGraw-Hill, 2014.
5. John Seeley. *Writing Reports*. Oxford: Oxford University Press, 2002.
6. Judith Leigh. *CVs and JobApplications*. Oxford: Oxford University Press, 2002.
7. Judith Leigh. *Organizing and Participating in Meetings*. Oxford: Oxford University Press, 2002.
8. Michael Swan. *Practical English Usage*. Oxford: OUP, 1980.
9. Pickett, Laster and Staples. *Technical English: Writing, Reading & Speaking.* 8th ed. London: Longman, 2001.
10. Diana Booher. *E-writing: 21st Century Tools for Effective Communication*.

Links:

1. Purdue University's Online Writing Lab (OWL)-https://owl.purdue.edu/
2. Business English Pod-https://www.businessenglishpod.com/

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	2	-	-	3	-	2
CO2	2	3	2	-	-	2	2	2	-	3	-	3
CO3	2	3	-	-	-	3	3	3	-	3	-	3
CO4	-	-	-	-	-	3	3	3	-	3	-	3
CO5	-	-	-	-	-	-	3	3	-	3	-	3

PAPER NAME: PHYSICS I LAB
PAPER CODE: PH191
CONTACT HOURS: 0:0:3
CREDIT: 1.5

Prerequisites: Knowledge of Physics up to 12th standard.

Course Outcomes (COs):

After attending the course students' will be able to

CO1 : demonstrate experiments allied to their theoretical concepts

CO2 : conduct experiments using LASER, Optical fiber, Torsional pendulum, Spectrometer

CO3 : participate as an individual, and as a member or leader in groups in laboratory sessions actively

CO4 : analyze experimental data from graphical representations , and to communicate effectively them in Laboratory reports including innovative experiments

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
ii) Proportional error calculation using Carrey Foster Bridge.

<u>Any 6 to be performed from the following experiments</u>

Experiments on Waves & Oscillations:
1. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.
2. Determination of elastic moduli of different materials (Young's modulus /Rigidity modulus)
3. Determination of Q factor using LCR Circuit.
4. Calibration of an oscillator using Lissajous Figure.

Experiments on Classical Optics:
5. Determination of wavelength of light by Newton's ring method.
6. Determination of wavelength of light by Laser diffraction method.
7. To determine the angle of optical rotation of a polar solution using polarimeter

Experiments on Quantum Physics-I:
8. Determination of Planck's constant using photoelectric cell.
9. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
10. Determination of Stefan's Constant

In addition it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment

Probable experiments beyond the syllabus:
1. Determination of wavelength of light by Fresnel's bi-prism method (beyond the syllabus).
3. Study of dispersive power of material of a prism.
4. Study of viscosity using Poiseuille's capillary flow method/using Stoke's law.
5. Measurement of nodal and antipodal points along transmission wire and measurement of wavelength.
6. Any other experiment related to the theory**.**

Recommended Text Books for Physics I Lab (PH 291):

Waves & Oscillations:
1. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:
1. A text book of Light- K.G. Mazumder & B.Ghoshs (Book & Allied Publisher)

Quantum Mechanics-I
1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)

Solid State Physics-I:
1. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)

Text Books:
1. Practical Physics by Chatterjee & Rakshit (Book & Allied Publisher)
2. Practical Physics by K.G. Mazumder (New Central Publishing)
3. Practical Physics by R. K. Kar (Book & Allied Publisher)

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	2	2	-	3	-	-	-	-	-	-	-	2
CO3	2	2	-	-	-	-	-	-	3	-	-	2
CO4	2	2	-	-	-	-	-	-	-	3	-	2

COURSE NAME: WORKSHOP AND MANUFACTURING PRACTICES
COURSE CODE: ME191
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisite: Higher Secondary with Mathematics, Physics and Chemistry.

Course Outcomes (COs):

After completion of this course students will be able to

CO1: Identify and operate various hand tools related to variety of manufacturing operations

CO2: Safely fabricate simple components with their own hands.

CO3: Get practical knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes.

CO4: Produce small devices of their interest in project or research purpose.

Course Content:

(i) Theoretical discussion & videos:
3P

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing
8. Plastic moulding& Glass Cutting

(ii) Workshop Practice:

Module 1 - Machine shop **6P**

Typical jobs that may be made in this practice module:
i. To make a pin from a mild steel rod in a lathe.
ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

Module 2 - Fitting shop **6P**

Typical jobs that may be made in this practice module:
i. To make a Gauge from MS plate.

Module 3 - Carpentry **6P**

Typical jobs that may be made in this practice module:
i. To make wooden joints and/or a pattern or like.

Module 4 - Welding shop (Arc welding 3P + gas welding 3P)
3P

Typical jobs that may be made in this practice module:
i. ARC WELDING (3P): To join two thick (approx 5mm) MS plates by manual metalarcwelding.
ii. GAS WELDING (3P): To join two thin mild steel plates or sheets by gas welding.

Module 5 - Electrical & Electronics **3P**
House wiring, soft Soldering

Module 6 – Smithy **3P**

Typical jobs that may be made in this practice module:
i. A simple job of making a square rod from a round bar or similar.
For further study (Optional)
Module 7 - Casting **3P**
Typical jobs that may be made in this practice module:
i. One/ two green sand moulds to prepare, and a casting be demonstrated.

Module 8 - Plastic moulding & Glass Cutting **3P**
Typical jobs that may be made in this practice module:
i. For plastic moulding, making at least one simple plastic component should be made.
ii. At least one sample shape on glass should be made using laser cutting machine.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text Books:
1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.
Reference Books:

1.Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2.Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
3.Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4.Manufacturing Science by A. Ghosh and A.K. Mallick, Wiley Eastern.
5.Principles of Metal Cutting/Principles of Machine Tools by G.C. Sen and A. Bhattacharya, New Central Book Agency, Kolkata.

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	2	3	2	-	2	2	2	3
CO2	2	2	3	2	2	2	2	-	3	2	2	3
CO3	3	2	2	2	2	2	2	2	2	2	2	3

CO4	2	2	3	2	3	3	2	-	3	3	3	3

First Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science courses	CH201	Chemistry-I	3	0	0	3	3
2	Basic Science courses	M201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	EE201	Basic Electrical Engineering	3	0	0	3	3
4	Engineering Science Courses	CS201	Programming for Problem Solving	3	0	0	3	3
	B. PRACTICAL							
5	Basic Science course	CH291	Chemistry-I Lab	0	0	3	3	1.5
6	Humanities and Social Sciences including Management courses	HSMC291	Professional Communication LAB	0	0	2	2	1.0
7	Engineering Science Courses	EE291	Basic Electrical Engineering Lab	0	0	3	3	1.5
8	Engineering Science Courses	ME292	Engineering Graphics and Design Lab	0	0	3	3	1.5
9	Engineering Science Courses	CS291	Programming for Problem Solving Lab	0	0	3	3	1.5
10	PROJECT	PR291	Theme based Project II	0	0	1	1	0.5
11	PROJECT	PR292	Skill Development II: Life Skill	1	0	0	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
12	Mandatory Course	MC281	NSS/Physical Activities / Meditation & Yoga / Photography	0	0	2	2	0
	TOTAL CREDIT							21

COURSE NAME: CHEMISTRY
COURSE CODE: CH201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36

CREDITS: 3

Pre requisites: A basic knowledge in 10+2 science with chemistry

Course Outcomes (COs):

After completion of this course students will be able to

CO1: Describe the fundamental properties of atoms & molecules, atomic structure and the periodicity of elements in the periodic table

CO2: Apply fundamental concepts of thermodynamics in different engineering applications.

CO3: Apply the knowledge of water quality parameters, corrosion control & polymers to different industries.

CO4: Determine the structure of organic molecules using different spectroscopic techniques.

CO5: Evaluate theoretical and practical aspects relating to the transfer of the production of chemical products from laboratories to the industrial scale, in accordance with environmental considerations.

Course Content

Module- I: Inorganic Chemistry **9L**

(i) Atomic structure
5L

Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers, Introduction to the concept of atomic orbitals, diagrams of s, p and d orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle and its limitation, introduction to Schrodinger equation.

(ii) Periodic properties **4L**

Modern Periodic table, group trends and periodic trends in physical properties: electron affinity, electronegativity, polarizability, oxidation states, effective nuclear charges, penetration of orbitals, variations of s, p and d orbital energies of atoms.

Module II: Physical Chemistry **8L**

(i) Use of free energy in chemical equilibria
6L

Thermodynamic functions: internal energy, enthalpy, entropy and free energy. 2nd Law of Thermodynamics, Estimations of entropy and free energies, Free energy and emf, Cell potentials, the Nernst equation and applications.

(ii) Real Gases **2L**

Reason for deviation of real gases from ideal behavior, Equations of state of real gases,Vander Waals' equation, pressure & volume correction, validity, critical state of gas.

Module III: Organic Chemistry **8L**

(i) Stereochemistry **4L**

Representations of 3 dimensional structures, Chirality, optical activity, isomerism, structural

isomerism, stereoisomers, enantiomers, diastereomers, configurations (D,L & cis trans), racemisation.

(ii) Organic reactions **4L**

Concepts of inductive effect, resonance, hyperconjugation, introduction to reactions involving substitution, addition, elimination, oxidation (Baeyer villiger oxidation), reduction (Clemmensen reduction, Wolff-Kishner reduction).

Module IV: Industrial Chemistry **8L**

(i) Water **2L**

Hardness, alkalinity, numerical

(ii) Corrosion. **2L**

Types of corrosion: wet & dry, preventive measures

(iii) Polymers **3L**

Classification of polymers, conducting polymers, biodegradable polymers

(iv) Synthesis of a commonly used drug molecule. **1L**

Paracetamol, Aspirin

Module V: Spectroscopic techniques in Chemistry **3L**

Electromagnetic radiation, Principles of spectroscopy, spectrophotometer, infrared spectroscopy, fingerprint region, functional group region, UV-VIS spectroscopy, ^{1}H Nuclear magnetic resonance spectroscopy, chemical shift.

Textbooks

1. A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
2. General & Inorganic Chemistry, P.K. Dutt
3. General & Inorganic Chemistry, Vol I, R.P. Sarkar
4. Physical Chemistry, P.C. Rakshit

Reference Books

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2. Fundamentals of Molecular Spectroscopy, by C. N.Banwell
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
4. Physical Chemistry, by P. W.Atkins
5. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Editionhttp://bcs.whfreeman.com/vollhardtschore5e/default.asp

Project Domain

1. Application of Thermodynamics
2. Application of polymers in daily life
3. Nanomaterials and its applications
4. Determination of water quality parameters
5. Electronic storage devices
6. Managing E –wastes
7. Application of chemistry in core engineering

8. Application of spectroscopy in medical field
9. Applications of green chemistry
10. Merits of commercial organic products
11. Bioplastics
12. Any other related topics

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	2	2	2	2
CO2	3	3	3	3	-	-	-	-	2	2	2	3
CO3	3	3	2	2	-	2	2	-	2	-	3	3
CO4	3	2	3	2	-	-	2	-	2	2	3	3
CO5	3	3	3	3	2	2	2	-	2	-	2	3

COURSE NAME: MATHEMATICS-II
COURSE CODE: M201
CONTACT: 3:1:0
TOTAL CONTACT HOURS: 48
CREDIT: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) calculus.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to

CO1: Recall the properties and formula related to ordinary differential equations, improper integral, Laplace transform and numerical techniques.

CO2: Determine the solutions of the problems related to ordinary differential equations, improper integral, Laplace transform and numerical techniques.

CO3: Apply appropriate mathematical tools of ordinary differential equations, improper integral, Laplace transform and numerical techniques for the solutions of the problems.

CO4: Analyze engineering problems by using differential equation, Laplace Transform and Numerical Methods.

Course Content:

Module I: First Order Ordinary Differential Equations (ODE): 10L

Solution of first order and first-degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation, Solution of first order and higher degree ODE: solvable for p, solvable for y solvable for x and Clairaut's equation.

Module II: Second Order Ordinary Differential Equations (ODE): 10L

Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations, Solution of simultaneous linear ODEs.

Module III: Laplace Transform (LT): 14L

Improper integrals; Beta and Gamma functions and their properties.
Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $t\,f\,(t)$, LT of $\frac{f(t)}{t}$, LT of derivatives of $f(t)$, LT of integral of $f(t)$, Evaluation of improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) using LT.

Module IV: Numerical Methods 14L

Introduction to error analysis, Calculus of finite difference. **Interpolation:** Newton forward and backward interpolation, Lagrange's interpolation, Newton's divided difference interpolation formula. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule. Numerical solution of ordinary differential equation: Euler method, Modified Euler method, Fourth order Runge-Kutta method.

Project Domains:

1. Mathematical modeling using ODE.
2. Application of ODE.
3. Application of Laplace Transform in different engineering branches.
4. Application of Numerical Methods in different engineering branches.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

6. Samanta Guruprasad, A text book of Engineering Mathematics-II, New age International Publishers
7. Mollah, S. A, Numerical Analysis and Computational Procedures, Books and Allied (P) Ltd.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Boyce, W. E. and DiPrima, R. C., Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
3. Ross, S. L., Differential Equations, 3rd Ed., Wiley India, 1984.
4. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.
5. Coddington, E. A., An Introduction to Ordinary Differential Equations, Prentice Hall, India, 1995.
6. Dey, Sukhendu, Gupta Sisir, Numerical Methods, MsGraw Hill Education (India) Private Limited.
7. Jain, M. K., Iyengar, S. R. K., Jain, R. K., Numerical Methods, New age International Publishers

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	-	-	-	-	-	-	-	-	2
CO4	2	3	2	2	-	-	-	-	-	-	-	2

COURSE NAME: BASIC ELECTRICAL ENGINEERING
COURSE CODE: EE201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3

Pre-requisite: Basic 12th standard Physics and Mathematics, Concept of components of electric circuit.

Course Outcomes (COs):

After attending the course students would be able to

CO1: understand and analyze basic electric circuits

CO2: study the working principles of electrical machines.

CO3: introduce the components of low voltage electrical installations

CO4: study the fundamentals of electrical Power systems and Control Systems

Course Content

Module- I: DC Circuits **8L**

Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchhoff ‘s laws, Source equivalence and conversion, Network Theorems - Superposition Theorem, Thevenin‘s Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

Module- II: AC Fundamentals **8L**

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

Module- III: Electrical Machines **10L**

Transformer: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation, and efficiency. Auto-transformer and three-phase transformer connections.

Rotating Machines - DC Machines: Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation. Three-Phase Induction Motor: Basic concept of three phase circuit and production of rotating magnetic field. Working principle of three-phase induction motor and torque-speed characteristics (concept only).

Module- IV: Electrical Installations **3L**

Earthing of Electrical Equipment, ideas of basic components- MCB, MCCB, ELCB, SFU, Megger. Types of Wires and Cables, Earthing.

Module- V: Fundamentals of Power Systems **5L**

Generation of power: Block schematic representation of Thermal and nuclear power plants. Renewable energy sources: solar, wind, tidal and geothermal (Block diagram and working only- No Problems). Power transmission: Typical electrical power transmission scheme-need for high voltage transmission-(Derivation is not needed, No Problems). Power Distribution: substation equipments, primary and secondary transmission and distribution systems- feeder, service mains.

Module- VI: Introduction to Control Systems **2L**

Concept control systems, Objectives of control system, Types of control systems, Real examples of control systems.

Text books:

D. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.

1. V. Mittle& Arvind Mittal, Basic Electrical Engineering, TMH.
2. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
3. Chakrabarti, Nath& Chanda, Basic Electrical Engineering, TMH.
4. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

Reference books:

1. E. Hughes, ―Electrical and Electronics Technology‖, Pearson, 2010.
2. V. D. Toro, ―Electrical Engineering Fundamentals‖, Prentice Hall India, 1989.

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	1
CO2	1	2	2	-	-	-	-	-	-	-	-	1
CO3	-	2	2	-	-	-	-	-	-	-	-	2
CO4	-	2	-	-	-	-	-	-	-	-	-	1

COURSE NAME: PROGRAMMING FOR PROBLEM SOLVING
COURSE CODE: CS201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36

CREDITS: 3

Prerequisites: Number system, Boolean Algebra

Course Outcomes (COs): After completion of the course students would be able to

CO1: Understand the fundamental concept of Computer and mathematical knowledge and apply them in designing solution to engineering problem.

CO2: Understand the basic concept of C programming and use of data types/operators/input/output function for developing and implementing complete program leading to solution of mathematical and engineering problem.

CO3: Use conditional branching, iteration, recursion and formulate algorithms and programs in solving mathematical/ scientific/ engineering problem leading to lifelong learning.

CO4: Understand the concept of arrays, pointers, file and dynamic memory allocation and apply it for problem solving and also create new data types using structure, union and enum.

CO5: Understand how to decompose a problem into functions and assemble into a complete program by means of modular programming possibly as a team.

Course Content:

Module-1: Fundamentals of Computer **9L**

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices.
Number System: basic of Binary, Octal, Decimal and Hexadecimal number systems; Representation and interchanging of number in different number systems. Introduction to complements system, Representation of signed and unsigned numbers in singed magnitude singed 1's complement system and signed 2's complement system.

Arithmetic– Addition and Subtraction (using1'scomplementand2'scomplement).
Representation of Characters-ASCII Code
Basics of Compiler, Interpreter and Assembler
Problem solving – Basic concept of Algorithm. Representation of algorithm using flow chart and pseudo code. Some basic examples.

Module-2: Introduction to C Programming
5L

Overview of Procedural vs Structural language; History of C Programming Language.
Variable and Data Types: The C characterse identifiers
And keywords, data type & sizes, variable names, declaration, statements.
Operators & Expressions: Arithmetic operators, relational operators, logical operators, increment anddecrementoperators,bitwiseoperators,assignmentoperators,conditionaloperators,specialoperators-typeconversion, C expressions, precedence and associativity.
Input and Output: Standard input and output, formatted output–print f,formatted input scan f.

Module-3: Branch and Loop
5L

Branching: Concept of Statement and Blocks in C, Simple if, if -else, nested if-else and if-else ladder.
Switch Case: break andcontinue; switch-case, concept of goto and labels
Loops - while, for, do while

Module-4: Program Structures **4L**

Function: Basics of Functions, function types, function prototypes, formal and actual parameter, function calling, functions returning values, functions not returning values. Recursion and Recursive Function.
Storage Class in C: Storage Class-auto, external, static and register storage class, scope rules and life time of variables
C pre-processor: Pre-processing directive and macro, parameterized macro.

Module-5: Array and Pointer
7L

Arrays: One dimensional arrays, Two-dimensional arrays, Passing an array to a function
Pointers: Pointers, Pointer andArray, Pointer and functions.
Strings: Character array and string, array of strings, Passing a string to a function, String related functions, Pointer and String.
Dynamic memory allocation: Malloc, calloc, realloc and free with example.

Module-6: Structures, Unions and Enum **3L**

Basic of structures, arrays of structures, structures and pointers, bit fields. Basics of union and enum, difference between structure and union.

Module-7: File in C **3L**

Files handling- opening and closing a file in different mode, formatted and unformatted files, Command line arguments, f open, f close, f get c, f put c, f print f, f scan f function.

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. KanetkarY.-LetusC,BPBPublication,15thEdition

ReferenceBooks:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

CO–PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3	3	3	3	2	-	-	-	-	-	-	-
CO2	2	2	3	2	-	-	-	-	-	-	-	-
CO3	2	3	2	2	-	-	-	-	-	-	-	3
CO4	3	2	2	2	3	-	-	-	-	-	-	-
CO5	2	2	2	2	-	-	-	-	3	2	-	-

COURSE NAME: CHEMISTRY LAB
COURSE CODE: CH291
CONTACT: 0:0:3
CREDIT: 1.5

Pre-requisite: A basic knowledge in 10+2 science with chemistry.

Course Outcomes (COs):

After attending this course, students would be

CO1: able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.

CO2: able to analyze and determine the composition of liquid and solid samples working as an individual and also as a team member.

CO3: able to analyze different parameters of water considering environmental issues.

CO4: able to synthesize drug and polymer materials.

CO5: Capable to design innovative experiments applying the fundamentals of chemistry.

Course Content:

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Determination of hardness of water
4. Determination of chloride content of water
5. Determination of the rate constant of a reaction
6. Determination of cell constant and conductometric titration
7. pH metric titrations
8. Synthesis of a polymer/drug
9. Saponification/acid value of an oil
10. Chemical analysis of a salt
11. Chemical oscillations- Iodine clock reaction
12. Determination of the partition coefficient of a substance between two immiscible liquids
13. Adsorption of acetic acid by charcoal
14. Estimation of iron in Mohr's salt solution by permanganometry (Redox Titration)
15. Innovative experiments (any one)
    - Synthesis of silver nano-particles
    - Green synthesis

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	-	2	3	-	-	-	-	2
CO2	2	2	2	2	-	2	-	-	-	2	-	2
CO3	-	-	-	-	-	-	-	-	3	3	2	2
CO4	2	2	2	2	-	-	2	-	-	-	-	2
CO5	3	3	3	3	2	2	2	2	-	-	2	2

COURSE NAME: PROFESSIONAL COMMUNICATION LAB
COURSE CODE: HSMC291
Contact: 0:0:2
CREDIT: 1

Pre requisites: Basic knowledge of LSRW skills.

Course Outcomes (COs):

After attending the course students' would be

CO1: Able to explain advanced skills of Technical Communication in English through Language Laboratory.

CO2: Able to apply listening, speaking, reading and writing skills in societal and professional life.

CO3: Able to demonstrate the skills necessary to be a competent Interpersonal communicator.

CO4: Able to analyze communication behaviours.

CO5: Able to adapt to multifarious socio-economical and professional arenas with the help of effective communication and interpersonal skills.

Course Content:

Module- 1: Introduction to the Language Lab

a. The Need for a Language Laboratory
b. Tasks in the Lab
c. Writing a Laboratory Note Book

Module- 2: Active Listening

a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c. Academic Listening vs Business Listening

d. Listening in Business Telephony
e. Study of Contextualized Examples based on Lab Recordings

Module- 3: Speaking

a. Speaking—Accuracy and Fluency Parameters
b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focussed activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
d. Accuracy-focussed activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
e. Group Discussion: Principles and Practice
f. Business Meetings and Sales Talks

Module- 4: Lab Project Work

a. Making a brief Advertisement video (1-2 minutes)
b. Making a brief Business Documentary film (5-7 minutes)
c. Client interaction video (5-7 minutes)
d. Making a short video CV (1-2 minutes)

References:

1. IIT Mumbai, Preparatory Course in English syllabus
2. IIT Mumbai, Introduction to Linguistics syllabus
3. Sasikumar et al. A Course in Listening and Speaking. New Delhi: Foundation Books, 2005.
4. Tony Lynch, Study Listening. Cambridge: Cambridge UP, 2004.

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	2	-	-	3	-	2
CO2	2	3	2	-	-	2	2	2	-	3	-	3
CO3	2	3	-	-	-	3	3	3	-	3	-	3
CO4	-	-	-	-	-	3	3	3	-	3	-	3
CO5	-	-	-	-	-	-	3	3	-	3	-	3

COURSE NAME: BASIC ELECTRICAL ENGINEERING LABORATORY
COURSE CODE: EE291

CONTACT: 0:0:3
CREDITS: 1.5

Prerequisite: Basic Physics and applied physics, Basic Mathematics, Basic concept of Electric Circuit.

Course Outcomes (COs):

After completion of this course students will be able to

CO1: Identify and use common electrical components.

CO2: To develop electrical networks by physical connection of various components and analyze the circuit behavior.

CO3: Apply and analyze the basic characteristics of transformers and electrical machines.

List of Experiments

1. Basic safety precautions – earthing, introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter methods.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing and speed control of DC shunt motor.
10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on single-phase Energy Meter.
13. Innovative experiments

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	1	-	-	1
CO2	-	2	2	2	-	-	-	-	2	-	-	1
CO3	-	2	-	2	-	-	-	-	2	-	-	1

COURSE NAME: ENGINEERING GRAPHICS AND DESIGN
COURSE CODE: ME292

CONTACT: 0:0:3
CREDITS: 1.5

Prerequisites: Basic knowledge of geometry

Course Outcomes (COs):

After attending the course students would

CO1: get introduced with Engineering Graphics and visual aspects of design.

CO2: know and use common drafting tools with the knowledge of drafting standards.

CO3: be able to apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.

CO4: be able to produce part models; carry out assembly operation and show working procedure of a designed project work using animation.

List of Drawing:

Traditional Engineering Graphics:

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

Module 1: Introduction to Engineering Drawing

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

Module 2: Orthographic & Isometric Projections

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only).

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerancing; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation,
CAD modeling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modeling, Part editing and printing documents.

Module 6: Demonstration of a simple team design project

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

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

2. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House

2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education

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

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	2	2	-	2	2	2	2
CO2	2	2	3	2	2	2	2	2	2	2	2	2
CO3	2	2	3	2	3	2	2	-	2	2	2	3
CO4	2	2	3	3	3	3	2	2	3	3	2	2

COURSE NAME: PROGRAMMING FOR PROBLEM SOLVING LAB

COURSE CODE: CS291
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisites: Number system, Boolean Algebra

Course Outcomes (COs):

After completion of the course students would be able to

CO1: Understand and propose appropriate command or function in running system or developing program for engineering and mathematical problems depending on the platform used even in changed environment leading to their lifelong learning.

CO2: Identify and propose appropriate data type, arithmetic operators, input/output functions and also conditional statements in designing effective programs to solve complex engineering problem using modern tools.

CO3: Design and develop effective programs for engineering and mathematical problems using iterative statements as well as recursive functions using modular programming approach possibly as a team maintaining proper ethics of collaboration.

CO4: Explain and organize data in arrays, strings and structures and manipulate them through programs and also define pointers of different types and use them in defining self-referential structures and also to construct and use files for reading and writing to and from leading to solution of engineering and mathematical problem.

CO5: Prepare laboratory reports on interpretation of experimental results and analyze it for validating the same maintaining proper ethics of collaboration.

Course Content:

Module-1: Familiarization with some basic commands of DOS and Linux. File handling and Directory structures, file permissions, creating and editing simple C program in different editor and IDE, compilation and execution of C program. Introduction to Code block.

Module-2: Problem based on

a) Basic data types
b) Different arithmetic operators.
c) Print f( ) and scan f( ) functions.

Module-3: Problem based on conditional statements using

a) if-else statements
b) different relational operators
c) different logical operators

Module-4: Problem based on

a) **for** loop
b) **while** loop
c) **do-while** loop

Module-5: Problem based on

a) How to write a menu driven program using **switch-case** statement
b) How to write a function and passing values to a function
c) How to write a **recursive function.**

Module-6: Problem based on

a) How to use **array (both I-Dand2-D).**
b) How to pass an **array** to a **function.**

Module-7: Problem based on manipulation of strings in different way.

Module-8: Problem based on

a) How to handle compound variables in C
b) How to handle file in C
c) How to use command line argument in C

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. KanetkarY.-LetusC,BPBPublication,15th Edition

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	-	-	-	3
CO2	3	3	3	3	3	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	3	3	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	3	-	3	-	-

2nd Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Basic Science course	M (ECS) 301	Mathematics III	4	0	0	4	4
2	Engineering Science Courses	ECS301	Circuit Theory and Networks	3	0	0	3	3
3	Engineering Science Courses	ECS302	Analog and Digital Electronics	3	0	0	3	3
4	Program Core Course	ECS303	Computer Organization and Architecture	3	0	0	3	3
5	Program Core Course	ECS304	Optoelectronics	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC303	Universal Human Values 2: Understanding Harmony	3	0	0	3	3
B. PRACTICAL								
7	Engineering Science Courses	ES 391	Numerical Method lab	0	0	3	3	1.5
8	Engineering Science Courses	ECS391	Circuits and Networks Lab	0	0	3	3	1.5
9	Engineering Science Courses	ECS392	Analog and Digital Electronics Lab	0	0	3	3	1.5
10	Program Core Course	ECS393	Computer Organization and Architecture Lab	0	0	3	3	1.5
11	PROJECT	PR391	Theme based Project III	0	0	1	1	0.5
12	PROJECT	PR392	Skill Development III: Technical Seminar Presentation	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC301	Environmental Science	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							26
D.MOOCS COURSES**								
14	MOOCS COURSES	HM301	MOOCS COURSE-I	1	3	1	4	4
TOTAL CREDIT WITH MOOCS COURSES								30

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

Course Name: Mathematics III
Course Code: M(ECS)301

Contact: 4:0:0
Total Contact Hours: 48
Credits: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) standard calculus, algebra.

Course Objectives:

The objective of this course is to provide basic concepts of algebraic structures and graph theory. It also aims to equip the students with concepts and tools of calculus of complex variables, Fourier series and Fourier transform as an intermediate to the advanced level of applications that they would find useful in their disciplines.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Recall the underlying principle and properties of Fourier series, Fourier transform, calculus of complex variable, group theory and graph theory
CO2: Exemplify the complex variables, complex functions, Fourier series, different types of graphs and groups
CO3: Apply Cauchy's integral theorem and the residue theorem to find the value of complex integration
CO4: Construct the shortest path and minimal spanning tree from a given graph using the algorithms of graph theory.
CO5: Find the Fourier series and Fourier transform of functions by organizing understandings of underlying principles and also evaluate the integral using Parseval's identity.

Course Content:

MODULE I: Fourier series and Fourier Transform:

Fourier series: Dirichlet's Conditions; Euler's Formula for Fourier Series; Fourier Series for functions of period 2π; Sum of Fourier series (examples); Theorem for the convergence of Fourier series (statement only); Fourier series of a function with its periodic extension; Half range Fourier series: Construction of half range Sine series and half range Cosine Series; Parseval's identity (statement only) and related problems.
Fourier Transform: Fourier Transform, Fourier Cosine Transforms, Fourier Sine Transforms (problems only); Properties of Fourier Transform: Linearity, Shifting, Change of Scale, Modulation (problems only); Fourier Transform of Derivatives (problems only); Convolution Theorem (statement only), Inverse of Fourier Transform (problems only). [13L]

MODULE II: Graph Theory:

Graph theory, important theorems and problems, digraphs, weighted graph, connected and disconnected graph, Bipartite graph, complement of a graph, regular graph, complete graph, walk, path, circuit, Euler graph, cut set, cut vertices, adjacency and incidence matrices of a graph(digraph),Isomorphism,
Tree, Important theorems: Binary Tree, Spanning Tree, minimal spanning tree, Dijkstra's algorithm, Kruskal's Algorithm, Prim's Algorithm. [12L]

MODULE III: Calculus of Complex Variable:

Functions of a Complex Variable (definition and examples); Concept of Limit, Continuity and Differentiability (problems only); Analytic Functions (definition and examples); Cauchy-Riemann Equations (statement only& related problems); Sufficient condition for a function to be analytic (statement only & related problems).
Concept of Simple Curve, Closed Curve, Smooth Curve & Contour; Some elementary properties of complex integrals (problems only); Cauchy's Theorem (statement only & related problems); Cauchy's Integral Formula(statement only & related problems); Cauchy's Integral Formula for the derivative of an analytic function(statement only & related problems); Cauchy's Integral Formula for the successive derivatives of an analytic function (statement only & related problems); Taylor's series and Laurent's series (problems only).
Zero of an Analytic Function and its order (definition & related problems); Singularities of an Analytic Function: Isolated Singularity and Non-isolated Singularity (definition & related problems); Essential Singularities, Poles (Simple Pole and Pole of Order m) and Removable Singularities (definition & related problems); Determination of singularities and their nature (problems only); Residue (definition & examples); Determination of the residue of a given function; Cauchy's Residue theorem (statement only & related problems). [13L]

MODULE IV: Group Theory:

Definition of a group, Examples: cyclic, dihedral, symmetric, matrix groups, Homomorphism, Subgroups and quotient groups, Cosets, Conjugacy classes, Normal subgroups, Lagrange's theorem, Isomorphism theorems [10L]

Project Domains:

6. Study of physical processes through Graph theory.
7. Application of calculus of complex variable in real world engineering problems.
8. Application of Abstract Algebra in engineering problems.
9. Application of Fourier series and Fourier transform in engineering problems.

Text and Reference Books:

1. Herman, R. L. An Introduction to Fourier Analysis, Chapman and Hall/CRC, 2016.
2. Grafakos, L. Classical Fourier Analysis, Springer, India, Private Ltd.
3. Mathews, J. H. and Howell, R. W. Complex Analysis for Mathematics & Engineering, Jones & Bartlett Pub, 2006.
4. Chowdhury, B. Elements of Complex Analysis, New Age International, 1993.
5. Grewal, B. S. Higher Engineering Mathematics, Khanna Pub.
6. Kreyszig, E. Advanced Engineering Mathematics, John Wiley & Sons, 2006.
7. Deo, N. Graph Theory with Applications to Engineering and Computer Science, Prentice Hall.
8. Mapa, S. K. Higher algebra: Abstract and Linear, Levant, 2011.
9. Chakraborty, S. K. and Sarkar, B. K. Discrete Mathematics, OXFORD University Press.

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	1	1	1	-	-	-	-	-	-	-	2
CO2	3	2	1	1	-	-	-	-	-	-	-	1
CO3	3	2	2	1	-	-	-	-	-	-	-	1
CO4	3	2	2	1	-	-	-	-	-	-	-	1
CO5	3	3	2	3	-	-	-	-	-	-	-	1

Course Name: Circuit Theory and Networks
Course Code: ECS301
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre-Requisite: Concept of Basic electrical and circuitry

Course Objectives:

1. To prepare the students to acquire basic knowledge in the analysis of Electrical Networks
2. To solve electrical network using mesh and nodal analysis by applying network theorems
3. To analyze the transient response of series and parallel circuits and to solve problems in time and frequency domains
4. To understand the concept of resonance in series and parallel circuits.
5. To design various types of filters.
6. To relate various two port parameters and transform them.

Course Outcomes:

On completion of this Subject/Course the student shall be able to:

CO1: Solve complex circuit problem by applying knowledge of circuit theorems.
CO2: Analyze dynamic performance of the networks using Laplace Transform.
CO3: Find out resonance of different circuit.
CO4: Analyze two port networks using A,B,C,D and Z,Y Parameter Model.

Course Contents:

Module1:

Introduction: Continuous & Discrete, Fixed & Time varying, Linear and Nonlinear, Lumped and Distributed, Passive and Active networks and systems. Independent & Dependent sources, Source Transformation, Star-Delta conversion [5L]

Network equations: Kirchoff's Voltage Law & Current Law, Formulation of network equations, Loop variable analysis, Supermesh Analysis, Node variable analysis, Supernode Analysis

Network theorem: Superposition, Thevenin's, Norton's, Maximum power transfer, Compensation & Reciprocity theorem. Millman's theorem and its application. Solution of Problems with DC & AC sources. [7L]

Module 2:

Laplace transforms: Concept of complex frequency, properties of Laplace Transform, Initial Value Theorem and Final Value Theorem, Concept of Convolution theorem and its application, Transformation of step, ramp, impulse, exponential, damped and undamped sine & cosine functions. Laplace Transform of Gate function & its application. Laplace transform of Periodic function. Inverse Laplace Transform, application of Laplace Transform in circuit analysis [7L]

Circuit Transients: Impulse, Step & Sinusoidal response of RL, RC, and RLC circuits. Transient analysis of different electrical circuits with and without initial conditions using AC & DC source. Solutions of Problems with DC & AC sources [5L]

Module 3:

Two port network analysis: Open circuit Impedance & Short circuit Admittance parameters, Transmission parameters, Hybrid parameters and their inter relations. Condition of Reciprocity & symmetry. Interconnection of two port networks. Solution of Problems with DC & AC sources. [6L]

Resonant Circuits: Series and Parallel Resonance, Impedance and Admittance Characteristics, Quality Factor, Half-Power Points, Bandwidth, Solution of problems [3L]

Module 4:

Graph of Network: Concept of Tree, Branch, Tree link, junctions, Incident matrix, Tie-set matrix and loop currents, Cut-set matrix and node pair potentials, duality of networks, solution of problems. [3L]

Text Books:

1. Network Analysis, M.E.Van Valkenburg (Prentice H all)
2. Engineering Circuit Analysis, W.H.Hayt, J.E.Kenmerly, S.M.Durbin,(TMH)
3. Network and Systems, D.Roychowdhury,(New Age International)

Reference Books:

1. Network and Systems, Ashfaq Husain,(Khanna Book Publisher)
2. Modern Netwok Analysis, F.M.Reza & S.Seely, McGraw Hill.
3.Circuits and Networks: Analysis and Synthesis Paperback , A. Sudhakar, Shyammohan S. Palli (TMH)
4. Network Analysis And Synthesis, C L Wadhwa, ,(New Age International)

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	-	-	-	-	-	-	-
CO2	3	2	1	2	2	-	-	-	-	-	-	-
CO3	3	2	2	1	1	-	-	-	-	-	-	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-

Course Name: Analog and Digital Electronic Circuits
Course Code: ECS302
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36
Prerequisite: Concept of basic electronics devices, basic law of circuit analysis

Course Objectives:
1. Provide a strong foundation on Linear Circuits.
2. Familiarize students with applications of various IC's.
3. Having a broad coverage in the field that is relevant for engineers to design Linear circuits using Op-amps.

Course Outcomes:
At the end of this course students will be able to
CO1: Design and analyze various amplifier circuits using transistors and operational amplifier
CO2: Design sinusoidal and non-sinusoidal oscillators
CO3: Realize basic gate operations and laws Boolean algebra.
CO4: Design combinational and sequential digital circuits as per the need.

Course Content:

Module 1: Amplifiers:

Small signal amplifiers: Introduction to Analog Integrated Circuits, BJT Modeling-hybrid model of transistors; Emitter follower circuits, High frequency model of transistors.
RC coupled amplifier, functions of all components, equivalent circuit, derivation of voltage gain, current gain, input impedance and output impedance, frequency response characteristics, lower and upper half frequencies, bandwidth, and concept of wide band amplifier.

Operational Amplifier: Introduction to Integrated Circuits, Ideal Operational Amplifier Characteristics, Differential Amplifier, Constant current source (current mirror etc.), level shifter, CMRR, Slew Rate, Open & Closed loop circuits

Applications of Operational Amplifiers: analog adder, subtractor, integrator, differentiator, comparator, Schmitt Trigger. Instrumentation Amplifier, Log & Anti-log amplifiers, Analog multiplier, Precision Rectifier, voltage to current and current to voltage converter **[11L]**

Module 2: Oscillators and Multivibrators:
Oscillators: Berkhausen criterion, Colpitts, Hartley's, Phase shift, Wien bridge and crystal oscillators **Multivibrator** – Monostable, Bistable, Astable multivibrators ; Monostable and astable operation using 555 timer.

Power Supply:
Brief analysis of DC voltage and ripple voltage with C, L-C and C-L-C filters in Rectifier Circuit Regulated DC power supplies- Series and Shunt Voltage Regulation – percentage regulation, Fixed output voltage IC regulator 78xx and 79xx series , Adjustable output voltage regulator, LM 337 series power supply ICs , Concept of **Switched** Mode Power Supply` **[7L]**
Module 3:
Binary Number System & Boolean Algebra (recapitulation); BCD, ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic, Venn diagram,Boolean algebra (recapitulation); Representation in SOP and POS forms; Minimization of logic expressions by algebraic method.
Logic families- TTL, MOS and CMOS - basicconcepts.

Combinational circuits - Adder and Subtractor circuits (half & full adder & subtractor); Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator **[8L]**

Module 4:
Sequential Circuits - Basic Flip-flop & Latch, Clocked F/F, Types -SR, JK, D, T and JK Master-slave Flip Flops, Registers (SISO, SIPO, PIPO, PISO) Ring counter, Johnson counter Basic concept of Synchronous and Asynchronous counters (detail design of circuits excluded), Design of Mod N Counter, Skip Counter **[10L]**

Text Books:
1. Millman Halkias – Integrated Electronics, McGraw Hill
2. Schilling & Belove—Electronic Circuit: Discrete & Integrated, 3/e, McGraw Hill
3. Ramakant A. Gayakwad —Op- Amps and linear Integrated Circuits, Pub: PHI
4. Boylested & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI
5. "Operational Amplifiers and Linear Integrated Circuits" by Robert F. Coughlin, Frederick F. Driscoll
6. Morries Mano- Digital Logic Design- PHI
7. Leach & Malvino—Digital Principles & Application, 5/e, McGraw Hill
8. H.Taub & D.Shilling, Digital Integrated Electronics- McGraw Hill

Reference Books:
1. Rashid-Microelectronic Circuits- Analysis and Design- Thomson(Cenege Learning)
2. Linear Integrated Circuits – D. Roy Choudhury & Shail B. Jain

3. Analog Integrated Circuits – J. B. Gupta
4. Floyed & Jain- Digital Fundamentals-Pearson

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	2	1	1	2	2	3	3
CO2	2	3	3	3	3	1	1	1	2	2	3	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3

Course Name: Computer Organization and Architecture
Course Code: ECS303
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Course Outcome(s):

CO1: To implement pipelining concepts and parallelism techniques with a prior knowledge of stored program methods.
CO2: To evaluate the performance of each type of memory in the hierarchy
CO3: To evaluate different mapping techniques.
CO4: To analyse the SIMD and MIMD architecture and their interconnection techniques**.**

Course Content:

Module1: Introduction
Introduction to basic computer architecture , Stored Program Concepts: Von Neumann & Havard Architecture , RISC VS CISC, Amdahl's law, Performance Measure: MIPS, Benchmark Programs(SPECINT,SPECFP)
[5L]

Module2:
Different Classification Scheme: Serial Vs. Parallel , Pipelining: Basic concepts, Linear vs. NonLinear, Static vs. Dynamic, Unifunction vs. Multifunction , Instruction Pipeline, Arithmetic pipeline , Hazards: Data hazards, control hazards and structural hazards, Techniques for handling hazards [7L]

Module 3:
Pipeline vs. Parallelism, Levels of parallelism, Instruction-Level Parallelism: Basic Concepts , Techniques for Increasing ILP, Superscalar, Super Pipelined and VLIW Processor Architectures , Array and Vector Processors [5L]

Module 4:
Memory Hierarchy: Secondary memory , Main Memory, Cache Memory , Cache coherence and synchronization mechanisms, Mapping Technique in cache memory: Direct, Full Associative and Set Associative , Performance Implementation in Cache Memory , Virtual memory Concepts, page replacement policies [11L]

Module 5:
Multiprocessor
architecture Introduction to Parallel Architecture-Different Classification scheme, Performance of Parallel Computers, PRAM model (EREW,CREW,CRCW) , Centralized and Shared- memory architecture: synchronization, Interconnection Network (Omega, Baseline, Butterfly, Crossbar) [8L]

Text Books:
1. 'Advanced Computer Architecture Parallelism Scalability Programmability', Tata McGraw HillEducation Private Limited ISBN-13: 978-0-07-053070-6 ISBN-10: 0-07-053070-X **2.** Hwang & Briggs—Computer Architecture & Parallel Processing, TMH

Reference Books:
1. Patterson D.A. and Hennessy, J.L. "Computer architecture a quantitative approach", 2nd ed.,Morgan Kaufman, 1996
2. Hayes J. P., "Computer Architecture & Organisation", McGraw Hill
3. Siegel, H.J., "Interconnection Network for Large Scale parallel Processing", 2nd Ed., McGrawHill, 1990
4. Design and Analysis of Parallel Algorithm-Schim G. Akl

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

	PO 1	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO10**	**PO1 1**	**PO1 2**
CO1	3	3	3	3	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-	-
CO4	3	2	2	3	-	-	-	-	-	-	-	-

Course Name: Optoelectronics
Course Code: ECS304
Contact: 3:0:0

Credits: 3
Total Contact Hours: 36
Prerequisite: Knowledge of optics and semiconductor physics

Course Objectives:

1. To make the learners understand the different aspects of optoelectronic sources
2. To make the learners understand the different aspects of optoelectronic detectors
3. To make the learners understand the different aspects of optical fiber
4. To make the learners understand the application and advantages of different fiber optic sensors

Course Outcomes:

After the completion of the course, earner will be able to:

CO1: compare double hetero junction LED, surface emitter LED, edge emitter LED, super luminescent LED, and semiconductor based LASER (p-n junction laser, double hetero junction laser, stripe geometry) as optoelectronic sources based on working principles and applications
CO2:compare optoelectronic detectors (p-n photodiode, p-i-n photodiode, avalanche photo diode, Schottky photodiode, hetero junction diode, phototransistor, LDR, photovoltaic cells, photo emissive cells) based on detector parameters, which are responsivity, efficiency, and working principle
CO3: select a suitable optical fiber for an engineering application, based on number of modes required, distance to be covered and V-parameter
CO4: justify the selection of intensity modulated fiber optic sensors, phase modulated fiber optic sensors, and spectrally modulated fiber optic sensors for engineering applications, which are measurement of temperature, pressure, displacement, and liquid level. Justify optical fiber as communication channel

Course Content:

Module 1: Optoelectronic sources and laser

Optoelectronics: Characteristics of optical emission, electro-luminescence, optical emission from p-n junction, direct bandgap and indirect band gap materials.
LED: spontaneous emission, power and efficiency calculation, materials of LED, structure of LED and its characteristics, double heterojunction LED, surface emitter LED, edge emitter LED, super luminescent LED.

Laser: Einstein relations, population inversion, 3- and 4-energy level systems, optical pumping, modes of laser, lasing materials-gaseous, liquid, and solid.
Semiconductor based lasers – p-n junction laser, double heterojunction laser, stripe geometry. Holography. [8L]

Module 2: Optoelectronic detectors
Optical detection principle, quantum efficiency, responsivity

Photo diode: p-n photodiode, p-i-n photodiode, avalanche photo diode, Schottky photodiode, hetero junction diode, phototransistor
LDR, photovoltaic cells, photo emissive cells - types, materials, construction, response. Opto-couplers – components, characteristics, noise figures, applications [7L]

Module 3: Optical fiber and fiber optics
Fiber optics: Optical fiber – materials, construction, step index and graded index fibres, ray propagation. Modes in optical fibres, intermodal dispersion. Single mode and multimode fiber, attenuation and dispersion in single mode and multimode optical fibers, Active fiber, Optical fiber coupling- splices and connectors [7L]

Module 4: Fiber optic sensors
Fibre-optic sensors: advantages, intrinsic and extrinsic sensors
Classification- intensity modulated sensors, phase modulated sensors, spectrally modulated sensors. Fibre optic sensors for Industrial applications: temperature, displacement, pressure and liquid-level sensors. Fiber optic interferometer- Mach –Zahnder interferometer, Sagnac interferometer [7L]

Module 5: Fiber optic communication
Introduction, block diagram of basic fiber optic communication system, advantages and disadvantages, introduction to repeater, comparison of WDM and OFDM [7L]

Books:

P. Bhattacharjee, Semiconductor Optoelectronic Devices, PHI
John Wilson and John Hawkes, Optoelectronics- An Introduction, PHI
John M. Senior, Optical Fibre Communications, PHI
R.P. Khare, Fiber Optics and Optoelectronics, Oxford

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	-	3	-	**1**	-	1	-	-	-	2	1
CO2	3	-	3	-	**1**	-	**1**	-	-	-	2	1
CO3	3	-	1	-	1	-	2	-	-	-	**1**	2
CO4	1	-	3	-	3	-	**1**	-	-	-	2	2

Course Name: Universal Human Values 2: Understanding Harmony
Course Code: HSMC303
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Course Outcomes:

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Develop holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
CO2: Cultivate the harmony in the human being, family, society and nature/existenc.
CO3: Strengthen self-reflection.
CO4: Build commitment and courage to act.

Course Content

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

Self-Exploration–what is it?-Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking. [8L]

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensureSanyam and Health. Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Ensuring health vs dealing with disease discussion. [6L]

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of

education etc. Gratitude as a universal value in relationships. Elicit examples from students' lives. [7L]

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Unstanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence. Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of echnology etc. [8L]

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics:

a. Ability to utilize the professional competence for augmenting universal human order

b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems,

c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order:

a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers

b. At the level of society: as mutually enriching institutions and organizations.Practice Exercises and Case Studies in Practice (tutorial) Sessions to discuss the conduct as an engineer or scientist etc. [7L]

Text Books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	2	1	-	-	-	2	3	3
CO2	3	2	**1**	1	3	2	-	1	2	-	3	3
CO3	3	2	2	**1**	2	3	1	-	2	1	3	3
CO4	3	1	**1**	2	**1**	-	-	2	-	3	3	3

Course Name: Numerical Method lab
Course Code: ES 391
Contact: 0:0:3
Credits: 1.5

Prerequisite: Any introductory course on programming language (example. C/ Matlab).

Course Objective: The purpose of this course is to provide basic programming skills for solving the problems in numerical methods.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Understand the theoretical workings of numerical techniques with the help of C/ Matlab

CO2: Execute basic command and scripts in a mathematical programming language

CO3: Apply the programming skills to solve the problems using multiple numerical approaches.

CO4: Analyze if the results are reasonable, and then interpret and clearly communicate the results.

List of Experiments:

1. Assignments on Newton forward /backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination, Tridiagonal matrix algorithm, Gauss-Seidel iterations. Successive over Relaxation (SOR) method, LU Factorization method.
4. Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Secant Method, Newton-Raphson method
5. Assignments on ordinary differential equation: Euler's method, Euler's modified method, Runge-Kutta methods, Taylor series method and Predictor-Corrector method.
6. Assignments on numerical solution of partial differential equation: Finite Difference method, Crank–Nicolson method.
   Implementation of numerical methods on computer through C/C++ and commercial Software Packages: Matlab / Scilab / Labview / Mathematica/NAG (Numerical Algorithms Group)/Python.

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	1	-	-	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	3	2	3	-	-	-	-	-	-	-	1

Course Name: Circuits and Networks Lab
Course Code: ECS391
Contact: 0:0:3
Credits: 1.5

Course Objectives:

1. To acquaint students with the simulation software such as MATLAB to carry out design experiments as it is a key analysis software of engineering design
2. To generate different signals and transform those to s- domain using MATLAB
3. To verify various network theorem and other network aspects using SIMULINK.
4. To provide basic laboratory experience with analyzing the frequency response of different filters using simulation software.

Course Outcomes:

On completion of this Subject/Course the student shall be able to:

CO1: Apply the techniques and skills of modern engineering tools necessary for engineering practice.
CO2:Identify, formulate and solve engineering problems with simulation software.

CO3:Analyze transient response of series /parallel R-L-C circuit using simulation software.
CO4: Determine frequency response of different filters using simulation software

List of Experiments:

1. Introduction to MATLAB
2. Generation of Periodic, Exponential, Sinusoidal, Damped sinusoidal, Step, Impulse, Ramp signals using MATLAB in both discrete and analog form
3. Verification of Network Theorems using simulation software
4. Determination of Laplace transform and inverse Laplace transformation using MATLAB
5. Transient response in R-L and R-C Network: Simulation/hardware
6. Transient response in R-L-C Series circuits Network: Simulation and hardware.
7. Determination of Impedance (Z) and Admittance(Y) parameters of two port network
8. Frequency response of LP and HP filters: Hardware
9. Frequency response of BP and BR filters
10. Evaluation of convolution integral for periodic & non-periodic signal using MATLAB
11. Innovative Experiment

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	-	-	-	-	-	-	-
CO2	3	2	1	2	3	-	-	-	-	-	-	-
CO3	2	2	2	3	3	-	-	-	-	-	-	-
CO4	1	2	1	1	1	-	-	-	-	-	-	-

Course Name: Analog and Digital Electronics Lab
Course Code: ECS392
Contact: 0:0:3
Credits: 1.5

Course Objectives:

1. Understand the scope of modern electronics.
2. Describe models of basic components.
3. Design and construct simple electronic circuits to perform a specific function, e.g.,designing of amplifiers, ADC etc.

Course Outcomes:

At the end of this course students will be able to:

CO1: Explore the operation and advantages of Amplifier using Transistors & operational amplifiers.
CO2: Design different types of filters and apply the same to oscillators and amplifiers.
CO3: Construct, analyze digital electronic circuits.
CO4: Analyze troubleshoot the digital circuits

List of Experiment:

1. Construction of a R-C coupled amplifier & study of its input impedance, output impedance and frequency response
2. Design and study of Smith trigger circuit using Op Amp.
3. Design Precision rectifier using op Amp.
4. Study of timer circuit using NE555 & configuration for monostable & astable multivibrator
5. Design and testing of Wien bridge Oscillator.
6. Study a linear voltage regulator using regulator IC chip
7. Realization of basic gates using Universal logic gates
8. Code conversion circuits- BCD to Excess-3 & vice-versa
9. Design of various combinational circuits – Decoder, Multiplexer, 7segment display, Adder, Subtractor
10. Realization of RS-JK & D flip-flops using Universal logic gates.
11. Realization of Universal Register using JK flip-flops & logic gates.
12. Realization of Universal Register using multiplexer & flip-flops.
13. Realization of Asynchronous and Synchronous Up/Down counter, Synchronous counter.
14. Extramural Experiments

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	1	2	-	3	-	-	-	-	-	-	-	1
CO3	1	2	-	-	-	-	-	-	3	-	-	1
CO4	2	3	1	1	1	-	-	1	-	-	-	1

Course Name: Computer Organization and Architecture Lab
Course Code: ECS393
Contact: 0:0:3
Credits: 1.5

Prerequisites: Knowledge of designing different circuits in Computer Organization Lab

Course Outcome(s):

CO1: To design the basic gates
CO2: To verify the truth table
CO3: To implement different mapping techniques
CO4: To design circuit using Xilinx tools

List of Experiment:

1. Implement different types of Basic gates and simulate for truth table verification.
2. Implement half adder circuit and simulate for truth table verification.
3. Implement full adder circuit and simulate for truth table verification.
4. Implement half subtractor circuit and simulate for truth table verification.
5. Implement full subtractor circuit and simulate for truth table verification.
6. Implement Multiplexer, Demultiplexer circuit and simulate for truth table verification.
7. Implement Encoder, Decoder circuit and simulate for truth table verification.
8. Implement different types of flip flop and simulate for truth table verification.
9. Implement different types of parallel circuits (SISO, SIPO, PISO, PIPO) and simulate the result.
10. Implement ALU and simulate the result.
11. Implement RAM chip and simulate the result.
12. Innovative Experiments.

CO-PO Mapping: (DETAILED: HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	
CO1	3	-	-	-	-	-	-	-	-	-	-	-	
CO2	-	2	-	-	-	-	-	-	-	-	-	-	
CO3	3	3	3	-	-	-	-	-	-	-	-	-	
CO4	3	3	3										

Course Name: Environmental Science
Course Code: MC301
Contact: 2:0:0
Credits : 2

Course Objective(s):

1. Be able to understand the natural environment and its relationships with human activities.
2. Be able to apply the fundamental knowledge of science and engineering to assess environmental and health risk.
3. Be able to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues.
4. Be able to solve scientific problem-solving related to air, water, noise & land pollution.

Course Outcome(s):

CO1: To understand the natural environment and its relationships with human activities.
CO2: To apply the fundamental knowledge of science and engineering to assess environmental and health risk.

CO3: To develop guidelines and procedures for health and safety issues obeying the environmental laws and regulations.
CO4: Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

Course Contents:

Module 1: General
Natural Resources: Forest Resource, water resource, mineral resource, energy resources: alternative source of energy
Population Growth: Exponential Growth, logistic growth, Maximum sustainable yield, demography
Disaster Management: Types of disasters (Natural & Man-made), Floods, Earthquake, Tsunamis, Cyclones, landslides (cause, effect & control)
Ecology & Ecosystem: Elements of ecology, definition of ecosystem- components types and function, Food chain & Food web, Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems
Environmental Management: Environmental impact assessment, Environmental laws and protection act of India(The Environment protection Act, Air pollution Act, Water Act, Wildlife Protection Act) , Hazardous waste(management and Handling) Rules. **[11L]**

Module 2: Air pollution and control Sources of Pollutants: point sources, nonpoint sources and manmade sources primary & secondary pollutant
Types of air pollutants: primary & secondary pollutant ; Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN, Smog (Photochemical smog and London smog),
Effects on human health & climate: Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion
Air pollution and meteorology: Ambient Lapse Rate, Adiabatic Lapse Rate, Atmospheric stability & Temperature inversion control of air pollution (ESP, cyclone separator, bag house, catalytic converter, scrubber (ventury). **[10L]**

Module 3: Water Pollution Classification of water (Ground & surface water)
Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, heavy metals, pesticides, volatile organic compounds.
Surface water quality parameters: pH, DO, 5 day BOD test, BOD reaction rate constants, COD. Numerical related to BOD
Lake: Eutrophication [Definition, source and effect].
Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only),ground water pollution (Arsenic & Fluoride; sources, effects, control)
Quality of Boiler fed water: DO, hardness, alkalinity, TDS and Chloride
Layout of waste water treatment plant (scheme only). **[9L]**

Module 4: Land Pollution Types of Solid Waste: Municipal, industrial, commercial, agricultural, domestic, hazardous solid wastes (bio-medical), E-waste
Solid waste disposal method: Open dumping, Land filling, incineration, composting, recycling (Advantages and disadvantages).
Waste management: waste classification, waste segregation, treatment & disposal **[3L]**

Module 5: Noise Pollution

Definition of noise, effect of noise pollution on human health, Average Noise level of some common noise sources
Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L10 (18 hr Index) . Noise pollution control. **[3L]**

Textbook:
1. A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education
2. Private Limited

References Books:
1. Environmental Studies, Dr. J P Sharma, University Science Press
2. Environmental Engineering, J K Das Mohapatra, Vikas Publication

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	2	-	3	2	2	-	3	3	2	-	3	-
CO2	2	3	3	3	-	1	3	3	-	1	3	3
CO3	-	3	3	2	2	-	-	-	2	2	3	-
CO4	-	3	3	2	2	1	-	-	-	2	3	3
CO5	-	3	3	2	-	-	-	-	-	-	3	-

2nd Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								

1	Basic Science course	PH (ECS)401	Physics-II	3	0	0	3	3
2	PC	ECS401	Microprocessor and Microcontroller	3	0	0	3	3
3	PC	ECS402	Operating System	3	0	0	3	3
4	PC	ECS403	Data Base Management System	3	0	0	3	3
5	PC	ECS404	Data structure and Algorithm	3	0	0	3	3
6	Humanities and Social Sciences including Management courses	HSMC402	Gender Culture and Development	2	0	0	2	2
B. PRACTICAL								
7	Basic Science course	PH(ECS)491	Physics-II lab	0	0	2	2	1
8	PC	ECS491	Microprocessor and Microcontroller Lab	0	0	3	3	1.5
9	PC	ECS492	Operating System Lab	0	0	3	3	1.5
10	PC	ECS493	Data Base Management System Lab	0	0	3	3	1.5
11	PC	ECS494	Data structure and Algorithm Lab	0	0	3	3	1.5
12	PROJECT	PR491	Theme based Project IV	0	0	1	1	0.5
13	PROJECT	PR492	Skill Development IV: Soft Skill and Aptitude-I	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
14	MC	MC 481	Learning an Art Form [vocal or instrumental, dance, painting, clay modeling, etc.] OR Environmental Protection Initiatives	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							25.0
D.MOOCS COURSES								
15	MOOCS COURSES	HM401	MOOCS COURSE-II	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**29.0**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

Course Name: Physics II
Course Code: PH(ECS)401
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Prerequisite: Knowledge of Physics up B. Tech 1st year Physics-I course

Course Objective:

The Physics-II course will provide the exposure to the physics of materials that are applied in digital circuitry, storage devices; The quantum mechanical operator formalism & use in systems to get an insight into of science & technology of next generation; foundations of electromagnetic theory and communication systems; concept of fundamental particles and associated applications in semiconductors

Course Outcome:

After completion of this course students will be able to

CO1: define, understand and explain the parameters and various phenomena associated with electromagnetic wave propagation using fundamentals of electrostatics, magnetostatics and electromagnetic theory as well as the operator formalism in Quantum Mechanics.

CO2: apply Schrödinger equation in variety of atomic scale problems including tunnel diode

CO3: analyze the importance of magnetic materials and semiconductors in data storage devices and role of quantum confinement in inducing novel features of a nano material.

CO4: justify the importance of Fermi energy level in turning electronic properties of various semiconductors

Module 1.01: Vector Calculus

Vector operators, Gradient, Divergence, Curl-Physical significance, Scalar and Vector field, Gauss's divergence theorem (statement only), Stoke's theorem (statement only), expression of gradient, divergence, curl in spherical and cylindrical coordinate system. 2L

Module 1.02: Electrostatics

Coulomb's law in vector form, Electrostatic field and its curl, Gauss's law in integral form and conversion into differential form, Equation of continuity, Extend to Poisson's & Laplace's equation, Application to parallel plate, spherical and cylindrical capacitors (equivalent 1D problem). 3L

Module 1.03: Magnetostatics

Lorentz force (concept in Hall effect), Biot-Savart law (non existence of magnetic monopole), Magnetic vector and scalar potential. Ampere's circuital law, force on a small current element placed in a magnetic field. force due to parallel and anti-parallel current carrying wire and definition of Ampere. 4L

Module 1.04: Electro-magnetism & Electromagnetic theory

Faraday's law-integral and differential form, Concept of displacement current, Maxwell's field equations with physical significance, wave equation in free space, transverse nature of electromagnetic wave. 3L

Module 2: Quantum Mechanics-II (8L)

Formulation of quantum mechanics and Basic postulates- superposition principle, orthogonality of wave function, expectation value; operator correspondence, Commutator. Measurements in

Quantum Mechanics-Eigen value, Eigen function, Schrödinger's equation as energy eigen value equation. 4L

Application of Schrödinger equation – Particle in an infinite square well potential (1-D and 3-D potential well; Discussion on degenerate levels), 1D finite barrier problem and concept of quantum tunnelling (solve only $E<V_0$). 4L

Module 3: Elements of Solid State Physics (12L)

Module 3.01: Free electron theory (qualitative) - Electronic conduction in solids : Drude's theory, B Wiedemann Frantz Law, Idea of quantization of energy-Sommerfeld theory. 3L

Module 3.02: Band theory of solids: Bloch Theorem-statement only, Kronig-Penny model (qualitative treatment)- Energy-band (E-k) diagram, allowed and forbidden energy bands, Effective mass, Distinction between metals, insulators & semiconductors on the basis of band theory of solid. 4L

Module 3.03: Magnetic materials and storage devices: Magnetic Field & Magnetization M, relation between **B, H, M**. Bohr magneton, susceptibility, Diamagnetism- & Paramagnetism - Curie law (qualitative discussion), Ferromagnetism– Curie Temperature, Weiss molecular field theory (qualitative) & Curie-Weiss law, Hysteresis, Hard ferromagnets, Comparison and applications of permanent magnets (storage devices) and Soft ferromagnets (Permalloys, Ferrites etc.) **5L**

Module 4: Physics of Nanomaterials (4L)

Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, grapheme, electronic, environment, medical). 4L

Books

1. Insulating Materials: Principles, Materials, Applications, Margit Pfundstein , Roland Gellert , Martin Spitzner & Alexander Rudolphi: Birkhauser Verlag AG; 1
2. High Voltage and Electrical Insulation Engineering, Ravindra Arora, Wolfgang Mosch: Online ISBN:
9780470947906 DOI: 10.1002/9780470947906 Series Editor(s): Mohamed E. El-Hawary
3. Physics-II, Sujay Kumar Bhattacharya and Soumen Pal, McGraw Hill Education Private Limited
4. Advanced Engineering Physics, S. P. Kuila, New Central Book Agency (P) Ltd.
5. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
6. Quantum Mechanics- Bagde Singh (S. Chand Publishers)
7. Principles of Engineering Physics Vol 1 and Vol 2; by Md. N. Khan and S. Panigrahi, Pub: Cambridge Univ. press
8. Advanced Quantum Mechanics-J. J. Sakurai (TMH)
9. Introduction to Electrodynamics-Griffiths David J.
10. The Feynman Lectures on Physics. 2 (2nd ed.)., Feynman, Richard P Addison-Wesley. ISBN 978-0-8053-9065-0
11. Solid State Physics, A. J. Dekker, McMillan
12. Solid State Physics, S.O. Pillai.

13.Nanostructure and Nanomaterials, B.K. Parthasarathy
14.Introduction to Nanotechnology, B.K. Parthasarathy
15.Essentials of Nanotechnology, Rishabh Anand
16.Nanomaterials Handbook (Advanced Materials and Technologies)-YuryGogotsi (Editor) 1.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	-	-	-	-	-	-	1
CO2	3	2	1	1	-	-	-	-	-	-	-	2
CO3	2	3	1	1	-	-	-	-	-	-	-	1
CO4	1	2	2	3	-	-	-	-	-	-	-	1
CO5	2	2	2	3	-	-	-	-	-	-	-	2

Course Name: Microprocessors and Microcontrollers
Course Code: ECS401
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Prerequisite: Concept of Digital electronics

Course Objectives:

1. To understand the architectures of 8085 & 8086 microprocessors and 8051 microcontrollers.

2. To familiarize with the assembly level programming technique.
3. To understand interfacing of 8-bit microprocessor /microcontroller with memory and peripheral chips involving in system design.
4. To be able to design a microprocessor /microcontroller based system.

Course Outcomes:

On completion of this course, students will be capable of

CO1: Apply the knowledge of the internal architecture 8085/8086 microprocessors and 8051 for a specific application.
CO2: Analyzing various instructions related to particular programs for specific applications. CO3: Applying the knowledge of interfacing circuits to some real time applications
CO4: Designing various microprocessor and microcontroller based systems for a specific application.

Course Contents:

Module1: Introduction to microprocessors:

Introduction to microprocessors, Evolution of microprocessors, The 8085 Internal architecture, Pin Diagram Instruction set and Assembly Language Programming. Addressing Modes. **[7L]**

Module 2: Microprocessor Related Operations:

The 8085 microprocessor: Timing diagrams, Stack and subroutine related operation, Counter and Time delay generation, Interrupt systems, DMA operation, Introduction to Serial Communication **[7L]**

Module 3: Peripherals interfacing techniques with 8085:

Interfacing memory, Interfacing I/O devices. Programmable peripheral Interface (PPI) – Intel 8255, Programmable interval timer – Intel 8254, A/D and D/A converters, Programmable Interrupt Controller 8259A, Intel 8251 USART **[8L]**

Module 4: Intel 8086/8088 Microprocessor:

Architecture, MIN/MAX Mode, Pipeline Architecture, Register organization, Clock Generator, Resetting the microprocessor, Wait State Inserting, Bus Buffering, Pin details, Assembly Language Programming and Addressing Modes. **[4L]**

Module 5: Introduction to single chip microcontrollers:

Intel MCS-51 family features, 8051/8031 architecture, pin configuration, I/O ports and Memory organization. Instruction set and basic assembly language programming. Timer/Counter and Serial Communication, Interrupts
Assembly language programming using 8051:
Moving data, external data moves, code memory read only data moves, PUSH, POP, data exchanges

Logical instructions, Byte level, bit level instructions, ROTATE, SWAP instructions, Arithmetic instructions, Flags, incrementing, decrementing, addition, subtraction, multiplication, division, decimal arithmetic
Jump and Call instructions, Jump and Call ranges, subroutines and return instructions
MCS-51 applications: Square wave and pulse wave generation. **[10L]**

Text Books:

1. Douglas V. Hall – Microprocessors & Interfacing, Tata McGraw-Hill
2. Ramesh S. Gaonkar , Microprocessor architecture, programming and applications with 8085/8085A, Wiley eastern Ltd, 1989.
3. Ray &Bhurchandi – Advanced Microprocessors & Peripherals, Tata McGraw-Hill
4. Kenneth J. Ayala – The 8051 Microcontroller, Architecture, Programming and Applications, West Publishing Company

Reference Books:

1. B.Ram , Fundamental of Microprocessor and Microcontrollers, DhanpatRai Publications.
2. Intel Corp: The 8085 / 8085A. Microprocessor Book – Intel marketing communication, Wiley interscience publications, 1980.
3. Walter A. Tribel – The 8088 and 8086 Microprocessors, Pearson Education
4. Barry B. Brey – The Intel Microprocessors, PHI/Pearson Ed. Asia
5. Muhammed Ali Mazidi and Janice GillispieMazidi – The 8051 Microcontroller and Embedded Systems, Pearson Education Inc.
6. Ajay V Deshmukh – Microcontrollers Theory and Applications, Tata McGraw-Hill
7. MykePredko, Programming and Customizing the PIC Microcontroller (Tab Electronics).

CO-PO Mapping:

COs	P O1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	2	1	1	1	1	1	3
CO2	3	3	2	3	2	2	1	1	1	1	1	3
CO3	3	2	3	2	2	2	1	1	1	1	1	3
CO4	3	2	3	3	2	2	1	1	1	1	1	3

Course Name: Operating System
Course Code: ECS402
Contact Hours: 3:0:0
Credit: 3
Total Contact Hours: 36L

Course Objectives

1. To understand the services provided by and the design of an operating system.
2. To understand the structure and organization of the file system.

3. To understand what a process is and how processes are synchronized and scheduled.

4. To understand different approaches to memory management.

5. Students should be able to use system calls for managing processes, memory and the file system.

6. Students should understand the data structures and algorithms used to implement an OS.

Course Outcomes

CO1: Describe how computing resources such as CPU, memory and I/O are managed by the operating system.

CO2: Analyze kernel and user mode in an operating system.

CO3: Solve different CPU scheduling problem to achieve specific scheduling criteria.

CO4: Apply the knowledge of process management, synchronization, deadlock to solve basic problems.

CO5: Evaluate and report appropriate design choices when solving real-world problems

Course Content:

Module1:

Functionalities of Operating System, Evolution of Operating System. Types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed, parallel, Structural overview, Protection & Security. [5L]

Module2:

Processes: Concept of processes, process states, PCB, process scheduling, co-operating processes, independent process, suspended process, Interaction between processes and OS, Inter process communication: Message passing, Inter process communication of multi core processor. **[2L]**

Module 3:

Threads: overview, benefits of threads, user and kernel level threads, Thread models, Programming on Multithreading using Pthread. [2L]

Module 4:

CPU scheduling: scheduling criteria, preemptive& non-preemptive scheduling, scheduling algorithms (FCFS, SJF, SRTF, RR, priority, multilevel queue, multilevel feedback queue scheduling), Overview of thread scheduling [5L]

Module 5:

Process Synchronization: background, critical section problem, synchronization hardware, classical problems of synchronization (producer-consumer, readers-writer, dining philosophers, etc), semaphores, monitors. [6L]

Deadlocks: deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock. [4L]

Module 6:

Background, logical vs. physical address space, swapping, contiguous memory allocation, paging, Segmentation, TLB. [3L]

Virtual Memory: background, demand paging, page replacement algorithms (FCFS, LRU, Optimal), thrashing, Working set model. [3L]

Module 7:

Disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN,LOOK,C-LOOK etc),disk reliability, disk formatting, boot block, bad blocks. [2L]

File: File concept, access methods, directory structure, file system structure, UNIX file structure, allocation methods (contiguous, linked, indexed), free-space management (bit vector). Overview of NTFS and FAT [2L]

I/O: I/O hardware, polling, interrupts, DMA, caching, buffering, blocking-non blocking I/O. [2L]

Text Book:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts.

2. Operating Systems& Systems Programming by P Balakrishna Prasad

Reference Book:

1. Dietel H. N., "An Introduction to Operating Systems", Addison Wesley.

2. Andrew Tanenbaum, Modern Operating Systems, Prentice Hall. 3. William Stallings, Operating Systems, Prentice Hall.

CO & PO Mapping

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	2	3	3	3	2	3
CO2	3	2	2	2	2	2	3	2	2	3	3	2
CO3	3	3	3	2	3	3	3	2	2	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

Course Name: Data Base Management System
Course Code: ECS403
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Prerequisite:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Objectives

1. To learn the data models, conceptualize and depicta database system
2. To design system using E-R diagram.
3. To learn SQL& relational database design.
4. Tounderstandtheinternalstoragestructuresusingdifferentfileandindexingtechniques.
3. To know the concepts of transaction processing, concurrency control techniques and recovery procedure

Course Outcomes

On completion of the course students will be able to
CO1: Apply the knowledge of Entity Relationship (E-R) diagram for an application.
CO2: Create a normalized relational database model
CO3: Analyze real world queriest o generate reports fromat.
CO4: Determine whether the transaction satisfies the ACID properties.
CO5: Create and maintain the database of an organization.

Course Contents

Module 1: Introduction
Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS. **[3L]**

Module 2: Entity-Relationship and Relational Database Model
Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. E-R Model to Relational Model Mapping. **[5L]**

Module3:
Relational Model Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications of the Database. **[4L]**

Module 4: SQL and Integrity Constraints

Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Primary Key Integrity Constraints, Referential Integrity Constraints, Domain Constraints , assertions, views, Nested Sub-queries, Database security application development using SQL, Stored procedures and triggers. **[6L]**

Module 5: Relational Database Design

Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, 1NF, 2NF, 3NF, Boyce-Codd Normal Form, Normalization using multi-valued dependencies, 4NF, 5NF , Case Study **[6L]**

Module 6: Internals of RDBMS

Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling **[6L]**

Module 7: File Organization & Index Structures

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes **[6L]**

Text Books:

1. Henry F. Korth and Silberschatz Abraham, “Database System Concepts”, Mc.Graw Hill.
2. Elmasri Ramezand Novathe Shamkant, “Fundamentals of Database systems”, Benjamin Cummings Publishing Company.

Reference Books:

1. Jain: Advanced Database Management System CyberTech
2. Date C. J., “Introduction to Database Management”, Vol. I, II, III, Addison Wesley.
3. “Fundamentals of Database Systems”, Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition
4. “Database Management Systems”, Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill
5. Ramakrishnan: Database Management System , McGraw-Hill
6. Gray Jim and Reuter Address, “Transaction Processing : Concepts and Techniques”, Moragan Kauffman Publishers.
7. Ullman JD., “Principles of Database Systems”, Galgottia Publication.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	2	1	1	2	2	3	3
CO2	2	3	3	3	3	1	1	1	2	2	3	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3

Course Name: Data structures and Algorithms

Course Code: ECS404
Contact: 3:0:0
Total contact Hours: 36
Credits: 3

Prerequisites:

1 Familiarity with the fundamentals of C or other programming language
2. A solid background in mathematics, including probability, set theory.

Course Objectives:

1. To learn the basics of abstract data types.
2. To learn the principles of linear and nonlinear data structures.
3. To build an application using sorting and searching.

Course Outcomes:

On completion of the course students will be able to

CO1.Differentiate how the choices of data structure & algorithm methods impact the performance of program.

CO2.Solve problems based upon different data structure & also write programs.

CO3.Identify appropriate data structure & algorithmic methods in solving problem.

CO4.Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

CO5.Compare and contrast the benefits of dynamic and static data structures implementations.

Course Content:

Module 1: Linear Data Structure

Introduction:

Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code [1L]

Algorithm efficiency and analysis, time and space analysis of algorithms – order notations [1L]
Array: Different representations – row major, column major [1L]

Sparse matrix - its implementation and usage, Array representation of polynomials [1L]

Linked List: Singly linked list – operations, Doubly linked list – operations [3L]

Circular linked list – operations, Linked list representation of polynomial and applications [1L]

Asymptotic Notations Time Complexity, Space Complexity, Big-oh Notation, Big-omega Notation and Big-theta Notation [2L]

Module 2: Linear Data Structure

Stack and Queue : Stack and its implementations (using array and linked list) [1L]

Applications (infix to Postfix, Postfix Evaluation) [1L]

Queue: Linear queue, Circular queue, de-queue , Priority queue [1L]

Implementation of queue- linear and circular (using array and linked list) [1L]

Recursion: Principles of recursion - use of stack, tail recursion. [1L]

Applications - The Tower of Hanoi [1L]

Module 3: Nonlinear Data structures

Trees: Basic terminologies, forest, tree representation (using array and linked list) [1L]

Binary trees - binary tree traversal (pre-, in-, post- order) [1L]

Binary search tree- operations (creation, insertion, deletion, searching) [1L]

Threaded binary tree [1L]

Height balanced binary tree – AVL tree (insertion with examples only) [1L]

Height balanced binary tree – AVL tree (deletion with examples only) [1L]

m –Way Search Tree, B Tree, B^+ Tree and Red-Black Tree– operations (insertion, deletion with examples only) [2L]

Graphs : Graph theory review [1L]

Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) - concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge) [2L]

Minimal spanning tree – Prim's algorithm, Kruskal's algorithm (basic idea of greedy methods)[1L]

Module 4: Searching, Sorting

Sorting Algorithms:

Bubble sort, Insertion sort, Selection sort – with notion of complexity (1L) Quick sort, Merge sort – with complexity [2L]

Concept of Max-Heap and Min-Heap (creation, deletion), Heap sort [1L]

Radix sort – with complexity [1L]

Searching :Sequential search – with complexity [1L]

Binary search, Interpolation Search– with complexity [1L]

Hashing : Introduction to Hashing and Hashing functions and Collision resolution techniques [2L]

Text books:

1. Data Structures Through 'C' Language by Samiran Chattopadhyay, Debabrata Ghosh Dastidar,Matangini Chattopadhyay, Edition: 2001, BPB Publications
2. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, UniversitiesPress

Reference books:

1. Data Structures, Algorithms, and Software Principles in C by Thomas A. Standish, 1 Edition,Pearson
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India)Private Limited
3. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition,Pearson
4. Data Structures in C by Aaron M. Tenenbaum, 1St Edition,Pearson

CO-PO Mapping

CO	PO1	PO2	POP3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	2	3	3	3	2	3
CO2	3	2	2	2	2	2	3	2	2	3	3	2
CO3	3	3	3	2	3	3	3	2	2	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

Course Name: Gender Culture and Development
Course Code: HSMC402
Contact: 2:0:0
Total contact Hours: 24
Credits: 2

Course Outcomes:

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Provide an analysis of the location of women in the processes of economic development; to understand what economic development is, the scales or levels at which it occurs, and the centrality of gender at every level.

CO2: Examine theoretical and conceptual frameworks for that analysis.

CO3: Reflect upon linkages between the global economy and the gendered macro and micro process of development and transitions from 'government' to 'governance.'

CO4: Explain the usefulness of a rights based approach to gender justice.

CO5: Provide basis for research, practical action and policy formulation and or evaluating for evaluating directions and strategies for social change from a gender perspective.

Course Content

Module 1:

Introduction to Gender, Definition of Gender, Basic Gender Concepts and Terminology, Exploring Attitudes towards Gender, Social Construction of Gender [4L]

Module 2:

Gender Roles and Relations, Types of Gender Roles, Gender Roles and Relationships Matrix, Gender-based Division and Valuation of Labour [6L]

Module 3:

Gender Development Issues , Identifying Gender Issues, Gender Sensitive Language, Gender, Governance and Sustainable Development, Gender and Human Rights, Gender and Mainstreaming. [5L]

Module 4:

Gender-based Violence, The concept of violence, Types of Gender-based violence, The relationship between gender, development and violence, Gender-based violence from a human rights perspective. [5L]

Module 5:

Gender and Culture Gender and Film, Gender and Electronic Media, Gender and Advertisement, Gender and Popular Literature. [4L]

Text Books:

1. Beneria, Lourdes. (2004). Gender, Development, and Globalization: Economics as if All People Mattered. Roultedge Press. (GDGE)
2. Molyneux and Razavi. (2002). Gender Justice, Development and Rights. Oxford University Press (GJDR or WGD)
3. Visvanathan, Duggan,Wiegersma and Nisonoff. (2011). The Women, Gender and Development Reader. 2nd Edition. Zed Press (WGD)

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	1	-	2	1	-	-	-	2	3	3
CO 2	3	2	-	1	3	2	-	1	2	-	3	3
CO 3	3	2	2	-	2	3	1	-	2	1	3	3
CO 4	3	1	-	2	-	-	-	2	-	3	3	3
CO 5	3	2	-	1	-	1	2	-	2	-	3	3

Course Name: Physics II Lab
Course Code: PH(ECS)491
Contact: 0:0:2
Credits: 1
Pre requisites: Knowledge of Physics up B. Tech. 1st year Physics-I course

Course Objective:

The Physics-II course will provide

1. exposure to the physics of materials that are applied in electrical engineering
2. an insight into the science & technology of next generation and related technicalities through quantum mechanics
3. advanced materials for electrical engineering
4. concept of fundamental particles and associated applications in semiconductors

Course Outcome:

At the end of the course students' will be able to

CO1 : demonstrate experiments allied to their theoretical concepts
CO2 : conduct experiments using semiconductors , dielectric and ferroelectrics CO3 : classify various types of magnetic materials
CO3 : participate as an individual, and as a member or leader in groups in laboratory sessions actively
CO4 : analyze experimental data from graphical representations , and to communicate effectively them in Laboratory reports including innovative experiments

List of Experiments:

Experiments on Module 1: Electric and Magnetic properties of materials (8L)

1. Study of dipolar magnetic field behavior.
2. Study of hysteresis curve of a ferromagnetic material using CRO.
3. Use of paramagnetic resonance and determination of Lande-g factor using ESR setup.
4. Measurement of Curie temperature of the given sample.
5. Determination of dielectric constant of given sample (frequency dependent)/Measurement of losses in a dielectric using LCR circuits.

Experiments on Module 2: Quantum Mechanics-II (6L)

6. Determination of Stefan's radiation constant.
7. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells & measurement of maximum workable power.
8. Measurement of specific charge of electron using CRT.

Experiments on Module 4: Solid state physics (9L)

1. Determination of band gap of a semiconductor.
2. Determination of Hall co-efficient of a semiconductor and measurement of Magneto resistance of a given semiconductor

In addition to regular 7 experiments it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Probable experiments beyond the syllabus:

1. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method.
2. Determination of thermal conductivity of a good conductor by Searle's mothod.
3. Study of I-V characteristics of a LED.
4. Study of I-V characteristics of a LDR
5. Study of transducer property: Determination of the thermo-electric power at a certain temperature of the given thermocouple.
6. Innovative Experiment

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	1
CO2	2	1		3	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	1
CO4	-	-	-	-	-	-	-	-	3	-	-	-

Course Name: Microprocessor and Microcontroller Lab
Course Code: ECS491
Contact: 0:0:3
Credits: 1.5

Course Objectives:

1. To enable the students analyze microprocessors and microcontrollers.
2. To grow programming concept using microprocessor.
3. To make students able to write programs, interface with peripherals and implement them in projects.
4. To be able to choice suitable microprocessors and microcontrollers for any design and implementations.
5. To be able to interfacing microprocessors and microcontrollers with peripherals device.

Course Outcomes:

After completion of this course, the students will be able to

CO1: Write microprocessor and microcontroller based programs to solve any given problem statement.

CO2: Design microprocessor based systems for real time applications.

CO3: Design microprocessor based interfacing as per the requirements.

CO4: Design microcontroller based interfacing as per the requirements.

List of Experiment:

1. Familiarization with 8085 and 8051 trainer kit components.

a) Program development using basic instruction set (data transfer, Load/ Sore, Arithmetic, Logical) using 8085 trainer kit such as

b) Addition and subtraction

c) Copying and shifting a block of memory

d) Packing and unpacking of BCD numbers

e) Addition of BCD numbers

f) Binary to ASCII conversions

g) String matching

h) Multiplication of two numbers

i) Sorting of array of numbers

2. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit, write subroutine for delay, reading switch state & glowing LEDs accordingly, finding out the frequency of a pulse train etc.
3. Study of 8051 Micro controller kit and writing programs as mentioned in section 2.
4. Innovative experiment

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO2	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
CO3	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**1**
CO4	**2**	**3**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**1**

Course Name: Operating Systems Lab
Course Code: ECS492
Contact: 0:0:3
Credits: 1.5

Course Objectives

1. To familiarize the students with the Operating System.
2. To demonstrate the process, memory, file and directory management issues under the UNIX/LINUX operating system
3. To introduce LINUX basic commands
4. To make students how to make simple programs in LINUX and administrative task of LINUX

Course Outcomes

CO1: Analyze different aspects of Linux.
CO2: Create or design different scripts using shell programming.
CO3: Implement process, thread, semaphore concept of operating system.
CO4: Create shared memory with the implementation of reading from, write into shared memory.

List of Experiments:

1. Essential Linux Commands: Commands for files and directories cd, cp, mv, rm, mkdir, more, less, creating and viewing files, using cat, file comparisons, View files, kill, ps, who, sleep, grep, fgrep, find, sort, cal, banner, touch, file related commands – ws, sat, cut, grep etc. Mathematical commands –expr, factor, units, Pipes (use functions pipe, popen, pclose), named Pipes (FIFOs, accessing FIFO)

2. Shell Programming: Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, and commands).

3. Process [3P]: Starting new process, replacing a process image, duplicating a process image.

4. Semaphore: Programming with semaphores (use functions semget, semop, semaphore_p, semaphore_v).

5. POSIX Threads: Programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)

6. Shared Memory: Create the shared memory, Attach the shared memory segment to the address space of the calling process, Read information from the standard input and write to the shared memory,Read the content of the shared memory and write on to the standard output, Delete the shared memory .

Books:

Yashavant P. Kanetkar, UNIX Shell Programming, 1st edition, BPB Publications Beej's
Guide to Unix IPC
W. Richard Stevens, UNIX Network Programming, 2nd edition, Prentice Hall

CO &PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	-	-	-	-	-	1	-	2
CO2	-	3	2	2	-	-	1	-	-	-	-	2
CO3	3			3	-	-	-	-	1	-		
CO4	-	3	2	-	-	1	-	-	-	-	1	2

Course Name: Data Base Management System Lab
Course Code: ECS493
Contact: 0:0:3
Credits: 1.5

Prerequisite:

1. Logic of programming language
2. Basic concepts of data structure and algorithm

Course Objectives

1. To learn the data models, conceptualize and depicta database system
2. To learn the fundamental concepts of SQL queries.
3. To understand the concept of designing database with the necessary attributes.
4. To know the methodology of Accessing, Modifying and Updating data & information from the relational databases
5. To learn database design as well as to design user interface and how to connect with database.

Course Outcomes:

On completion of the course students will be able to

CO1: Understand the basic concepts regarding database, know about query processing and techniques involved in query optimization and understand the concepts of database transaction and related database facilities including concurrency control, backup and recovery.

CO2: Understand the introductory concepts of some advanced topics in data management like distributed databases, data warehousing, deductive databases and be aware of some advanced databases like partial multimedia and mobile databases.

CO3: Differentiate between DBMS and advanced DBMS and use of advanced database concepts and become proficient in creating database queries.

CO4: Analyze database system concepts and apply normalization to the database.

CO5: Apply and create different transaction processing and concurrency control applications.

List of Experiment:

1. Structured Query Language (SQL)

a. Creating Database (SQL DDL):

b. Creating a Table Specifying Relational Data Types Specifying Constraints, Creating Indexes, DROP, ALTER, TRUNCATE

c. Table and Record Handling: (SQL DML):

d. INSERT, SELECT, UPDATE etc

2. a. Retrieving Data from a Database The SELECT statement

b. Using the WHERE clause

c.Using Logical Operators in the WHERE clause

d.Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause Using Aggregate Functions Combining Tables Using JOINS

3. Sub-queries

4. Creating Column Aliases Creating Database Users Using GRANT and REVOKE

5. PL/SQL: Functions and store procedure, trigger, cursors etc.

6. Design and implementation of some online system like Library Management System, Hospital Management System etc

7. Extramural Experiment

Text Books:

1) SQL, PL/SQL by Ivan Bayross, BPB Publications
2) Oracle PL/SQL Programming, 6th Edition - O'Reilly Media By Steven Feuerstein, Bill Pribyl

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	2	1	1	2	2	3	3
CO2	2	3	3	3	3	1	1	1	2	2	3	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3

Course Name: Data structure and Algorithm Lab using C/C++
Course Code: ECS494
Contact: 0:0:3
Credits: 1.5
Perquisites: Programming for Problem Solving Lab

Course Objectives:

1. To write and execute programs in C/C++ to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs, hash tables and search trees.
2. To write and execute write programs in C/C++ to implement various sorting and searching methods

Course Outcomes:

CO1. Choose appropriate data structure as applied to specified problem definition.
CO2. Handle operations like searching, insertion, deletion, traversing mechanism on various data Structures.
CO3. Have practical knowledge on the applications of data structures.
CO4. Able to store, manipulate and arrange data in an efficient manner.
CO5. Able to implement queue and stack using arrays and linked list. Implementation of queue, binary tree and binary search tree.

List of Experiments:

1. Basic programming with C++
2. Write a C/C++ program to implement Single Link List
3. Write a C/C++ program to implement Double Link List
4. Write a C/C++ program to implement Single Circular Link List
5. Write a C/C++ program to implement Double Circular Link List
6. Write a C/C++ program to implement Polynomial addition and Polynomial multiplication using Linked List.
7. Write a C/C++ program to convert a given infix expression into its postfix Equivalent.
8. Write C/C++ programs to implement a queue ADT using i) array and ii) doubly linked list respectively.
9. Write a C/C++ program to implement Binary Search Tree (BST).
10. Write C/C++ programs for implementing the following sorting methods to arrange a list of integers in ascending order:

a. Insertion sort
b. Merge sort

11. Write C/C++ programs for implementing the following sorting methods to arrange a list of integers in ascending order:

a. Quick sort
b. Selection sort

12. Write C/C++ programs for implementing the following searching methods:

a. Linear Search
b. Binary Search

13. Write a C/C++ program to implement all the functions of a dictionary (ADT) using hashing.

14. Write C/C++ programs for implementing the following graph traversal algorithms:

a. Depth first search

b. Breadth first search

15. Innovative Experiment

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3	2	1	1	2	2	1	1
CO2	3	3	3	3	3	1	1	1	2	2	2	2
CO3	2	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3

3rd Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	T	P	Total	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC505	Principles of Management	2	0	0	2	2
2	PC	ECS501	Communication Engineering	3	0	0	3	3
3	PC	ECS502	Formal Language and Automata theory	3	0	0	3	3
4	PC	ECS503	Internet of Things and its Applications	3	0	0	3	3
5	PE	ECS504A	Object Oriented Programming with JAVA	3	0	0	3	3
		ECS504B	Information Theory and Coding					
		ECS504C	Sensors and Applications					
B. PRACTICAL								
7	PC	ECS591	Communication Engineering Lab	0	0	3	3	1.5
8	PC	ECS592	Compiler Design	0	0	3	3	1.5
9	PC	ECS593	Internet of Things Lab	0	0	3	3	1.5
10	PE	ECS594A	Object Oriented Programming with JAVA	0	0	3	3	1.5
		ECS594B	Information Theory and Coding Lab					
		ECS594C	Sensors and Applications Lab					
11	PROJECT	PR591	Minor Project I	0	0	3	3	1
12	PROJECT	PR592	Skill Development V: Soft Skill & Aptitude-II	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
14	MC	MC 501	Constitution of India	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							21.5
D. MOOCS COURSES**								
15	MOOCS COURSES	HM501	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**25.5**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

Course Name: Communication Engineering
Course Code: ECS501

Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre-Requisite: Signals and Systems, Analog and digital electronic circuits

Course Objectives:

1. To understand the building blocks of communication system.
2. To prepare mathematical background for communication signal analysis.
3. To understand and analyze the signal flow in a communication system.
4. To analyze error performance of a communication system in presence of noise and other interferences.
5. To understand concept of spread spectrum communication system.

Course Outcomes:

CO1: Able to analyze the performance of a baseband and pass band communication system in terms of error rate and spectral efficiency.
CO2: Able to perform the time and frequency domain analysis of the signals in a communication system.
CO3: Able to select the blocks in the design of a communication system.
CO4: Able to analyze Performance of spread spectrum communication system.

Course Contents:

Module1: Elements of communication system:

Basic elements of a communication system, Concept of transmitter and receiver, origin of noise and its effects in communication system, Concept and effects of SNR and its importance in system design.
Linear (AM) modulation, Generation and demodulation of AM wave. Concept of DSBSC, SSBSC and brief discussion of VSBSC. Concept of QAM.
Basic principle of nonlinear (FM, PM) modulation and their relations. Generation and demodulation of FM waves. [10L]

Module 2: Sampling and Pulse Modulation techniques:

Sampling theorem, sampling rate, impulse sampling, natural & flat-top sampling, reconstruction of signal from samples, Concept of Aliasing and anti-aliasing filter.
Quantization noise, Uniform quantization, non-uniform quantization, A-law and μ-law.
A/D and D/A conversion techniques, Concept of Bit rate, Baud rate, M-ary encoding.
Analog pulse modulation-PAM, PWM, PPM.
Fundamentals of PCM, Block diagram of PCM, Linear and non-linear PCM basic concept of Delta modulation, Adaptive delta modulation. Introduction to DPCM.
Different types of multiplexing: TDM, FDM.

[8L]

Module 3: Digital Transmission:

Basic concept of Digital communication, comparative study of digital communication and analog communication.
Encoding, coding efficiency. Line coding & its desirable properties, Different types of line coding: NRZ & RZ, AMI, Manchester coding and their spectra.
Base band pulse transmission, optimum filter, Matched filter and correlation filter, Inter Symbol Interference (ISI), Power Spectral Density (PSD)Eye pattern, Signal power in binary digital signal. [8L]

Module 4: Digital carrier modulation & demodulation technique:

Introduction to the digital modulation techniques- ASK. FSK, PSK, BPSK, QPSK, M-ary PSK and their comparisons.
Basic concept of spread spectrum modulation and CDMA. [6L]

Module 5: Introduction to coding theory:

Introduction, Measurement of Information and its unit, Entropy, Mutual information, Information rate, Basic principle of error control & error correction coding. [4L]

Text Books:

1. Modern Digital and Analog Communication systems, B.P. Lathi, Oxford University press
2. Communication Systems (Analog and Digital), Dr. Sanjay Sharma, S. K. Kataria & Sons
3. Analog communication system, P. Chakrabarty, Dhanpat Rai & Co.
4. Principle of digital communication, P. Chakrabarty, Dhanpat Rai & Co.

Reference Books:

1. Digital and Analog communication Systems, Leon W Couch II, Pearson, Education Asia.
2. An Introduction to Analog and Digital communication, Simon Haykin, Wiley India.
3. Principles of Communication Systems, Taub and Schilling, Tata McGraw-Hill Education

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2	3	-	-	-	-	1	1	1
CO2	1	2	1	3	2	-	-	-	-	2	3	1
CO3	2	2	3	2	2	-	-	-	-	2	2	2
CO4	1	3	2	3	3	-	-	-	-	2	2	1

Course Name: Formal Language and Automata theory
Course Code: ECS502
Contact: 3:0:0

Credits: 3
Total Contact Hours: 36

Prerequisite:

4. Digital Logic
5. Computer organization
6. Computer Fundamentals

Course Outcomes:

CO1: To acquire the knowledge of the basics of state machines with or without output and its different classifications
CO2: To understand synchronous sequential circuits as the foundation of digital system.
CO3: To apply techniques of designing grammars and recognizers for several programming languages.
CO4: To analyze Turing's Hypothesis as a foreword to algorithms.
CO5: To perceive the power and limitation of a computer, and take decisions on computability.

Course Content:

Module 1:
Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram
Introduction to Finite State Model (FSM), Design of sequence detector, Finite State Machine, Finite Automata, Deterministic Finite Automation (DFA) and Non-deterministic Finite Automation (NFA), Transition diagrams, Transition tables and Language recognizers.
NFA with empty transitions, Equivalence between NFA with and without empty transitions. NFA to DFA conversion.
Minimization of FSM: Minimization Algorithm for DFA, Introduction to Myhill-Nerode Theorem
Limitations of FSM, Application of Finite Automata **[9L]**

Module 2:
Finite Automata with output − Moore & Mealy machine. Representation of Moore & Mealy Machine, Processing of the String through Moore & Mealy Machine, Equivalence of Moore & Mealy Machine – Inter-conversion.
Equivalent states and Distinguishable States, Equivalence and k-equivalence, Minimization of Mealy Machine
Minimization of incompletely specified machine − Merger Graph, Merger Table, Compatibility Graph
Lossless and Lossy Machine – Testing Table, Testing Graph **[7L]**

Module 3:
Regular Languages, Regular Sets, Regular Expressions, Algebraic Rules for Regular Expressions, Arden's Theorem statement and proof
Constructing Finite Automata (FA) for given regular expressions, Regular string accepted by FA
Constructing Regular Expression for a given Finite Automata
Pumping Lemma of Regular Sets. Closure properties of regular sets **[5L]**

Module 4:
Grammar Formalism - Context Free Grammars, Derivation trees, sentential forms. Right most and leftmost derivation of strings, Parse Tree, Ambiguity in context free grammars.
Minimization of Context Free Grammars, Removal of null and unit production
Chomsky normal form and Greibach normal form.
Pumping Lemma for Context Free Languages.

Enumeration of properties of CFL, Closure property of CFL, Ogden's lemma & its applications
Regular grammars − right linear and left linear grammars
Push down Automata: Push down automata, definition. Introduction to DCFL, DPDA, NCFL, NPDA
Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence.
Equivalence of CFL and PDA, inter-conversion. **[9L]**

Module-5:
Turing Machine: Turing Machine, definition, model
Design of TM, Computable functions, Church's hypothesis, counter machine, Types of Turing machines
Universal Turing Machine, Halting problem **[6L]**

Textbook:

1. "Introduction to Automata Theory Language and Computation", Hopcroft H.E. and Ullman J. D.,Pearson Education.

Reference Books:

1. "Formal Languages and Automata Theory", C.K.Nagpal, Oxford
2. "Switching and Finite Automata Theory", Zvi Kohavi, 2nd Edition., Tata McGraw Hill

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	-	2	-	-	-	-	2	1	1
CO2	3	1	2	-	3	-	-	-	-	2	1	1
CO3	3	-	2	2	2	-	-	-	-	2	1	-
CO4	2	3	2	3	1	-	-	-	-	1	2	2
CO5	2	3	1	2	1	-	-	-	-	1	1	2

Course Name: Internet of Things and its Applications
Course Code: ECS503
Contact: 3:0:0

Credits: 3
Total Contact Hours: 36

Prerequisite:

5. Fundamental knowledge in computer networking.
6. Basic knowledge of Microcontroller fundamentals.

Course Objectives:

Students will understand the concepts of Internet of Things and can able to build IoT applications.

Course Outcomes:

On completion of the course students will be able:

CO1 Understand and differentiate the concepts of Internet of Things and Internet
CO2 Identify appropriate MAC protocols and routing protocols while solving a problem
CO3 Analyze and compare the basic protocols in wireless sensor network and IoT
CO4 Solve different real life problems in different domains based upon the concept of IoT and sensor network
CO5 Implement basic IoT applications on embedded platform

Course Content:

Module 1:
Fundamentals of IoT
The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges. [7L]

Module 2:
Wireless Sensor Network
Network & Communication aspects, ISM Band, Wireless medium access issues, MAC protocol , routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination. [6L]

Module 3:
IoT and M2M
A Basic Perspective– Introduction, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. [7L]

Module 4:
IoT Architecture
Introduction, ArchitectureReference Model- Introduction, Reference Model and architecture, IoT

reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. [7L]

Module 5:

IoT Applications for Value Creations
Introduction to Arduino and Raspberry Pi, Cloud Computing, Fog Computing and their comparison, Connected Vehicles, Data Aggregation for the IoT in Smart Cities,Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT in health care, Value for Industry, smart home Management [5L]

Module 6:

Internet of Things Privacy, Security and Governance
Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security. IoT Protocols at different Layers: MQTT, AMQP, 6LowPAN, WiFi, NFC, BLE, LTE, LoRaWAN etc [4L]

Text books:

1.Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2.Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

Reference books:

1.Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1
2.Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	3	3	2	-	-	-	-	1	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	1
CO3	3	3	3	2	2		1	-		-	1	2
CO4	3	3	3	3	3	2	2	-		-	-	1
CO5	3	3	3	3	3	2	2		2	2	1	1

Course Name: Object Oriented Programming using JAVA
Course Code: ECS504A

Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Course Objectives:

1. It allows to map with real world Object (Object orientation) rather than action (Procedure) that comes to produce software as separated code modules which rise up decoupling and increases code re-usability.
2. It demonstrates that how can you change the implementation of an object without affecting any other code by increasing data security and protecting unwanted data access. (Encapsulation).
3. It allows you to have many different functions, all with the same name, all doing the same job, but depending upon different data. (Polymorphism).
4. It guides you to write generic code: which will work with a range of data, so you don't have to write basic stuff over, and over again. (Generics).
5. It lets you write a set of functions, then expand them in different direction without changing or copying them in any way. (Inheritance)

Course Outcomes:

CO1: Design the process of interaction between Objects, classes & methods with respect to Object Oriented Programming.
CO2: Acquire a basic knowledge of Object Orientation with different properties as well as different features of Java.
CO3: Analyze various activities of different string handling functions with various I/O operations.
CO4: Discuss basic code reusability feature with respect to Inheritance, Package and Interface.
CO5**:** Implement Exception handling, Multithreading and Applet (Web program in java) programming concept in Java

Course Content:

Module 1: Introduction:
Object Oriented Analysis & Design-Concepts of object-oriented programming language, Object, Class**;** Relationships among objects and classes-Generalization, Specialization, Aggregation, Association, Composition, links, Meta-class**;** Object Oriented Programming concepts - Difference between OOP and other conventional programming advantages and disadvantages. Class, object, Method**;** Properties of OOP- message passing, inheritance, encapsulation, polymorphism, Data abstraction**;** Difference between different OOPs Languages. [5L]

Module 2: Java Basics:
Basic concepts of java programming - Advantages of java, Byte-code & JVM, Data types, Different types of Variables**;** Access specifiers, Operators, Control statements & loops**;** Array**;** Creation of class, object, method**;** Constructor- Definition, Usage of Constructor, Different types of Constructor**;** finalize method and garbage collection, Method & Constructor overloading**;** this keyword, use of objects as parameter & methods returning objects**;** Call by value & call by reference**;** Static variables & methods. Nested & inner classes. [9L]

Module 3: Basic String handling & I/O:
Basic string handling concepts- Concept of mutable and immutable string, Methods of String class- charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring()**;**

toCharArray(), toLowerCase(), toString(), toUpperCase() , trim() , valueOf() methods, Methods of String buffer class- append(), capacity(), charAt(), delete(), deleteCharAt();ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString(); Command line arguments, basics of I/O operations – keyboard input using BufferedReader & Scanner classes. [5L]

Module 4: Inheritance and Java Packages:

Inheritance - Definition, Advantages, Different types of inheritance and their implementation;Super and final keywords, super() method; Method overriding, Dynamic method dispatch; Abstract classes & methods; Interface - Definition, Use of Interface; Multiple inheritance by using Interface; Java Packages -Definition, Creation of packages; Importing packages, member access for packages. [8L]

Module 5: Exception handling, Multithreading and Applet Programming :

Exception handling - Basics, different types of exception classes. Difference between Checked & Unchecked Exception; Try & catch related case studies,Throw, throws & finally; Creation of user defined exception; Multithreading - Basics, main thread, thread life cycle; Creation of multiple threads-yield(), suspend(), sleep(n), resume(), wait(), notify(), join(), isAlive();Thread priorities, thread synchronization;Interthread communication, deadlocks for threads; Applet Programming - Basics, applet life cycle, difference between application & applet programming; Parameter passing in applets [10L]

Text books:

1. Herbert Schildt – "Java: The Complete Reference " – 9th Ed. – TMH
2. E. Balagurusamy – " Programming With Java: A Primer " – 3rd Ed. – TMH.

Reference Books:

1. R.K Das – " Core Java for Beginners " – VIKAS PUBLISHING.
2. Rambaugh, James Michael, Blaha – " Object Oriented Modelling and Design " – Prentice Hall, India
3. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	2	3	3	2	2	-	1	-	-	-	1	1
CO2	3	2	3	1	2	-	-	-	-	-	1	1
CO3	3	3	2	3	2	-	2	-	1	-	2	2
CO4	2	-	2	2	2	-	-	-	2	-	1	2
CO5	2	-	3	1	2	-	-	-	2	-	2	2

Course Name: Information Theory and Coding
Course Code: ECS504B

Contact: 3:0:0
Credits: 3
Total Contact Hours: 36
Prerequisite: Probability & Statistics

Course Outcomes:

After completion of the course students will be able to

CO1: Understand the basic concept of information and apply this knowledge in designing solution for real life engineering problem.
CO2: Understand the basic concept of coding theory and use this knowledge for designing and implementing mathematical and engineering problem leading to lifelong learning.
CO3: Understand the concept of channel models to determine the mutual information in the channels.
CO4: Outline the concept of error detection techniques and design a model for building a new solution as a professional engineering practice as a team.
CO5: Understand how convolutional theory works and develop an approach to solve it by means of existing and new methods as a team work.

Course Content:

Module 1:
Information Theory:
Introduction, Measure of Information, Average Information Content (Entropy) of a Zero Memory Source,Extension of Zero Memory Source, Entropy of a Source with Memory
[4L]

Module 2:
Source Coding
Introduction, Types of Codes, Prefix Codes, Source Coding Theorem, Shannon's Encoding Theorem, Huffman Coding, Arithmetic Coding, Lempel-Ziv Algorithm, Run Length Encoding, An Overview on Speech and Image Compression. [9L]

Module 3:
Information Channels
Introduction, Channel Models, System Entropies, Mutual Information (Trans information), Channel Capacity, Capacity of Channels, Continuous Channels [4L]

Module 4:
Error Control Coding
Introduction, Need for Error Control Coding, Types of Codes, Coding Gain, Codes , Linear Block Codes, The Hamming Codes, Cyclic Codes, Golay Codes, Shortened Cyclic, Probability of an Undetected Error Pattern for an LBC over a BSC, Equivalent Codes, CRC Code [8L]

Module 5:
Burst Error Correcting Codes
Introduction, Burst Errors, Interleaved Codes, Product Codes, Fire Codes, BCH Codes, Non-Binary BCH Codes, Reed-Solomon Code [6L]

Module 6:
Convolution Codes

Introduction, Convolution Encoder, Representation of Convolution Code, Transfer Function of a Convolution Code, Distance Properties of Convolution Codes, Decoding of Convolution Codes, Stack Algorithm, Known Good Convolution Codes [5L]

Textbook:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.

Reference Books:

1.Introduction to Information Theory - M Mansurpur; McGraw Hill.
2. Information Theory - R B Ash; Prentice Hall.
3. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	3	3	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	3	-	-	-
CO5	3	3	3	3	-	-	-	-	3	2	-	-

Course Name: Sensors and Applications
Course Code: ECS504C

Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Course Objective:

1. To deal with various types of Sensors & Transducers and their working principle.
2. To deal with Resistive, Capacitive and Inductive transducers.
3. To deal with some of the miscellaneous transducers.
4. To know the overview of different advance sensors.

Course Outcomes:

Students should be able to:
CO1: Illustrate the fundamental principles of various types of sensors.
CO2: Employ appropriate sensors to perform engineering tasks and scientific researches.
CO3: Reorganize the basics of modern sensors.
CO4: Understand the basics of the bio sensors.
CO5: Reorganize the basics of modern sensors

Course Content:

Module 1:
Introduction to the basic Sensors:
Introduction to sensors and transducers, Principles of sensing & transduction, Classification of sensors, sensitivity calculation, error estimation.
Resistive Sensing Element
Potentiometer: Loading effect, Strain gauge: Basics, types, temperature compensation, and applications: force, velocity and torque measurements.
Inductive Sensing Element
Self-inductive transducer, Mutual inductive transducers, Variable Reluctance type, Linear Variable Differential Transformer (LVDT): construction, Characteristic Curve, application: LVDT Accelerometer, LVDT displacement sensors
Capacitive Sensing Element
Capacitive transducer: Basic concepts of Variable Area Type, Variable distance type, Variable Permittivity type, calculation of sensitivities, applications [13L]

Module 2:
Piezoelectric & Piezo resistive Sensing Element
Piezoelectric effects, charge and voltage coefficients, crystal model, materials, natural and synthetic types – their comparison, force and stress sensing, piezoelectric accelerometer, piezo resistive sensor.
Tachometers: Stroboscopes, Encoders, seismic accelerometer, Measurement of vibration, Proximity switches, Load cells: pneumatic, piezoelectric, elastic and magneto-elastic types - their mounting.

Optical Sensors:
Light Dependent Resistor, Optocoupler, Photodiode, Phototransistor, Photomultiplier tube, solar cell.

Magnetic Sensors

Sensors based on Villari effect for assessment of force, torque, rpm meters, Hall Effect and Hall drive, and performance characteristics

Radioactive sensors

Gieger counter, proportional counter, Scintillation detection, Ionization chamber . [6L]

Module 3:

Miscellaneous Sensors & Their Applications: -

IC temperature Sensor, Electrochemical Gas sensors, Fibre optic sensors- Thick film technology- MEMS sensors- Nano sensors- Sensors for intelligent systems- Introduction to Smart sensors and Sensor network.

[6L]

Module 4:

Overview of biosensor & their applications in the field of medicine, agriculture, bio production, and environment. Desired characteristics of biosensors: reliability, simplicity, cost, and related parameters, operating conditions, calibration, positive and negative controls, Safety .Electrical signal transduction [5L]

Textbook:

1. Patranabis. D, "Sensors and Transducers", Prentice Hall of India, 1999.
2. John Brignell,"Intelligent Sensor Systems", CRC Press; 2nd Revised edition edition,1996
3. Brian R Eggins - Biosensors an Introduction, First edition, John Wiley & Sons Publishers, 1996.

Reference Books:

1. Doebelin. E.A, "Measurement Systems – Applications and Design", Tata McGraw Hill, New York, 2000.
2. John. P, Bentley, "Principles of Measurement Systems", III Edition, Pearson Education, 2000.
3. Murthy.D.V.S, "Transducers and Instrumentation", Prentice Hall of India, 2001.
4. Sawhney. A.K, "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, DhanpatRai& Company Private Limited, 2007.
5. Tran Minh Canh - Sensor Physics & Technology - Biosensors, First Edition, Champan & Hall, 1993.Elizabeth A Hall - Biosensors, First Edition, Open University, Milton Keynes, 1990.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	1	2	-	-	-	-	-	-	1	2
CO2	1	1	-	3	2	2	1	-	-	-	2	2
CO3	1	2	3	1	2	2	2	-	-	-	2	1
CO4	2	2	2	1	3	-	2	-	-	-	2	2
CO5	3	2	2	1	1	2	1	-	-	-	1	1

Course Name: Communication Engineering Lab
Course Code: ECS591
Contact: 0:0:3
Credits: 1.5

Course Objectives:

The course objectives are to enable the students to
1. Understand the fundamental concepts of communication systems.
2. Understand and compare different analog modulation schemes.
3. Understand and compare different digital modulation schemes.
4. Understand the design trade-offs and performance of communications systems.
5. Learn about practical communication systems

Course Outcomes:

CO1: To learn signal and linear time invariant system properties.
CO2: Study, design, and build modulation systems examining trade-offs indifferent communication systems.
CO3: To be able to perform experiments in converting analog information into digital data via sampling, quantization, and coding.
CO4: To be able to choose necessary modulation technique for specific signal transmission.

List of Experiments: -

1. Observation of modulation index in Amplitude modulation and construction of envelope for different values of modulation index.
2. Observation and generation of Double Side Band Suppressed Carrier (DSB-SC) signal.
3. Observation and generation of Single Side Band Suppressed Carrier (SSB-SC) signal.
4. Observation of Frequency Modulation & Demodulation and calculation of modulation index.
5. Generation of Time Division Multiplexing (TDM) & DE multiplexing interlacing several sampled signals using PAM.
6. To interpret Pulse Amplitude Modulation (PAM) and demodulation for various modulating voltages.
7. Generation of Pulse Width Modulation (PWM) and demodulation for various modulating voltages.
8. To analyze a FSK modulation system and interpret the modulated and demodulated Waveforms.
9. Innovative Experiment

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	1	2	2	2	-	-	-	-	-	2	1	-
CO2	1	2	3	3	-	-	-	-	-	1	1	-
CO3	1	2	3	2	-	-	-	-	-	3	3	-
CO4	3	3	2	3	-	-	-	-	-	3	2	

Course Name: Compiler Design Lab
Course Code: ECS592
Contact: 0:0:3
Credits: 1.5

Course Objective:

- To implement Lexical Analyzer using Lex tool & Syntax Analyzer or parser using YACC Tool
- To implement NFA and DFA from a given regular expression
- To implement front end of the compiler by means of generating Intermediate codes
- To implement code optimization techniques

Course Outcome:

After the completion of the course, the students will be able to
CO1: Design & conduct experiments for NFA and DFA from a given regular expression. [CO1]
CO2: Apply the knowledge of lex tool & yacc tool to develop a scanner & parser. [CO2]
CO3: Design & implement a front end of the compiler. [CO3]
CO4: Develop program for implementing symbol table. [CO4]
CO5: Develop program for solving parser problems. [CO5]
CO6: Apply the knowledge of patterns, tokens & regular expressions in programming for solving a problem in the field of data mining.

List of Experiments:

1. NFA Construction from a regular expression.
2. Conversion between NFA and DFA.
3. Use LEX tool to implement a lexical analyser.
4. Use YACC tool to implement a syntax analyser or parser.
5. Implementation of a recursive descent parser for an expression grammar that generates arithmetic expressions with digits, + and *.
6. Checking whether a string belongs to a grammar or not.
7. Calculation of leading & trailing for all the non-terminals of the given grammar.
8. Calculation of FIRST, FOLLOW of the given grammar.
9. Identifying whether a given string is a identifier or not.
10. Identifying whether a string is a keyword or not.
11. Identifying whether a string is a constant or not.

Recommended Books

[1] Das, V. V. (2007). Compiler Design using FLEX and YACC. PHI Learning Pvt. Ltd.
[2] Mason, T., & Brown, D. (1990). Lex & yacc. O'Reilly & Associates, Inc.
[3] Johnson, S. C. (1975). Yacc: Yet another compiler-compiler (Vol. 32). Murray Hill, NJ: Bell Laboratories.

CO-PO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	1	-	-	-	1	2	2
CO2	3	1	3	-	2	2	-	-	-	2	1	2
CO3	3	3	1	2	-	1	-	-	-	2	2	1
CO4	2	2	3	2	3	1	-	-	-	1	2	1
CO5	3	2	1	2	2	-	-	-	-	-	1	-
CO6	3	3	1	3	3	-	-	-	-	-	-	-

Course Name: Internet of Things Lab
Course Code: ECS593
Contact: 0:0:3
Credits: 1.5

Prerequisite: Sensors, System Integration Cloud and Network Security

Course Outcome:

After learning the course, the student will be able:

CO1: Understand internet of Things and its hardware and software components

CO2: Interface I/O devices, sensors & communication modules

CO3: Remotely monitor data and control devices

CO4: Develop real life IoT based projects

List of Experiments:

1. Define and Explain Eclipse IoT Project.
2. List and summarize few Eclipse IoT Projects.
3. Sketch the architecture of IoT Toolkit and explain each entity in brief.
4. Demonstrate a smart object API gateway service reference implementation in IoT toolkit.5.
5. Write and explain working of an HTTP- to-CoAP semantic mapping proxy in IoT toolkit.
6. Describe gateway-as-a-service deployment in IoT toolkit.
7. Explain application framework and embedded software agents for IoT toolkit.
8. Explain working of Raspberry Pi. Connect Raspberry Pi with your existing system components.
9. Give overview of Zetta.
10. Design based Problems (DP)/Open Ended Problem: 1. How do you connect and display your RaspberryPi on a Monitor Or TV? 2. Create any circuitry project using Arduino.
11. Major Equipment: Raspberry pi, Arduino

List of Open Source Software/learning website:

- https://github.com/connectIOT/iottoolkit
- https://www.arduino.cc/
- http://www.zettajs.org/
- Contiki (Open source IoT operating system)
- Arduino (open source IoT project)
- IoT Toolkit (smart object API gateway service reference implementation)
- Zetta (Based on Node.js, Zetta can create IoT servers that link to various devices and sensors)

12. Case Study: Intelligent Traffic systems (case study), Smart Parking (case study), Smart watermanagement (case study), Any other innovative experiment

CO-PO MAPPING

CO s	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	2	1	1	2	2	3	3
CO2	2	3	3	3	3	1	1	1	2	2	3	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3

Course Name: Object Oriented Programming using JAVA
Course Code: ECS594A
Contact: 0:0:3
Credits: 1.5

Prerequisites:

1. Computer Fundamentals
2. Basic understanding of Computer Programming and related Programming Paradigms

3. Problem Solving Techniques with proper logic Implementation.

Course Objectives:

- It demonstrates that how can you change the implementation of an object without affecting any other code by increasing data security and protecting unwanted data access. (Encapsulation).
- It allows you to have many different functions, all with the same name, all doing the same job, but depending upon different data. (Polymorphism).
- It guides you to write generic code: which will work with a range of data, so you don't have to write basic stuff over, and over again. (Generics).
- It lets you write a set of functions, then expand them in different direction without changing or copying them in any way. (Inheritance)

Course Outcome(s):

CO1: Create the procedure of communication between Objects, classes & methods.
CO2: Understand the elementary facts of Object Orientation with various characteristics as well as several aspects of Java.
CO3: Analyze distinct features of different string handling functions with various I/O operations.
CO4: Discuss simple Code Reusability notion w.r.t. Inheritance, Package and Interface.
CO5: Apply Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

Course Contents:

Module 1: Java Basics:

1. Simple Java programming using operators, control statements & loops, array.
2. Programming on class, object, and method, access specifier.
3. Programming on constructor, method/constructor overloading.
4. Programming on this keyword, call by value & call by reference, static variables & methods, inner classes.

Module 2: Basic String handling & I/O:Programming to show the use of String class methods - charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(), toCharArray(), toLowerCase(), toString(), toUpperCase(), trim(), valueOf() methods.

1.Programming to show the use of StringBuffer class methods - append(), capacity(), charAt(), delete(), deleteCharAt(),ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods.
2.Programming on Command line arguments.
3.Programming using keyboard input by implementing BufferedReader& Scanner classes.

Module 3: Inheritance, Interface and Java Packages:

1. Programming on Simple Inheritance, super and final keywords, super() method.

2. Programming on method overriding, dynamic method dispatch,abstract classes & methods, multiple inheritance by using interface.
3. Programming on importing system package, creating user-defined package, importing user-defined package, using protected access specifier, subclassing an imported class of a package, using same names for classes of different packages, adding multiple public classes to a package.

Module 4: Exception handling, Multithreading and Applet Programming:

1. Programming on exception handling using try-catch block, implementing throw and throws keywords, using finally block, creating user-defined exception.
2. Programming on creating child threads i) by extending thread class ii) by implementing runnable interface, creating child threads by assigning thread priorities.
3. Programming on creating simple applet to display some message, creating applet two add 2 integers, creating applet to do GUI based programming.

Textbooks:

1. Herbert Schildt – "Java: The Complete Reference " – 9th Ed. – TMH
2. E. Balagurusamy – " Programming With Java: A Primer " – 3rd Ed. – TMH.

Reference Books:

1. R.K Das – " Core Java for Beginners " – VIKAS PUBLISHING.
2. Rambaugh, James Michael, Blaha – " Object Oriented Modelling and Design " – Prentice Hall, India

CO-PO Mapping:

COs	Programme Outcomes(POs)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	-	-	-	1	-	-	1
CO2	3	2	2	-	1	-	-	-	1	-	-	2
CO3	2	3	2	3	-	-	-	-	2	-	-	-
CO4	1	-	-	-	-	-	-	-	1	2	-	2
CO5	2	1	1	-	1	-	-	-	2	-	-	2

Course Name: Information Theory and Coding Lab
Course Code: ECS594B
Contact: 0:0:3
Credits: 1.5

Course Outcome:

After completion of the course students will be able to

CO1: Understand and use proper code in appropriate platform using suitable syntax for developing program to solve problems related to Mathematics and Engineering field leading to lifelong learning.

CO2: Identify and use variables, constants, data type, operator, expression, statements, loops, vector, matrix, array, function, file handling to design the problem using modern tools for solving complex engineering problems.
CO3: Design and construct effective programs using useful resources as a professional engineering practice.
CO4: Understand, explain and analyse the problems, sketch it in effective manner and interpret it as a team work leading to solution of mathematical and engineering problem.
CO5: Interpret the result of the experiments, prepare laboratory reports based on observed output and analyze it to validate professional ethics and responsibilities and norms of the engineering practice.

List of Experiments:

1: Revision on programming using C language. Familiarization with MATLAB environment setup, syntax, variables, commands, data types, operators, decisions, loops, vectors, matrix, arrays, functions, and advanced part, creating and editing basic MATLAB program in an editor, compilation and execution of MATLAB program.

2: Determination of various entropies and mutual information using C/MATLAB of the following channels

a. Noise free channel

b. Noisy channel

3: Generation and evaluation of following variable source coding using C/MATLAB

a. Shannon – Fano coding
b. Huffman Coding and Decoding
c. Lempel Ziv Coding and Decoding

4: Coding & Decoding of the following codes using C/MATLAB: a. Linear block codes
b. Cyclic codes
c. Convolutional codes

5: Coding & Decoding of the following codes using C/MATLAB: a. BCH code
b. RS code

6: Problem based on

a. study performance of a coded and uncoded communication system (Calculate the error probability) using C/MATLAB.
b. source coding and channel coding for transmitting a text file using C/MATLAB

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	2	-	-	-	-	1	3
CO2	3	3	3	3	3	-	1	-	-	-	-	-
CO3	3	3	3	3	2	-		3	-	-	1	1

CO4	3	3	3	3	-	-		3	3	-	-	-
CO5	1	1	2	-	-	-		3	-	3	-	-

Course Name: Sensors and Its Application Lab
Course Code: ECS594C
Contact: 0:0:3
Credits: 1.5

Course Objectives:

1. To identify suitable instruments for the specific physical parameter measurement.
2. To operate Resistive, Capacitive and Inductive transducers.
3. To recommend the transducers for specific physical parameter measurement.
4. To characterize specific transducers.

Course Outcome:

CO1: Illustrate the working of transducers and various transducers used for the measurement of various physical variables.
CO2: Analyze the characteristics of the transducers.
CO3: Design sensor based on the real time application.
CO4: Estimate the design specifications of different transducers.

List of Experiment:

1.Displacement measurement by using a capacitive transducer.
2.Pressure and displacement measurement by using LVDT.
3.Study of a load cell with tensile and compressive load.
4.Torque measurement Strain gauge transducer.
5.Speed measurement using magnetic proximity sensor.
6.Speed measurement using a Stroboscope.
7.Study of the characteristics of a LDR.
8.Pressure measurement using Piezo-electric transducer
9.Study of the Characteristics of Hall-effect transducer
10. Study the measurement and transmission of bio signal.
11. Innovative experiment

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**2**
CO2	**3**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**

CO3	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**3**	**2**	**2**	**1**
CO4	**1**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**1**

3rd Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
				L	**T**	**P**	**Total**	
A. THEORY								
1	Humanities and Social Sciences including Management courses	HSMC 604	Economics for Engineers	2	0	0	2	2
2	PC	ECS601	Computer Networking	3	0	0	3	3

3	PC	ECS602	Control System Engineering	3	0	0	3	3
4	PE	ECS603A	Industrial Automation	3	0	0	3	3
		ECS603B	Software Engineering					
		ECS603C	Python Programming					
5	PE	ECS604A	Machine Learning	3	0	0	3	3
		ECS604B	Optical and Satellite communication					
		ECS604C	Digital Signal Processing					
6	OE	ECS605A	Introduction to Data Science	3	0	0	3	3
		ECS605B	Introduction to Robotics					
		ECS605C	Soft Computing					
B. PRACTICAL								
7	PC	ECS691	Computer Networking Lab	0	0	3	3	1.5
9	PC	ECS692	Control System Engineering Lab	0	0	3	3	1.5
10	PE	ECS693A	Industrial automation Lab	0	0	2	2	1
		ECS693B	Software Engineering					
		ECS693C	Python Programming Lab					
11	PROJECT	PR 691	Minor Project II	0	0	3	2	1
12	PROJECT	PR 692	Skill Development VI: Soft Skill and Aptitude-III	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 601	Intellectual Property Right	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							22.5
D.MOOCS COURSES**								
14	MOOCS COURSES	HM 601	MOOCS COURSE-IV	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**26.5**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

Course Name: Computer Networking
Course Code: ECS601
Contact: 3:0:0
Credits: 3
Total Contact Hours: 3

Prerequisite:

1. Familiarity and knowledge of Operating Systems and Computer Architecture
2. Programming languages concepts like C, Java.

Course Objectives:

1. To educate basic knowledge of networking technologies and network management concepts
2. To interpret the layering concepts in computer networks.
3. To analyze the functions of each layer and gain knowledge in different applications that use computer networks.
4. To emphasize the hand-on experience of network topology in a laboratory environment
5. To be familiar with contemporary issues in networking technologies.

Course Outcomes:

After completion of the course students will be able to

CO1: Understand Basic introduction of Computer Network along with Physical layer of OSI and TCP/IP model.
CO2: Analyze Datalink layer protocols with MAC and LAN technologies.
CO3: Design applications using internet protocols, routing and UDP,TCP.
CO4: Develop application layer protocols and understand socket programming
.

Course Contents:

Module1: Introduction to Computer Network:

Introduction: Computer Network, data communication, topology, OSI & TCP/IP Reference Models, layers and characteristics, Wireless Network, comparison to wired and wireless network

Physical Layer: Overview of data (analog & digital), signal (analog & digital), transmission (analog & digital) & transmission media (guided & unguided); Circuit switching: time division & space division switch, TDM bus; Telephone Network [6**L]**

Module 2: Data Link Layer:

Framing, Error Control, Error Detection and Correction, Flow Control, Data Link Protocols, Simple Stop-and-Wait Protocol, ARQ mechanism, Sliding Window Protocols, One-Bit Sliding Window Protocol, Go-Back-N and Selective Repeat, HDLC, PPP Medium Access Control Sub- layer, The Channel Allocation.

Multiple Access Protocols : ALOHA, Carrier Sense Multiple Access Protocols, IEEE 802.x Ethernet, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, Wireless LANs - IEEE 802.xx , Bluetooth, RFID, Bridges, Virtual LANs, Switching. [10L]

Module 3: Network Layer:

IP Addressing, IPv4 and IPv6. Difference between IPv4 and IPv6, Conversion of IPv4 and IPv6, Sub netting, Super netting, ARP, IP, ICMP and DHCP–Delivery protocols Other Protocols such as mobile IP in wireless Network. Routing: Shortest Path Algorithms, Flooding, Distance Vector Routing, Link State Routing, RIP, OSPF, BGP

Transport Layer:

Process to Process delivery; UDP; TCP, Congestion control in TCP, Quality of service: Techniques to improve QoS: Leaky bucket algorithm. [16L]

Module 4: Application Layer:

Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW: Cryptography (Public, Private Key based), Digital Signature, Firewalls

Socket Programming:Introduction to Socket Programming, UDP socket and TCP Socket [4L]

Text Books:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH
2. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI

Refeence Books:

1. Kurose and Rose – " Computer Networking -A top down approach featuring the internet" – Pearson Education
2. Leon, Garica, Widjaja – "Communication Networks" – TMH
3. Walrand – "Communication Networks" – TMH.
4. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI
5. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
6. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP

CO-PO Mapping:

COs	P O1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	1	3	-	2	-	2	-	1	-
CO2	3	2	1	2	-	1	-	1	3	1	-	2
CO3	1	3	2	2	2	-	3	-	2	-	2	1
CO4	2	2	3	-	3	2	1	-	2	1	-	1

Course Name: Control System Engineering
Course Code: ECS602
Contact: 3:0:0
Credit: 3
Total Contact Hours: 36L

Prerequisite:

The students to whom this course will offer must have the Knowledge of electrical measurement systems, basic laws of mathematics and formulation of integral and differential equations

Course Objective:

1. To apply Laplace transform and state space techniques to model dynamic systems.

2. To Demonstrate an understanding of the fundamentals of control systems.
3. To Determine the time domain responses of first and second-order systems.
4. To Analyse the system behaviour in frequency domain & the system stability using compensator.

Course Outcomes:

CO1: Describe how computing resources such as CPU, memory and I/O are managed by the operating system.

CO2: Analyze kernel and user mode in an operating system.

CO3: Solve different CPU scheduling problem to achieve specific scheduling criteria.

CO4: Apply the knowledge of process management, synchronization, deadlock to solve basic problems.

CO5: Evaluate and report appropriate design choices when solving real-world problems

Course Contents:

Module1: Mathematical Model of Physical System & Analysis in Time Domain

Introduction to Elementary control concepts: -Brief introduction, Applications area. Open loop and close loop system and their comparison. Mathematical Model of Physical Systems: - Introduction, Differential equation representation of physical systems, Transfer function concepts, Block diagram algebra, Signal flow graphs :- Mason's gain formula. Time Response Analysis: - Introduction, Review of standard test signals-Step, Ramp , Impulse , sinusoid .Time response of first order system, Design specifications of first order systems, Time response of second order systems, Design specifications of second order systems. [12L]

Module2: Stability Analysis of System in Time Domain

Stability Analysis in Time Domain: The concept of stability, Assessment of stability from pole positions, Necessary conditions for stability, Routh Stability Criterion, Relative stability analysis, Illustrative examples. Root Locus Technique: Introduction, the root locus concept, Root locus construction rules, Root contours, Advantages & limitations, Relative stability analysis using root locus. [10L]

Module 3: Stability Analysis of System in Frequency Domain

Frequency Response Analysis: Introduction, Performance Indices, Frequency response of second order systems, Polar plots, Bode plots, All pass systems, Minimum-phase and Non-minimum-phase systems, Assessment of relative stability – Gain Margin and Phase Margin, examples. Stability Analysis in Frequency Domain: Introduction, A brief review of Principle of Argument, Nyquist stability criterion, Illustrative examples. Introduction to Design: The design problem, Concepts of cascade and feedback compensation, Realization of basic compensators- Lead, Lag, Lag-Lead compensator. State variables: Concepts of state, state variables and state model, State models of linear continuous-time systems, Concept on Controllability and Observability. [14L]

Text Book:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts.

2. Operating Systems& Systems Programming by P Balakrishna Prasad

Reference Book:

1. Dietel H. N., "An Introduction to Operating Systems", Addison Wesley.

2. Andrew Tanenbaum, Modern Operating Systems, Prentice Hall. 3. William Stallings, Operating Systems, Prentice Hall.

CO & PO Mapping

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	2	3	3	3	2	3
CO2	3	2	2	2	2	2	3	2	2	3	3	2
CO3	3	3	3	2	3	3	3	2	2	3	3	2
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

Course Name: Industrial Automation
Course Code: ECS603A
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Prerequisite: knowledge of I/O in computer-based systems, knowledge of network

Course objectives:

1. To make the learner understand the benefits of using industrial automation systems
2. To make the learner acquainted with the features of PLC, DCS, and SCADA (basic architectures, networking principles, programming, I/O systems)
3. To make the learner able to program a PLC

4. To make the learner able to compare the strengths of PLC, DCS, and SCADA

Course Outcomes:

After completion of this course student will be able to:
CO1: appreciate the advantages of automated manufacturing systems

CO2: identify the uniqueness of PLC, DCS, and SCADA

CO3: select a suitable PLC or DCS or SCADA system for an automation solution, based on the type and size of the production facility

CO4: program a PLC for a given automation problem

Course Contents:

Module I: PLC [8L]

Introduction to Programmable Logic Controllers (PLCs) – Basic Architecture and Functions; Input-Output Modules and Interfacing; CPU and Memory; Relays, Timers, Counters and their uses; Ladder diagram Programming, Scan time; Applications of PLC

Module II: DCS [12L]

DCS – basic components and their functions.

HMI – operator & engineering interface, functions and requirements.

Communication – ISO/OSI reference model; data highway and Fieldbus ; HART

Network access protocols – TDMA, CSMA/CD, token passing, Master – Slave

Transmission media – twisted pair, co-axial, optical fiber ;

Network topology – mesh, ring, star, bus;

Redundancy – processor, bus and input-output level

Module III: Plant Automation [10L]

Plant Automation System network Elements of Plant Automation System (PAS) : Smart Sensors, Sensor networks, Intelligent actuators, SCADA systems, Introduction, Different Generations, I/O Modules (wired and wireless), MTU and RTU, AS-Interface.

Safety Interlocks, Sequence Controls PAS network and typical system architecture

Module IV: Case studies [6L]

Case studies- rolling mill control (system with time delay), pH control (nonlinear system), temperature control and pressure control of a boiler

Text Books:

1. R.G. Jamkar, Industrial Automation Using PLC, SCADA, and DCS, Global Education Ltd, 2018
2. R. Mehra and V. Vij, PLC and SCADA- Theory and Practice, Laxmi Publications Pvt Ltd, 2017

Reference Books:

1. M. Elshafei, Modern Distributed Control System, Amazon Digital Services, 2016
2. B.G. Liptak (ed.), Instrument Engineers' Handbook (vol.2), CRC Press, 2014

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	2	2	3	2	2	1	1	1	1	1
CO2	3	2	2	2	3	1	1	1	1	1	2	1
CO3	3	3	3	3	3	1	2	2	2	2	2	1
CO4	3	3	3	2	3	1	2	1	2	2	2	2

Course Name: Software Engineering
Course Code: ECS 603B
Contact: 3:0:0
Total contact Hours: 36
Credits: 3

Prerequisites:

Mathematics, Data Structure and Basic Computations

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Course Objectives:

In this course, students will gain a broad understanding of the discipline of software engineering and its application to the development of and management of software systems. Knowledge of basic software engineering methods and practices and their appropriate application.

Course Outcomes:

After completion of this course student will be able to

CO1: Ability to analysis and design of complex systems and meet ethical standards, legal Responsibilities.

CO2: Ability to apply software engineering principles, techniques and develop, maintain, Evaluate large-scale software systems.

CO3: To produce efficient, reliable, robust and cost-effective software solutions and perform independent research and analysis.

CO4: Ability to work as an effective member or leader of software engineering teams and manage time, processes and resources effectively by prioritizing competing demands to achieve personal and team goals.

Course Content:

Module 1:

Introduction: Definition of Software Engineering, Software crisis, Evolution of technology- Hype curve, Exploratory style of Software development vs. Software Engineering, Human cognition mechanism, Software Engineering principle- abstraction and decomposition

Software Development Life Cycle (SDLC) models: Water fall model, V-shape Model, Prototyping Model, Spiral Model, RAD Agile Model, Verification and Validation. [6L]

Module 2:

Software Project Management: Responsibility of a project manager, Project planning, Metrics for project size estimation, Project estimation techniques, COCOMO model, Halstead's Software Science, Scheduling- CPM, PERT, Gantt chart, Risk management, Software configuration management, Staffing and team leader project and planning

Requirement analysis and specification: SRS, Requirement gathering and specification, Functional requirement, Traceability. [10L]

Module 3:

Software Design: Characteristics of a good software, Cohesion and coupling, Function oriented design- DFD, Structure chart. Design phase in life cycle, System Design Definitions, Concept and methodologies, data flow oriented Design, Program Design and the requirements. Object oriented design- class and relationship, UML diagrams.

Coding and Testing: Coding Standard, software documentation, Testing- unit testing, black box testing- equivalence class partitioning, boundary value analysis, white box testing- McCabe's Cyclometric Complexity, Mutation Testing, Debugging, Program analysis tool, Integration Testing, Grey box testing, System testing- Smoke and performance testing. [15L]

Module 4:

Software Reliability and Quality Management: Reliability, Hazard, MTTF, Repair and Availability, Software quality, Software reliability and fault-tolerance, six-sigma.

Computer-aided software engineering: Computer-aided software engineering (CASE)-environment and benefit. Function point methods (FSM, ISO, OMG) & Metrics. Standards: Capability Maturity Model Integration, ISO 9001. [5L]

Text Books:

1. Rajib Mall: Software Engineering, PHI
2. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Seventh Edition, Mc Graw-Hill International Edition.

Reference Books Edition.:

1. Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
3. Software Engineering: Iyan Somarville, 7th

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	1	-	-	1	1
CO2	-	3	1	2	2	-	-	1	-	-	1	1
CO3	2	1	3	-	1	-	-	1	-	-	-	1
CO4	-	-	2	3	3	-	-	1	-	-	-	1

Course Name: Python Programming
Course Code: ECS603C
Contact: 3:0:0
Credit: 3
Total Contact Hours: 36L

Course Objective:

1. Describe the core syntax and semantics of Python programming language.
2. Discover the need for working with the strings and functions.
3. Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
4. Indicate the use of regular expressions and built-in functions to navigate the file system.
5. Infer the Object-oriented Programming concepts in Python

Course Outcomes

After the completion of the course, earner will be able to:

CO1: Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.

CO2: Express proficiency in the handling of strings and functions.

CO3: Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.

CO4: Identify the commonly used operations involving file systems and regular expressions.

CO5: Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.

Module 1:

Parts of Python Programming Language, Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language, Control Flow Statements, The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elif…else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Catching Exceptions Using try and except Statement, Functions, Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments. [8L]

Module 2:

Strings, Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, Lists, Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement. [7L]

Module 3:

Dictionaries, Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement, Tuples and Sets, Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Tuple Methods, Using zip() Function, Sets, Set Methods, Traversing of Sets, Frozenset. [7L]

Module 4:

Files, Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules, Regular Expression Operations, Using Special Characters, Regular Expression Methods, Named Groups in Python Regular Expressions, Regular Expression with glob Module [7L]

Module 5:

Object-Oriented Programming, Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, The Polymorphism. [7L]

TEXT BOOK

1. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372

REFERENCE BOOKS / WEBLINKS:

1. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-1491912058
2. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 2nd Edition, O'Reilly Media, 2019. ISBN – 13: 978-9352139057.
3. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365
4. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", 2nd Edition, O'Reilly Media, 2018. ISBN-13: 978-1491991732.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3	1	-	-	-	1	1	1
CO2	2	2	2	1	3	1	-	-	-	2	1	2
CO3	3	3	2	2	3	2	-	-	-	-	2	1
CO4	2	2	2	2	3	2	-	-	-	2	2	1
CO5	3	3	2	2	3	-	-	-	-	-	1	1

Course Name: Advanced Machine Learning
Course Code: ECS604A
Contact: 3:0:0
Credit: 3
Total Contact Hours: 36L

Prerequisites:

Probability, Linear Algebra, Multivariable Calculus, Programming

Course Objectives:

1. This introductory course gives an overview of many concepts, techniques, and algorithms in machine learning related to classification and regression problems.
2. The course will give the student the basic ideas and intuition behind modern machine learning methods as well as a bit more formal understanding of how, why, and when they work.
3. The underlying theme in the course is statistical inference as it provides the foundation for most of the methods covered.

4. Make use of Data sets in implementing the machine learning algorithms

Course Outcome:

At the end of the course students will be able to:

CO1: Recognize the characteristics of machine learning that make it useful to real-world problems.
CO2: Characterize machine learning algorithms as supervised, semi-supervised, and unsupervised.
CO3: Be able to use support vector machines.
CO4: Understand the learning algorithm for hidden Markov model with latent variables.

Course Contents:

Module1: Basics of Linear Algebra:

Introduction to Machine Learning, linear classification, perceptron update rule, Perceptron convergence, generalization, Maximum margin classification, Classification errors, regularization. [8L]

Module2: Logistic regression

Linear regression, estimator bias and variance, active learning, Active learning, non-linear predictions, Regression/Classification Basic methods: Distance-based methods, Nearest Neighbors, Decision Trees, Kernel regression, kernel optimization, Model selection criteria, Description length, feature selection, expectation maximization [9L]

Module 3: Classification

Classification problems; decision boundaries; nearest neighbor methods, Probability and classification, Naive Bayes, Bayes' Rule and Naive Bayes Model, Hidden Markov models (HMMs), Bayesian networks, Learning Bayesian networks, Logistic regression, online gradient descent, neural network, support vector machine (SVM), kernel ridge regression. [10L]

Module 4: Introduction to Deep Learning
Definition, Need of Deep Learning, Different Techniques: ANN, CNN, Recursive Neural Deep Model, Framework: Tensorflow, Tensorflow light [9L]

Text Books
1. Machine Learning. Tom Mitchell. First Edition, McGraw-Hill.
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

Reference Books:

1. Simon Haykin, Neural Networks and Learning Machines Third Edition, Pearson Publisher.
2. Christopher M. Bishop, Pattern Recognition and Machine Learning (Information Science andStatistics), Springer, 2006.
3. Pattern Classification. Richard Duda, Peter Hart and David Stock. Second Edition Wiley Interscience.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	-	2	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	3	-
CO3	2	-	-	2	3	-	-	-	2	-	2	-
CO4	1	3	3	-	2	-	-	-	-	-	1	-

Course Name: Optical and Satellite communication
Course Code: ECS604B
Contact: 3:0:0
Credit: 3
Total Contact Hours: 36L

Prerequisite:
The students to whom this course will offer must have the Knowledge of Optoelectronics, Communication Engineering

Course Objective:

1. To make understand the students about the huge applicability of fiber communication w.r.t the copper cable
2. To make understand the students about different features of the Optical fiber communication like better transmission quality, high data rate, larger BW
3. To make understand the students about the essentiality of Satellite communication
4. This course is facilitating the students to apply the basic principles of optical communication systems & the satellite communication systems to maintain different types of applications based on it.

Course Outcome:
The students will be able to:
CO1: Interpret the functions of the various blocks of optical fiber communication
CO2: Measure the optical fiber enable parameters
CO3: Select relevant architecture of the optical networks for the given applications
CO4: Visualize the architecture of satellite systems as a means of high speed, high range communication system.
CO5: State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
CO6: Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Course Content:

Module 1: Fundamentals of Optical Fiber Communication:
Basics of Optical fiber: Construction and classification of Optical fiber (in brief), working, advantages, disadvantages, applications

Optical fiber communication: block diagram and explanation, splicing technics, connectors.
Surface Plasmon polariton: SPP, LRSPP, Plasmonics and its applications. Low loss waveguide [6L]

Module 2: OTDR:
Different types of losses in optical fibers, anticipatory actions and remedial arrangements
OTDR: block diagram, working principles, specifications and applications [5L]

Module 3: Optical Networks:
Optical Networks components, use and features: Amplifiers, splitters and optical switches
WDM: basic concepts and features
SONET/ SDH: Architecture and Hierarchy
Ethernet Standards of Optical Network features: IEEE 803.2j, 803.2y, 803.2z [7L]

Module 4: Overview of Satellite System:
Introduction to Satellite Communication: Principles and architecture of satellite Communication, Earth segment, Space Segment, active and passive satellite, geostationary and geosynchronous satellites
advantages, disadvantages, applications and frequency bands used for satellite communication-uplink & down link frequency. Orbital Mechanics: Orbital equations, Kepler's laws, LEO, MEO, GEO, Elliptical orbit.
Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day. [5L]

Module 5: Satellite Segments & Services:
Satellite Earth Station: Block diagram, Satellite sub-systems: Antenna subsystem, LNA, Power subsystem, Attitude and orbit control system (AOCS), Communication sub-system, etc.
Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Telemetry Tracking and Command (TTAC) subsystem
Spinning satellite stabilization, Momentum wheel Stabilization, Station keeping, thermal control transponder: Single, Double conversion, Regenerative type. [6L]

Module 6: Transmission Loss and Applications:
Space link: Equivalent Isotropic Radiated Power (EIRP)
Transmission losses: Free-space transmission loss, Feeder losses, Antenna misalignment losses, Fixed atmospheric and Ionosphere losses
Satellite Applications: GPS: concept, working principle, transmitter and receiver
VSAT: Overview, Architecture, working principle, architecture [7L]

Text books:
1. John M. Senior, Optical Fibre Communications, PHI
2. R.P. Khare, Fiber Optics and Optoelectronics, Oxford
3. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002

Reference Books:
1. P. Bhattacharjee, Semiconductor Optoelectronic Devices, PHI
2. John Wilson and John Hawkes, Optoelectronics- An Introduction, PHI
3. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009
4. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009

CO-PO Mapping:

CO	PO1	PO2	PO 3	PO 4	P O5	PO 6	PO 7	PO 8	PO 9	P10	P11	P12	PS O1	PS O2
CO1	3	2	3	2	1	1	-	3	2	1	2	1	3	3
CO2	3	2	2	3	3	1	-	2	1	1	1	2	2	2
CO3	3	2	2	1	2	1	-	2	1	1	3	2	1	1
CO4	3	3	2	2	3	1	-	3	2	1	2	3	3	1
CO5	3	2	2	3	2	1	-	2	2	1	2	2	2	1
CO6	3	2	2	3	2	1	-	2	2	1	1	2	2	2

Course Name: Digital Signal Processing
Course Code: ECS604C
Contact: 3:0:0
Credit: 3
Total Contact Hours: 36L

Prerequisite: Analog Electronics circuit, Signals & Systems, Analog Filters

Course Objective:

1. To develop the knowledge on signals used in digital signal processing.
2. To impart the knowledge of the principles of discrete-time signal analysis to perform various signal operations
3. Apply the principles of Fourier transform analysis to describe the frequency characteristics of discrete-time signals and systems
4. To study various sampling techniques and different types of filters
5. To learn the use of computer programming tools to create, analyze process and visualize signals and to plot and interpret magnitude and phase of LTI system frequency responses
6. To understand the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation.

Course Outcomes

The students will be able to:
CO1: Apply the knowledge about continuous and discrete time signals
CO2: Understand the Fourier Transform, and examine the process of Quantization and the effects of finite register length
CO3: Understand and implement DFTs on long data sets such as speech signals and images. CO4: Develop different types of FIR & IIR filter structures and their implementations
CO4: Use of FFTs for efficient implementation of linear convolution
CO5: Excel in fields such as speech processing, audio signal processing, digital image processing, video and audio compression.

Course Content:

Module 1: LTI systems:

Concept of signals & systems, digital signal processing and its relevance to digital communication.
Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercise, properties of convolution, interconnection of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems. [8L]

Module 2: Discrete Fourier Transform:

Concept of frequency in discrete and continuous domain and their relationship (radian and radian/sec), freq. response in the discrete domain. Discrete system's response to sinusoidal/complex inputs (DTFT), Representation of LTI systems in complex frequency domain.
Concept and relations for DFT/IDFT; Relation between DTFT & DFT; Twiddle factors and their properties; DFT/DFT as linear transformation and matrices ; Computation of DFT/IDFT by matrix method; Properties of DFT – periodicity, linearity, time reversal, circular time & frequency shift, symmetry, circular symmetry, duality, multiplication of two DFTs, circulation convolution, circular correlation ; Computation of circular convolution by graphical; Linear filtering using DFT, aliasing error, filtering of long data sequences- Overlap- Save and Overlap-Add methods.

Fast Fourier Transforms: Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithm, signal flow graph, Butterflies, computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises. [14L]

Module 3: Filter Design:

Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transform. Concept of Chebyshev filters and comparison with Butterworth filter. Design of linear phase FIR filters -no. of taps, rectangular, Hamming and Blackman windows. Effect of quantization. Some examples on practical filters.

Multirate Digital Signal Processing: Introduction to multirate digital signal processing, sampling rate conversion, multistage interpolator & decimator, digital filter banks. [2L]

Module 4: Digital Signal Processor:

Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713 processor, writing of small programs. [6L]

Text Books:

1. Digital Signal Processing–Principles,Algorithms and Applications, J.G.Proakis&D.G.Manolakis, Pearson Ed.
2. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co.
3. Digital Signal Processing Signals, Systems and Filters, A. Antoniou, TMH Publishing Co.

4. Digital Signal processing – A.V. Oppenheim,R.W.Schafer, Prentice Hall
5. Discrete-time Signal processing – A.V. Oppenheim,R.W.Schafer, John R. Buck, Prentice Hall

Reference Books:

1. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj& C. Gnanapriya, TMH Publishing Co.
3. Digital Signal Processing; A Hands on Approach, C. Schuler &M.Chugani, TMH Publishing Co.
4. Digital Signal Processing,A. NagoorKani, TMH Education
5. Digital Signal Processing S. Poornachandra& B. Sasikala, MH Education
6. Digital Signal Processing; Spectral Computation and Filter Design Chi-Tsong Chen, Oxford University Press
7. Texas Instruments DSP Processor user manuals and application notes.
8. Digital Signal Processing: A MATLAB-Based Approach, V.K.Ingle and J.G.Proakis, Cengage Learning
9. Modern Digital Signal Processing,V. Udayashankara, PHI Learning

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	1	1	1	2	2	1	2	2
CO2	3	3	1	2	1	1	2	1	1	1	1	1
CO3	3	3	1	3	3	3	1	1	1	1	1	1
CO4	3	3	3	3	1	2	1	1	1	1	1	1
CO5	3	3	3	3	3	1	1	1	1	1	1	1

Paper name: Introduction to Data Science
Paper code: ECS605A
Contacts: 3L
Credits: 3
Total contact hours: 36

Course objectives:

1. To make the learner understand the data analysis, regression, and regularization
2. To make the learner acquainted with data classification, classification, and feature engineering
3. To make the learner able to apply text mining
4. To make the learner understand network analysis

Course Outcomes:

Upon completion of this course, the learner will be able to:

CO1: Select and evaluate a model
CO2: Classify data
CO3: Use the technique of clustering
CO4: Use text mining and retrieve information

Module I: [10L]

Introduction to data science, Exploratory data analysis, Linear regression and

regularization, Model selection and evaluation

Module II: [10L]

Classification: kNN, decision trees, SVM; Ensemble methods: random forests,

Naïve Bayes and logistic regression (10L)

Module III: [8L]

Feature engineering and selection, clustering: k-means, hierarchical clustering,

Dimensionality reduction: PCA and SVD (8L)

Module IV: [8L]

Text mining and information retrieval, Network Analysis, Recommender systems (8L)

Text Books:

1. Herbert Jones, Data Science, Bravex Publication, 2020
2. Joel Grus, Data Science from Scratch, O'Reilly, 2015

Reference Books:

1. G. Anand and R. Sharma, Data Science Fundamentals and Practical Approaches, BPB Publication, 2020
2. F. Provost and T. Fawcett, Data Science for Business, Shroff, 2013

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	3	2	3	2	2	1	1	1	1	2
CO2	3	2	3	2	3	2	1	1	2	1	2	1
CO3	3	3	3	3	3	1	1	1	2	2	2	1
CO4	3	3	3	2	3	2	1	2	2	2	2	2

Course Name: Introduction to Robotics
Course Code: ECS605B
Contact: 3:0:0
Credit: 3
Total Contact Hours: 36L

Course Objective:

1. Impart knowledge about basic mathematics related to industrial robots for their control.
2. Design and application of robotics & automation in modern Industries.

Course Outcomes

CO1: Perform kinematic and dynamic analyses with simulation. Design control laws for a simple robot.
CO2: Integrate mechanical and electrical hardware for a real prototype of robotic device.
CO3: Select a robotic system for given industrial application.
CO4: Use of robots in domestic applications.

Course Contents:

Module1: Introduction to Robotics:
Types and components of a robot, Classification of robots, Robotic kinematics systems; Concept of mechanisms and manipulators, Definition of Degrees of Freedom [6L]

Module2: Introduction to Robot Kinematics and Dynamics:
Concept of Kinematic Modeling: Translation and Rotation Representation, Coordinate transformation, Forward and inverse kinematics, Jacobian, Singularity, and Statics, Denavit–Hartenberg parameters, Concept of Dynamic Modeling such as Forward and inverse dynamics, Equations of motion by using Euler-Lagrange formulation and Newton Euler formulation. [8L]

Module 3: Robotic Sensors and Actuators:
Robotic Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc. Introduction to Cameras, calibration techniques, Geometry of the Image formation, Different transforms such as Euclidean or Projective transformations, Different types of vision applications in robotics.
Actuators: Electric, Pneumatic and Hydraulic actuators, Parameters for selection of actuators, Transmission Gears, Timing Belts and Bearings. [5L]

Module 4: Robot Control:

Basics of control: open loop and closed loop, Definition of transfer functions, Control mechanisms, P, PD, PID, Linear and Non-linear controls. [7L]

Module 5: Embedded Systems for Robotics and control hardware interfacing mechanisms:
Embedded Systems, Microprocessors and Microcontroller Architecture and interfacing with robotic sensors, actuators and other components, Programming techniques for Industrial robot. [6L]

Module 6: Artificial Intelligence in Robotics
Applications in unmanned systems, examples: defense, medical, industries, etc. Robotics and Automation for Industrial benefits, Robot safety and social robotics [4L]

Text Books:

1. Introduction to Robotics: J. Craig, Pearson
2. Robot Dynamics and Control, Spong&Vidyasagar, McGraw Hill
3. Robotics Engineering: R. Klafter, PHI
4. Robotics: Subir K Saha, McGrawHill
5. Industrial Robotics: M. P. Groover, AshishDutta, McGraw Hill

Reference Book:

1. Richard Paul, Robot Manipulators: Mathematics, Programming and Control, MIT Press, 1981
2. Robert Shilling, Fundamentals of Robotics, Prentice-Hall , 2003
3. Laxmidhar Behera and Indrani Kar, “Intelligent Systems and Control”, Oxford University Press, Nov

2009.
4. M. Felix Orlando, Laxmidhar Behera, Tomayo Tamei, Tomohiro Shibata, Ashish Dutta and Anupam Saxena," On Redundancy Resolution of the Human Thumb, Index and Middle Fingers in Cooperative Object Translation," Robotica, vol. 35, pp. 1992-2017, 2016.

CO & PO Mapping

COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	1	3	2	1	2	1	2	3
CO2	1	2	2	3	2	1	3	2	4	2	1	2
CO3	1	2	2	1	2	2	3	3	2	3	2	2
CO4	1	3	2	1	3	2	1	3	3	3	2	3

Course Name: Soft Computing
Course Code: ECS605C
Contact: 3:0:0
Credit: 3
Total Contact Hours: 36L

Prerequisite:
Knowledge of set theory, nervous system, and biological evolution

Course Objective:

1. To make the learners understand the advantages of soft computing techniques
2. To make the learners understand the different aspects of fuzzy logic and fuzzy reasoning
3. To make the learners understand the different aspects of artificial neural networks
4.To make the learners understand the different aspects of genetic algorithm

Course Outcomes

After the completion of the course, earner will be able to:
CO1: justify the use of fuzzy logic for decision making in presence of uncertainty
CO2: design a fuzzy logic control system for a continuous-time plant with single i/p-single o/p
CO3: compare the supervised and unsupervised learning techniques in artificial neural networks
CO4: explain the operation of genetic algorithm-based optimization technique

Course Contents:

Module1: Soft Computing and Fuzzy logic
Soft-computing-definition, advantage over conventional computing, areas of application Fuzzy Sets, membership function and membership value, linguistic variable

Fuzzy operators, T- Norms and S- Norms
Fuzzy relations, implications, cylindrical extensions, projection Fuzzification and defuzzification [10L]

Module2: Fuzzy reasoning and fuzzy logic control

Fuzzy extension principle, compositional rule of inference, approximate reasoning (fuzzy reasoning)
Different Fuzzy models-Mamdani's model, Sugeno's model (T-S-K model)
Fuzzy logic control system, fuzzy PID controller [12L]

Module 3: Genetic algorithm

Genetic Algorithm (GA)- basic concept, components-chromosome and gene, GA operators, methods of selection, elitism
Fuzzy-GA system [5L]

Module 4: Artificial neural networks

Artificial neural network (ANN)- basic concept, areas of application, McCulloch and Pitts model, perceptron, realization of logic gates, training of ANN, Supervised and unsupervised learning-techniques and comparison Neuro-fuzzy system [9L]

Text Books:

1. D.Dirankov, H. Hellendoorn, and M.Reinfrank, An Introduction to Fuzzy logic control,Narosa
2. S.Rajasekaran and G.A.V. Pai, Neural Networks, Fuzzy logic and Genetic Algorithm: Synthesys and Applications, Pearson Education
3. J.S.R.Jang, C.T. Sun and, E.Mizutani, Neuro-fuzzy and soft Computing, Pearson Education
4. T.J.Ross, Fuzzy Logic with Engineering Applications, Wiley (India)

Reference Book:

1. Simon Haykin, Neural Networks- A Comprehensive Foundation, Prentice Hall
2. B.Yegnanarayana, Artificial Neural Networks, PHI

CO & PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	1	1	1	-	-	-	-	-	2
CO2	3	-	3	1	3	2	-	-	-	-	-	2
CO3	3	-	1	2	1	3	-	-	-	-	-	2
CO4	3	-	1	2	1	2	-	-	-	-	-	2

Course Name: Computer Networking Lab
Course Code: ECS691
Contact: 0:0:3
Credits: 1.5

Prerequisite: Require the Basic Linux commands and little bit programming languages concepts like C, Java.

Course Objectives:

1. Familiarization with Network devices, cables and other tools.
2. To implement Different protocols of Transport Layer like UDP, TCP.
3. Implementing different Routing protocols of Network Layer.
4. To interpret different congestion control Algorithms
5. To analyze the functions of each layer and gain knowledge in different applications that use computer networks.
6. To emphasize the hand-on experience of network topology in a laboratory environment

Course Outcomes:

CO1: Installation of different Network devices, simulators, hardware connection using cables and other tools.
CO2: Demonstrate TCP & UDP using socket program.
CO3: Develop the code for Data link layer protocol simulation.
CO4: Examine the performances of Routing protocol with congestion control algorithm using network simulator

List of Experiment:

1. Familiarization of UNIX or Linux environment, UNIX or Linux general Commands specially

Network Commands. Familiarization of Internetworking - Network Cables - Color coding - Crimping.

Internetworking Operating Systems – Configurations

2. Implementation of flow control mechanisms

3. Socket Programming using TCP and UDP

4. Implementing routing protocols such as RIP, OSPF.

5. Familiarization of advanced simulators like Packet Tracer, NS2/NS3, OMNET++, TinyOS

Server Configuration: only web server (If time permit..instructor can do more than that)

Text Book:

1. B. A. Forouzan – "Data Communications and Networking (3rd Ed.) "– TMH
2. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI

Reference Book:

1. Kurose and Rose – "Computer Networking -A top down approach featuring the internet" – Pearson Education
2. Leon, Garica, Widjaja – "Communication Networks" – TMH
3. Walrand – "Communication Networks" – TMH.
4. Comer – "Internetworking with TCP/IP, vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	-	-	-	-	2	-	-	1
CO2	-	2	1	-	-	-	2	-	3	-	1	1
CO3	1	3	-	2	2	-	1	-	2	-	1	-
CO4	2	2	-	-	3	2	-	-	2	1	-	1

Course Name: Control System Engineering Lab
Course Code: ECS692
Contact: 0:0:3
Credits: 1.5
Prerequisite: Student should have the knowledge of MATLAB with SIMULINK

Course Objective:

1. Will have a strong knowledge on MATLAB software.
2. They get the basic knowledge on practical control system.
3. To get the Design applications of control system.
4. They get the knowledge of stability analysis of different control systems.

Course Outcome:

The students will be able to:
CO1: Apply formulate transfer function for given control system problems.
CO2: Demonstrate an understanding of the fundamentals of control systems.
CO3: Determine time response of given control system model.
CO4: Analyze the system behaviour through Root Locus, Bode plots & Nyquist plot fora given control system model.

List of Experiments:

1. Familiarization with MATLAB & SIMULINK control system toolbox.
2. Study of impulse, step, ramp & sinusoidal response for first and second order system with unity feedback and calculation of parameters for different system designs.
4. Modelling of a first order system and its response analysis.
5. Modelling of a second order system and its response analysis.
6. Simulation of impulse response for types 0, 1 and 2 with unity feedback using MATLAB.
7. Determination of root-locus, using MATLAB toolbox for a given second order transfer function and analysis of result.
8. Bode plot, using MATLAB toolbox for a given second order transfer function and analysis of result.
9. Nyquist plot using MATLAB toolbox for a given second order transfer function and analysis of result.
10. Study of position control system (AC/DC).
11. Innovative Experiment

Text Books:

1: B. C. Kuo “Automatic Control Systems” 8th edition– by 2003– John wiley and son’s.,
2: I. J. Nagrath and M. Gopal, “Control Systems Engineering” New Age International (P) Limited, Publishers, 2nd edition.

Reference Books:

1. Katsuhiko Ogata "Modern Control Engineering" Prentice Hall of India Pvt. Ltd., 3rd Edition, 1998.
2. N.K.Sinha, "Control Systems" New Age International (P) Limited Publishers, 3rd Edition, 1998.
3.NISE "Control Systems Engg." 5th Edition – John wiley
4. Narciso F. Macia George J.
Thaler, "Modeling & Control of Dynamic Systems" Thomson Publishers

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	2	2	3	1	2	-	-	-	-	-	2	3
CO2	1	3	1	3	2	-	-	-	-	-	1	2
CO3	2	2	3	1	2	-	-	-	-	-	3	1
CO4	3	3	1	2	1	-	-	-	-	-	2	2

Course Name: Industrial Automation Lab
Course Code: ECS693A
Contact: 0:0:3
Credits: 1.5

COURSE OUTCOME:

After completion of the laboratory course students will be able to:

CO1: Recognize & explain basic elements of an automated process (controller, actuator, final control element) via hands on experiment.

CO2: Control different process variable (flow, pressure, level & temperature) using DCS

CO3: Develop and test ladder diagram for different application

CO4: Use SCADA for an automated process

Experiments:

1. Study of a automatic control system
2. Monitoring and control of Temperature Control Loop using DCS
3. Monitoring and control of Pressure Control Loop using DCS
4. Monitoring and control of Flow Control Loop using DCS
5. Monitoring and control of Level Control Loop using DCS
6. Study of PLC field device interface modules (AI,AO,DI,DO modules) and software
7. Programming Logic Gates Function in PLC Ladder Logic
8. Develop /Execute a ladder program for the given application using following:- timer, counter, comparison, logical, arithmetic instruction.
9. Develop/ test ladder program to blink LED/lamp.

10. Develop Ladder Logic for Traffic light Control System and test it through PLC using Ton instruction.
11. Logic for counting the objects
12. Use various functions of SCADA simulation editors to develop simple project.

CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	2	2	3	1	2	1	2	1	2	1
CO2	3	3	3	3	3	1	2	2	2	1	3	1
CO3	3	3	3	3	3	1	2	2	2	1	3	2
CO4	3	3	2	3	3	1	2	2	1	1	3	2

Course Name: Software Engineering Lab
Course Code: ECS693B
Contact: 0:0:3
Credits: 1.5

Course Objective:

Demonstrate the UML diagrams with ATM system descriptions, Demonstrate the working of software testing tools with c language, Understanding Project Planning Tools.

Course Outcome:

CO1: Ability to analysis and design of complex systems and meet ethical standards, legal responsibilities

CO2: Ability to apply software engineering principles, techniques and develop, maintain, evaluate large-scale software systems.

CO3: To produce efficient, reliable, robust and cost-effective software solutions and perform independent research and analysis.

CO4: Ability to work as an effective member or leader of software engineering teams and manage time, processes and resources effectively by prioritizing competing demands to achieve personal and team goals.

List of Experiments:

1. Identifying the Requirements from Problem Statements
2. Requirements, Characteristics of Requirements, Categorization of Requirements,Functional Requirements, Identifying Functional Requirements

3. Estimation of Project Metrics
4. Project Estimation Techniques -COCOMO, Basic COCOMO Model, Intermediate COCOMO Model, Complete COCOMO Model, Advantages of COCOMO, Drawbacks of COCOMO, Halstead's Complexity Metrics
5. Modeling UML Use Case Diagrams and Capturing Use Case Scenarios
6. Use case diagrams, Actor, Use Case, Subject, Graphical Representation, Association between Actors and Use Cases, Use Case Relationships, Include Relationship, Extend Relationship, Generalization Relationship, Identifying Actors, Identifying Use cases, Guidelines for drawing Use Case diagrams
7. Identifying Domain Classes from the Problem Statements
8. Introduction to selenium tool for software testing.
9. JUnit, Static analysis, Junit Framework
10. Prepare a SRS document in line with the IEEE recommended standards
11. Draw the use case diagram and specify the role of each of the actors. Also state the pre condition, post condition and function of each use case.
12. Draw the sequence diagram for any two scenarios.
13. Draw the collaboration diagram.
14. Draw the state chart diagram & component diagram.
15. Draw the deployment diagram.

Text Book

1. Rajib Mall: Software Engineering, PHI
2. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", SeventhEdition, Mc Graw-Hill International Edition

Reference Book

1. Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.Software Engineering: Iyan Somarville, 7th Edition

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	2	-	-	-	2	-	-	2	-	-	1	1
CO2	1	3	-	1	2	-	-	1	-	-	1	2
CO3	1	2	3	2	-	-	-	1	-	-	-	-
CO4	1	2	1	2	-	-	-	1	-	-	2	2

Course Name: Python Programming Lab
Course Code: ECS693C
Contact: 0:0:3

Credits: 1.5

Course Objectives:

To be able to introduce core programming basics and program design with functions using Python programming language.

To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.

To understand the high-performance programs designed to strengthen the practical expertise.

Course Outcomes:

CO1: Student should be able to understand the basic concepts scripting and thecontributions of scripting language

CO2: Ability to explore python especially the object-oriented concepts,

C O 3 : Ability to implement built-in objects of Python.

CO4: Ability to create practical and contemporary applications such as TCP/IP network programming, Web applications, discrete event simulations

List of Programs:

1. Write a program to demonstrate different number data types in Python.
2. Write a program to perform different Arithmetic Operations on numbers in Python.
3. Write a program to create, concatenate and print a string and accessing sub-stringfrom a given string.
4. Write a python script to print the current date in the following format "Sun May 2902:26:23 IST 2017"
5. Write a program to create, append, and remove lists in python.
6. Write a program to demonstrate working with tuples in python.
7. Write a program to demonstrate working with dictionaries in python.
8. Write a python program to find largest of three numbers.
9. Write a Python program to convert temperatures to and from Celsius, Fahrenheit.[Formula: c/5 = f-32/9]
10. Write a Python program to construct the following pattern, using a nested for loop

```
*
* *
* * *
* * * *
* * * * *
* * * *
* * *
* *
*
```

11. Write a Python script that prints prime numbers less than 20.
12. Write a python program to find factorial of a number using Recursion.
13. Write a program that accepts the lengths of three sides of a triangle as inputs. The program output should indicate whether or not the triangle is a right triangle (Recall from the Pythagorean

Theorem that in a right triangle, the square of one side equals the sum of the squares of the other two sides).

14. Write a python program to define a module to find Fibonacci Numbers and import themodule to another program.
15. Write a python program to define a module and import a specific function in that module to another program.
16. Write a script named **copyfile.py**. This script should prompt the user for the names of two text files. The contents of the first file should be input and written to the second file.
17. Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.
18. Write a Python class to convert an integer to a roman numeral.
19. Write a Python class to implement pow (x, n)
20. Write a Python class to reverse a string word by word.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	2	3	3	1	2	-	-	-	-	-	2	2
CO2	3	3	2	1	1	-	-	1	-	-	1	2
CO3	1	2	3	2	2	-	-	2	-	-	1	1
CO4	1	2	1	-	1	-	-	1	-	-	1	2

Course Name: Intellectual Property Right
Course Code: MC601
Contact: 2:0:0
Credit: 2

Total Contact Hours: 24L

Course Outcomes:

On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Explain fundamental aspects of Intellectual Property Rights to students
CO2: To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
CO3: To disseminate knowledge on copyrights and its related rights and registration aspects
CO4: To disseminate knowledge on trademarks and registration aspects
CO5: To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
CO6: To aware about current trends in IPR and Govt. steps in fostering IPR

Course Content

Module 1:
Overview of the IPR: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - International organizations. agencies and treaties [4L]

Module 2:
Patents- Trips Definition, kind of inventions protected by Patent-Patentable and Non patentable inventions. Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Le8al requirements for patents — Granting of patent - Rights of a patent-exclusive right. Patent application process: Searching a patent- Drawing of a patent- Filing of a patent- Types of patent applications- Parent document: specification and Claims.
Registration Procedure, Rights and Duties of Patentee, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties [4L]

Module 3:
Trademarks- Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - trade mark registration processes. [4L]

Module 4:
Copyrights- Right and protection covered by copyright - Law of copy rights: Fundamental of copyright law. originality **of material,** rights of reproduction, rights to perform the worth publicly, copy right ownership issues, obtaining copy right registration, notice of copy right. International copy right law. Infringement of Copyright under Copyright Act

The Role arid Liabilities of lPRs in India - Cyberlaw issues: Criminal law. data safety, online privacy. Health privacy, Freedom of expression and human rights, net neutrality, national security. [4L]

Module 5:
Geographical Indication of Goods: Types, why and how GI need protection and GI laws. Indian GI act.
Industrial Designs: protection. Kind of protection provided by industrial designs. Integrated Circuits [4L]

Module 6:
India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes IPR – Career Opportunities in IP - IPR in current scenario with case studies [4L]

Text book:

1. Fundamentals oflP for Engineers: K.Bansl& P.Bansal
2. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
3. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

Reference book: 1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	2	3	-	-	2	-	2	3	3
CO2	3	1	-	1	-	-	1	-	1	-	3	3
CO3	3	-	1	2	3	-	-	2	-	2	3	3
CO4	3	1	-	1	-	-	1	--	1	-	3	3
CO5	3	-	2	-	2	3	-	-	-	2	3	3
CO6	3	2	-	1	-	-	-	2	2	-	3	3

4th Year 1st Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours/Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PE	ECS701A	Embedded System Design	3	0	0	3	3
		ECS701B	Digital Image Processing					
		ECS701C	Cloud Computing					
2	PE	ECS702A	Quantum Computing	3	0	0	3	3
		ECS702B	Information theory and Coding					
		ECS702C	Wireless Sensor Network					
3	OE	ECS703A	Power Electronics	3	0	0	3	3
		ECS703B	Virtual Instrumentation					
		ECS703C	Artificial Intelligence					
4	OE	ECS704A	Electromagnetic Wave	3	0	0	3	3
		ECS704B	Cyber Law and Ethics					
		ECS704C	Cryptography and Network Security					
B. PRACTICAL								
5	PE	ECS 791A	Embedded System Design Lab	0	0	0	3	1.5
		ECS 791B	Digital Image Processing Lab					
		ECS 791C	Cloud Computing Lab					
6	OE	ECS 793A	Power Electronics Lab	0	0	2	2	1
		ECS 793B	Virtual Instrumentation Lab					
		ECS 793C	Artificial Intelligence Lab					
7	PROJECT	PR 791	Major Project-I	0	0	0	4	2
8	PROJECT	PR 792*	Industrial Training / Internship	0	0	0	0	1
9	PROJECT	PR 793	Skill Development VII: Seminar and Group Discussion	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 781	Entrepreneurship & Innovation Skill	2	0	0	2	0
TOTAL CREDIT WITHOUT MOOCS COURSES								18
D.MOOCS COURSES**								
11	MOOCS COURSES	HM701	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								**22**

***Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).**

**** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET**

Course Name: Embedded System Design

Course Code: ECS701A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre-Requisite: Knowledge of Microprocessor and Microcontroller.

Course Objectives:

1. An ability to design a system, component, or process to meet desired needs within realistic constraints.
2. Ability to understand microcontroller, microcomputer, embedded system.
3. Understand different components of a micro-controller and their interactions.
4. To become familiar with the programming environment used to develop embedded systems.
5. Understand key concepts of embedded systems like IO, timers, interrupts, interaction with peripheral devices
6. Learn debugging techniques for an embedded system

Course Outcomes:

After completion of the course, the students will be able to

CO1: Understand the architecture and classifications of different embedded systems and the related programming knowledge.

CO2: Understand the concepts of embedded systems like I/O, timers, interrupts, interaction with peripheral devices

CO3: Choose case-specific debugging technique for an embedded system.

CO4: Design various real time systems using embedded systems

Course Contents:

Module1:

Introduction to the Embedded System: Embedded system Vs General computing systems, Purpose of Embedded systems, classifications of embedded systems, fundamentals of embedded processor and microcontrollers, CISC vs. RISC, ASIC. [5L]

Module 2:

Serial and parallel communication: devices and protocols, wireless communication: devices and protocols, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth. [9L]

Module 3:

Program Modeling Concepts ; Fundamental issues in Hardware software co-design, Unified Modeling Language(UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system [5L]

Module 4:

Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS [5L]

Module 5:

PIC microcontroller: introduction, architecture, comparison of PIC with other CISC and RISC based systems and microprocessors, assembly language programming, addressing modes, instruction set, interfacing with various sensors and actuators using PIC microcontroller. Programming concepts and embedded programming, embedded architecture [12L]

Text Books:

1. Introduction to Embedded Systems: Shibu K. V. (TMH)
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)
3. Embedded Systems: Rajkamal (TMH)
4. Embedded Systems: L. B. Das (Pearson)

Reference Books:

1. Embedded System design: S. Heath (Elsevier)
2. Embedded microcontroller and processor design: G. Osborn (Pearson)
3. Programming PIC microcontrollers with PIC basic by chuck helebuyck
4. PIC microcontrollers-programming in basic by Milan verle

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	1	2	-	-	-	2	-	3	1
CO2	2	1	3	2	1	-	-	-	1	-	2	-
CO3	2	2	3	1	1	-	-	-	1	-	1	3
CO4	3	2	2	-	-	-	-	-	-	-	1	2

Course Name: Digital Image Processing
Course Code: ECS701B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Objectives:

To become familiar with:

1. Digital image fundamentals
2. Transform of Digital Images and its applications
3. Simple image enhancement techniques in both spatial and frequency domains.
4. Image compression, recognition, restoration segmentation and representation techniques
5. The Edge detection & Security in Digital Image Processing.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

CO1: Mathematically represent the various types of images and analyze them.
CO2: Process these images for the enhancement of certain properties or for optimized use of the resources.
CO3: Develop algorithms for image compression and coding

CO4: Explaining the Edge detection & Security in Digital Image Processing & Demonstrate the basic steps of Video processing

Module 1: (5L)
Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling

and quantization, basic relationships between pixels - neighborhood, adjacency, connectivity, distance measures.

Module 2: (6L)
Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications,
pixel-domain smoothing filters - linear and order-statistics, pixel-domain sharpening filters - first and second derivative, two-dimensional DFT and its inverse, frequency domain filters -low-pass and high-pass.
Color Image Processing-Color models-RGB, YUV, HSI; Color transformations- formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Module 3: (7L)
Image Segmentation- Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.
Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform,

Module 4: (7L)
Time frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub band filter banks, wavelet packets.
Image Compression-Redundancy-inter-pixel and psycho-visual; Lossless compression - predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards-JPEG and JPEG-2000.

Module 5: (6L)
Fundamentals of Video Coding-Inter-frame redundancy, motion estimation techniques - full-search, fast search strategies, forward and backward motion prediction, frame classification - I, P and B; Video sequence Hierarchy-Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards - MPEG and H.26X.

Module 6: (5L)
Video Segmentation-Temporal segmentation-shot boundary detection, hard-cuts and soft-cuts; spatial segmentation-motion-based; Video object detection and tracking.

Text/Reference Books:

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

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	3	1	2	1	2	-	-	-	3	-	3	1
CO2	3	1	3	2	1	-	-	-	2	-	2	-
CO3	2	2	2	1	2	-	-	-	2	-	1	3
CO4	3	2	2	1	-	-	-	-	1	-	1	2

Course Name: Cloud Computing
Course Code: ECS701C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite

1. Should have the basic knowledge of Operating Systems.
2. Should be aware of the fundamental concepts of Networking.
3. Should have knowledge of heterogeneous systems and resource management.

Course Objective(s):

- To learn the workflow of cloud business model and optimized resource allocation.
- To gain knowledge of cloud service and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.
- To learn virtualization techniques, load balancing, and work strategy of different cloud infrastructure.
- To know the security and privacy issues in cloud infrastructure

Course Outcome(s):

CO1: To articulate the business model concepts, architecture and infrastructure of cloud computing, including cloud service models and deployment models.
CO2: To apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.
CO3: To explore some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.
CO4: To analyze the core issues of cloud computing such as security, privacy, interoperability, and

its impact on cloud application.

Course Contents:

Module 1: Definition of Cloud Computing and its Basics [8L]

Definition of Cloud Computing: Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public, Private, Hybrid and Community Clouds), Service models – Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/ service providers, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing [3]
Cloud Architecture: Cloud Infrastructure, Architecture of each component, Virtualization versus Traditional Approach, Virtualization Model for Cloud Computing. [2]
Services and Applications by Type [3]
IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos.
PaaS – Basic concept, tools and development environment with examples
SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform
Identity as a Service (IDaaS) Compliance as a Service (CaaS)

Module 2: Use of Platforms in Cloud Computing [6L]

Concepts of Abstraction and Virtualization [2L]

Virtualization technologies: Types of virtualizations, Load Balancing and Virtualization: Basic Concepts,

Network resources for load balancing; Classification of Virtualization Environment: Scheduling-based Environment, Load-Distribution-Based Environment, Energy Aware-Based Environment, Operational-Based Environment, Distributed Pattern-Based Environment, Transactional-Based Environment
Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine imaging (including mention of Open Virtualization Format – OVF) [2L]
Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance
Concepts of Platform as a Service [2L]
Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development. Use of PaaS Application frameworks.

Module 3: Cloud Service Models [6L]

Use of Google Web Services [2L]
Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service.
Use of Amazon Web Services [2L]
Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store, Amazon SimpleDB and Relational Database Service

Use of Microsoft Cloud Services [2L]
Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services

Module 4: Cloud Infrastructure [10L]

Types of services required in implementation – Consulting, Configuration, Customization and Support
Cloud Management [3L]
An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle)

Live Migration of Virtual Machines: [2L]
Need of Live Migration of Virtual Machine, A Designing Process of Live Migration, and Security Issues during live migration.

Concepts of Cloud Security [3L]
Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security, Identity and Access Management.
Auditing and Compliance in Cloud Environment: [2L]
Data Security in Cloud Computing Environment, Need for Auditing in Cloud Computing Environment, Third Party Service Provider, Cloud Auditing Outsourcing Lifecycle Phases, Auditing Classification.

Module 5: Concepts of Services and Applications [6L]

Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA
architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs [6]

Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs [2]

Cloud-based Storage: Cloud storage definition – Manned and Unmanned. [1]
Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services [1]

Textbooks:

1.Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India)PrivateLimited,2013

2. Fundamentals of Cloud Computing by P. K. Pattnaik, S. Pal, M. R. Kabat, Vikas Publications, 2014.

Reference Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013

2. Cloud Computing: A Practical Approach, Anthony T. Velte, Tata Mcgraw-Hill

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1	-	-	-	1	1	2	-	2
CO2	3	3	2	2	1	-	1	2	2	2	-	2
CO3	2	2	-	1	3	-	2	1	1	-	-	1
CO4	-	1	-	3	2	-	2	-	-	1	-	-

Course Name: Quantum Computing
Course Code: ECS702A
Contact: 3:0:0
Total Contact Hours: 36

Credits: 3

Prerequisites: Discrete Structures

Course Objective(s):

The objective of this course is to provide:

1. the students an introduction to quantum computation.
2. Much of the background material related to the algebra of complex vector spaces and quantum mechanics is covered within the course.

Course Outcome(s):

After completion of the course students will be able to:

CO1 : Understand the basic idea of quantum computing including background of mathematics and physics required for developing and solving complex engineering problem in the domain of quantum computing possibly using modern engineering tools.

CO2 : Understand and explain the concept of quantum circuits using single and multiple qubit gates and also designing of quantum circuits for solving engineering problem including societal and environmental issues.

CO3: Compare between classical and quantum information theory and explain and apply Bell states, Quantum teleportation, Quantum Cryptography and no cloning theorem in solving engineering problem possibly in a team maintain proper ethics of professional collaboration.

CO4 : Understand, explain and apply different quantum algorithms including classical computation on quantum computers like Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search and also relate between quantum and classical complexity classes for solving engineering problem.

CO5: Understand noise and error correction including graph states and codes, quantum error correction, fault-tolerant computation and apply it in designing and solving complex engineering problems leading to their lifelong learning.

Course Content:

Module1: Introduction to Quantum Computation: 8L

Quantum bits, Bloch sphere representation of a qubit, multiple qubits. Background Mathematics and Physics: Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics
of quantum mechanics, Measurements in bases other than computational basis.

Module2: Quantum Circuits: 6L

Single qubit gates, multiple qubit gates, design of quantum circuits.

Module3: Quantum Information and Cryptography: 6L

Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.

Module4: Quantum Algorithms: 8L
Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.

Module5: Noise and error correction: 8L
Graph states and codes, Quantum error correction, fault-tolerant computation.

Text book:
1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms

Reference Books:
1. P Kaye, R Laflamme and M Mosca, An Introduction to Quantum Computing.
2. Eleanor G. Rieffel , Wolfgang H. Polak , "Quantum Computing - A Gentle Introduction" (Scientific and Engineering Computation)
3. Yanofsky's and Mannucci, Quantum Computing for Computer Scientists.
4. Riley Tipton Perry, "Quantum Computing from the Ground Up", World Scientific Publishing Ltd.
5. Scott Aaronson, "Quantum Computing since Democritus", Cambridge.
6. P. Kok, B. Lovett, "Introduction to Optical Quantum Information Processing", Cambridge.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	-	1	-	-	2
CO2	3	3	3	3	2	2	2	-	1	-	-	2
CO3	3	2	2	3	1	2	1	2	2	-	-	2
CO4	1	2	2	2	1	1	2	2	-	-	-	2
CO5	2	3	3	1	-	1	2	-	-	-	-	3

Course Name: Information theory and Coding
Course Code: ECS702B
Contact: 3:0:0
Total Contact Hours: 36

Credits: 3

Prerequisites: Probability & Statistics

Course Outcome(s):

After completion of the course students will be able to

CO1: Understand the basic concept of information and apply this knowledge in designing solution for real life engineering problem.
CO2: Understand the basic concept of coding theory and use this knowledge for designing and implementing mathematical and engineering problem leading to lifelong learning.
CO3: Understand the concept of channel models to determine the mutual information in the channels.
CO4: Outline the concept of error detection techniques and design a model for building a new solution as a professional engineering practice as a team.
CO5: Understand how convolutional theory works and develop an approach to solve it by means of existing and new methods as a team work.

Course Content:

Module-1: Information Theory[4L]

Introduction, Measure of Information 1L
Average Information Content (Entropy) of a Zero Memory Source 1L
Extension of Zero Memory Source 1L
Entropy of a Source with Memory 1L

Module 2: Source Coding [9L]

Introduction, Types of Codes, Prefix Codes 1L
Source Coding Theorem 1L
Shannon's Encoding Theorem 2L
Huffman Coding 1L
Arithmetic Coding 1L
Lempel-Ziv Algorithm 1L
Run Length Encoding 1L
An Overview on Speech and Image Compression. 1L

Module 3: Information Channels [4L]

Introduction, Channel Models. 1L
System Entropies 1L
Mutual Information (Trans information), Channel Capacity 1L
Capacity of Channels, Continuous Channels 1L

Module 4: Error Control Coding [8L]

Introduction, Need for Error Control Coding, Types of Codes, Coding Gain, Codes 2L
Linear Block Codes 1L
The Hamming Codes, 1L
Cyclic Codes 1L
Golay Codes, Shortened Cyclic 1L
Probability of an Undetected Error Pattern for an LBC over a BSC, Equivalent Codes 2L

Module 5: Burst Error Correcting Codes [6L]

Introduction, Burst Errors 1L
Interleaved Codes 1L
Product Codes, Fire Codes 1L
BCH Codes 1L
Non-Binary BCH Codes 1L
Reed-Solomon Codes 1L

Module 6: Convolution Codes [5L]

Introduction, Convolution Encoder 1L
Representation of Convolution Code, Transfer Function of a Convolution Code 1L
Distance Properties of Convolution Codes, Decoding of Convolution Codes 1L
Stack Algorithm, 1L
Known Good Convolution Codes 1L

Textbook:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.

2. Information and Coding - N Abramson; McGraw Hill.

Reference Books:

1.Introduction to Information Theory - M Mansurpur; McGraw Hill.

2. Information Theory - R B Ash; Prentice Hall.

3. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	2	-	-	-	-	-
CO2	3	3	3	2	2	2	2	-	1	1	-	3
CO3	3	2	3	3	1	2	2	-	-	-	-	2

CO4	**3**	**2**	**1**	**2**	**1**	**1**	**-**	**-**	**3**	**-**	**-**	**1**
CO5	**3**	**3**	**1**	**3**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**1**

Course Name: Wireless Sensor Network
Course Code: ECS702C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: The candidates should have the basic knowledge of communication and networks.

Coarse Objective(s):

The objective of this course is to provide:

1. the concept of various types of Wireless Sensors and their applications
2. the concept of sensor networks and the challenges

Course Outcome(s):

After successful completion of this course, students should be able to:

CO1: Understand the fundamentals of wireless sensor networks and its application.

CO2: Study the various protocols at various layers and its differences with traditional protocols.

CO3: Realize the issues pertaining to sensor networks and the challenges.

CO4: Employ appropriate sensors to perform engineering tasks and scientific researches

Course Content:

Module I [6L]: Introduction:

Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

Module II [8L]: **Introduction to adhoc/sensor networks:**

Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.

Module III [8L]: MAC **Protocols:**

Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

Module IV [8L]: Routing Protocols:

Issues in designing a routing protocol, classification of necessary routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical and power aware routing protocols

Module V [6L]: **QoS and Energy Management:**

Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.

Text Books:

1. C. Siva Ram Murthy&B. S. Manoj, "AdHoc Wireless networks ", Pearson Education

2. Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication

Reference Books:

1. Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition

2. William Stallings, "Wireless Communications and Networks ", Pearson Education

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	3	2	1	2	2	2	1	1	1
CO2	3	2	1	2	2	3	2	1	2	1	2	2
CO3	2	3	2	3	1	2	1	2	2	2	2	1
CO4	1	1	1	2	1	1	-	-	3	1	1	1

Course Name: Power Electronics
Course Code: ECS703A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Knowledge of analog electronics & circuit theory.

Course Objective:

1. To understand the constructional features and characteristic of power semiconductor devices
2. To understand the working principle and switching operation of different semiconductor devices.
3. To prepare the students to analyze and design different power converter circuits.
4. To implement the different power supply modules.

Course Outcome:

CO1: Acquire knowledge about fundamental concepts and techniques used in power electronics.

CO2: Ability to express characteristics of SCR, BJT, MOSFET and IGBT.

CO3: Ability to analyze & design of various single phase and three phase power converter, inverters circuits and understand their applications.

CO4: To develop skills to build, and troubleshoot power electronics circuits like SMPS, Intelligent power module, etc's.

Module I:

Power Semiconductor Devices & switching devices: [8L]

Rectifier diodes, fast recovery diode and Schottky barrier diode, BJT, Thyristor (SCR), TRIAC, GTO, MOSFET, IGBT and MCT.

Module II:

Thyristor triggering & commutation techniques: [7L]

UJT and RC triggering circuit, resonant commutation, self commutation, auxiliary commutation, Complementary commutation.

Module III:

Converters: [11L]

Rectifiers: Single phase and three phase controlled bridge rectifiers, DC to DC converters (Choppers): principle of step up and step down converters, DC to AC converters (inverters) : Single phase and three phase inverters, Cycloconverters : Single phase to single phase and three phase to single phase circuits, blocked group operation, circulating current mode.

Module IV:

Applications: [8L]

Modern trends in industrial drives and control; AC motor drives in transportation system and traction; induction heating, electronic ballast, UPS, Intelligent power modules.

Text Books:

1. P.C. Sen, Power Electronics, TMH, New Delhi

2. M. H. Rashid, Power Electronics, PHI/Pearson Education

3. C. W. Lander, Power Electronics, Mc Graw Hill

Reference Books:

1. Mohan N, Underland T M & Robbins W P – Power Electronics, John Wiley &Sons

2. P. S. Bimbhra – Power Electronics, KhannaPublishers

3.Soumitra Kumar Mandal- Power Electronics, Mc Graw HillEducation

CO-PO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	3	2	-	-	1	2	1
CO2	1	2	3	2	2	3	1	-	-	2	1	3
CO3	2	2	2	2	1	1	1	-	-	2	2	3
CO4	1	1	1	1	3	1	2	-	-	2	2	2

Course Name: Virtual Instrumentation
Course Code: ECS703B
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36

Prerequisite:

Sensors and Transducers, Process Instrumentation, Programming Languages, Communication Engineering

Course Objective:

The objective of this course is:

1. To introduce the concept of virtual instrumentation
2. To develop basic VI programs using loops, case structures etc. including its applications in image, signal processing and motion control

Course Outcome:

After the successful completion of the course the students will be able to:

CO1: To explain the working of LabVIEW.
CO2: To Understand the various types of structures used in LabVIEW.
CO3: To analyze and design different type of programs based on data acquisition.
CO4: To apply the knowledge of LabVIEW for signal processing, image processing etc.

Module I: **[8L]**

Review of Virtual Instrumentation:

Historical perspective, Block diagram and Architecture of Virtual Instruments Data, Review of measurement systems- analog systems, digital systems Flow Techniques: Graphical programming in data flow, Comparison with conventional programming.

Module II: **[10L]**

Virtual instrumentation in LabVIEW:

Introduction (Front Panel, Block Diagram), Data Types, Operators, Instructions, Graphs, Plots

Module III: **[10L]**

VI Programming Techniques:

VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O. Virtual Instrument projects

Module IV: **[8L]**

Data Acquisition Basics:

ADC, DAC, DIO, Counters and timers**.**

Data acquisition boards – Serial ports: RS-232, USB ; Parallel ports: IEEE-1284, GPIB standard IEEE-488.2 , System buses, Interface buses: PCMCIA, VXI, SCXl, PXI, etc.

Text Books:

1. Johnson, G., LabVIEW Graphical Programming, McGraw Hill (2006).
2. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996).
3. Gupta, S. and Gupta, J.P., PC Interfacing for Data Acquisition and Process Control, Instrument Society of America (1988)

Reference Books:

1. Jeffrey Travis, Jim Kring, LabVIEW for Everyone: Graphical Programming Made Easy and Fun
2. Nitesh Pradhan, Let Us LabVIEW: Part 1, Notion Press
3. 2. Nitesh Pradhan, Let Us LabVIEW: Part 2, Notion Press

CO-PO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	P10	P11	P12
CO1	3	1	2	1	1	1	2	1	-	2	3	3
CO2	1	1	1	3	2	2	2	2	-	2	2	2
CO3	1	3	2	2	2	1	1	1	-	1	1	1
CO4	2	2	2	3	2	1	1	1	-	1	-	1

Course Name: Artificial Intelligence

Course Code: ECS703C

Contacts: 3:0:0

Total Contact Hours: 36

Prerequisites:

Linear algebra and probability theory. Basic understanding of control systems and computing.

Course Outcome:

CO1: Demonstrate fundamental understanding of the history of artificial intelligence (AI) and itsfoundations.

CO2: Apply basic principles of AI in solutions that require problem solving, inference, perception,knowledge representation, and learning.

CO3: Gain knowledge of Elements of robots

CO4: Calculate the forward kinematics and inverse kinematics of serial and parallel robots

CO5: Able to do the motion planning & control for a robotic system

Course Contents:

Module-I: Introduction: [2L]

Foundations and History of Artificial Intelligence & Robotics, Turing Test, Intelligent Agents, classificationand usage of robots.

Module-II: Searching and Problem Solving: [5L]

Problem formulation with suitable examples, -8 puzzle problem, Tower of Hanoi, Data driven and goal driven search, Uninformed search strategies -Breadth-first search, Depth first search, Bidirectional search, Hill climbing, simulated annealing.

Module-III: Knowledge Representation and Reasoning: [5L]

Introduction to data, information and Knowledge, Propositional logic, first order predicate logic (FOPL), Rule of inference, Inference engine, knowledge representation technique, Forward and Backward reasoning, Bayes' rule and Bayesian Networks.

Module-IV: Learning: [6L]

General model of learning agents, Inductive learning, learning decision trees, decision trees as performance elements, induction decision trees from example, Neural Networks (Network structures, Single layer feed- forward neural network, Multilayer feed-forward neural network, learning weights), classification & clustering concept.

Module-V: Elements of robots: [6L]

Position and orientation of a rigid body, Homogeneous transformations, Representation of

joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo motors, Purpose of sensors– tachometers, strain gauge-based force-torquesensors, proximity sensors and vision.

Module-VI: Kinematics of robots: [8L]
Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace ofa serial robot, Inverse kinematics of constrained and redundant robots, Degrees of- freedom of parallelmechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators.

Module-VII: Motion planning and control: [4L]
Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes.

TEXT BOOKS:

1. Artificial Intelligence: A Modern Approach, Russell & Norvig, Prentice Hall.
2. Robotics: Fundamental Concepts and Analysis, Ashitava Ghosal, OXFORD University Press.
3. Artificial Intelligence, Elain Rich and Kevin Knight, TMH.

REFERENCE BOOK:

1. Jacek M. Zurada, “Introduction to Artificial Neural Systems”, PWS Publishers
2. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	3	1	1	1	1	1	1	3
CO2	3	3	3	1	3	1	1	1	1	1	1	3
CO3	3	3	3	3	3	2	2	1	1	1	2	3
CO4	3	3	3	3	3	2	2	1	1	2	1	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3

Course Name: Electromagnetic Wave
Course Code: ECS704A
Contacts: 3:0:0
Total Contact Hours: 36

Prerequisite: Concept of physics , vector analysis

Course Objective(s):

1. To acquire the knowledge of Electromagnetic field theory that makes the student to get a theoretical foundation to be able in the future to design emission , propagation and reception of electromagnetic wave systems
2. To identify, formulate and solve the problems related to fields and electromagnetic waves propagation in a multidimensional frame
3. Understand the basic concepts of electric and magnetic fields
4. To provide the students with a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies
5. Understand the concept of conductors, dielectrics, inductance and Capacitance, Gain knowledge on the nature of magnetic materials. Understand the concept of static and time varying fields.

Course Outcome(s):

Student will be able to:
CO1: understand and interpret the physical meanings of gradient, divergence and curl, vector calculus and orthogonal coordinates.
CO2: apply the concept of steady fields and different associated laws in different cases and mediums and realize the physical significances of Maxwell's equations for static field.
CO3: solve different problems of the time varying fields and correlate the Poynting vector and Poynting theorem and understand the thorough treatment of the theory of electro dynamics, mainly from a classical field theoretical point of view, and includes such things as electrostatics and magneto statics, boundary conditions.
CO4:analyze the wave equations, and be able apply the concepts in transmission line, wave guide and universal concepts in three-dimension real world.

Course content:

Module I: Introduction to the Electromagnetic Theory:

Vector calculus – orthogonal Coordinate Systems, Curvilinear co-ordinate system (basics). Transformations of coordinate systems; Del operator; Gradient, Divergence, Curl – their physical interpretations; Divergence Theorem, Stoke's Theorem, Laplacian operator.**6L**

Module II: Coulomb's law, electric field intensity, charge distribution.; Gauss' law, flux density and electric field intensity. Current Densities, Conductors, Poisson's & Laplace's equations, Uniqueness theorem, Biot-Savart law, Ampere's law, Relation between J & H, Vector magnetic Potential. Maxwell's equations for static field. Study of different Applications on static fields using MATLAB Programming
6L

Module III:

Faraday's law & Lenz's law, Displacement Current, J C – J D Relation, Maxwell's equations for time varying field, Time harmonic fields, Maxwell's equations for time harmonic field, Wave Equation, Boundary Conditions between media interface; Uniform Plane wave; Wave Propagation in Lossy Dielectric, Loss-less Dielectric, Free space, good conductor, skin effect and skin depth. Poynting Theorem, Power flow, Poynting vector. Wave polarizations. **10L**

Module IV

Transmission Lines: Concept of Lump parameters and Distributed parameters, Line Parameters,

Transmission line equations and solutions, Physical significance of the solutions. Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation, group velocity, phase velocity; Distortion-
less Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith chart, Load Matching Techniques. **7L**

Module V

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.
Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna **7L**

Text Books:

1. Mathew N.O.Sadiku , Principles of Electromagnetics, 4thEdition

2. W.H. Hayt& J.A. Buck, Engineering Electromagnetics, 7th Edition, Tata-McGraw-Hill

Reference Books:

1. Edminister , Theory and Problems of Electromagnetics , 2nd Edition, Tata-McGraw-Hill

2. S.P.Seth, Elements of Electromagnetic Fields

3. Syed Hasan Saeed And FaizanarifKhan , Electromagnetic FieldTheory

4. G.S.N. Raju , Electromagnetics Field Theory & Transmission Lines, Pearson

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	-	-	-	1	1	2
CO2	3	2	1	1	2	1	-	-	-	1	1	1
CO3	3	2	2	3	1	2	-	-	-	1	2	1
CO4	3	3	1	3	3	2	-	-	-	2	1	1

Course Name: Cyber Law and Ethics
Course Code: ECS704B
Contacts: 3:0:0
Total Contact Hours: 36

Prerequisite:
1. Familiarity in computer Networking.
2. Basic concepts about network security.

Course Objective(s):
- To understand, explore and acquire acritical understanding of Cyber Law.
- To learn the basics of a Cyber security
- To develop competencies for dealing with frauds and deceptions (Confidence Tricks, Scams)

Course Outcome(s):

CO1: To understand the importance of professional practice, Law and Ethics in their personal lives and professional careers.
CO2: To acquire in depth knowledge of information technology act, security policies, and legal framework of right to privacy, data security and data protection
CO3: To develop the understanding of relationship between commerce and cyberspace
CO4: To be familiar with network security threats and countermeasures

Course Contents:
Module – 1: Introduction of Cybercrime [7L]
Cybercrime, Forgery, Hacking, Software Piracy, Computer Network intrusion
Jurisdiction to prescribe/Legislative Jurisdiction; Jurisdiction to adjudicate to enforce;
Cyber Jurisdiction in Civil, Criminal & International Cases.
Criminals plan attacks, passive attack, Active attacks, cyberstalking.

Module – 2: Cybercrime Mobile & Wireless devices[8L]
Security challenges in mobile devices, cryptographic security for mobile devices,
Attacks on mobile/cell phones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop.

Module -3: Tools and Methods used in Cyber-crime[7L]
Proxy servers, Password checking, Random checking, Trojan Horses and Backdoors;
DOS & DDOS attacks; SQL injection: Buffer over flow Attacks, Scripts Kiddies and Packaged Defense.

Module – 4: Cybercrime & Cyber security[4L]
Phising methods, ID Theft; Online identity method Legal aspects, Indian laws, IT act,
Public key certificate, Design of Cyber Security Policy of an Organization, Unicitral Model Law.

Module -5: Cyber Ethics[5L]
The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations

and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block Chain Ethics.

Text Books:

1. Cyber security by Nina Gobole & Sunit Belapune; Pub: Wiley India.
2. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
3. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).
4. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)

Recommended Books:

1. Kenneth J. Knapp, "Cyber Security and Global Information Assurance: Threat Analysis and Response Solutions", IGI Global, 2009.
2. Jonathan Rosenoer, "Cyber law: The Law of the Internet", Springerver lag, 1997
3. Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York,
4. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003) .

CO PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	2	3	-	3	2	3
CO2	2	3	3	2	2	3	1	2	-	2	1	2
CO3	2	1	2	2	1	1	2	2	-	1	2	1
CO4	3	2	2	1	2	2	1	1	-	2	2	2

Course Name: Embedded System Design Lab
Course Code: ECS791A
Contact: 0:0:3
Credits: 1.5

Prerequisites: Concept of Digital Electronics Lab, Microprocessor and Microcontroller Lab.

Course Outcomes:

- **CO1.** Familiarization with PIC Microcontroller, ARM Microcontroller, FPGA and their interfacing.
- **CO2.** Design of different types real time projects with digital controllers.
- **CO3.** Program ARM microcontroller to perform various tasks.
- **CO4.** Understand the key concepts of embedded systems such as I/O, timers, interrupts and interaction with peripheral devices.

Experiments:

1. PIC based experiment (Any Five)
   a) Familiarization of PIC kit.
   b) Interface and control a LED, LCD, Keyboard, ADC& DAC using PIC.

c) Connect two PIC kit and transfer data serially.
d) Design a Digital watch based on PIC.
e) Control a stepper motor and display temperature from a temperature sensor on a LCD.

2. ARM based experiment (Any Four)
a) Familiarization with ARM evaluation system
b) Familiarization with Raspberry Pi
c) Interfacing with a real time clock using a serial port to display time.
d) Interface a Keyboard and display the keystrokes on a LCD, LED.
e) Familiarization of image processing using ARM

3. FPGA based experiment
a) Design a 3 to 8 decoder circuit.
b) Design an UP/DOWN counter and display the count on a 7-segment display.
c) Designing an ALU and verify with mathematical operations.
d) Innovative Project.

CO-PO Matrices:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	3	-	-	-	2	3
CO2	3	3	3	2	3	1	3	3	3	1	3	3
CO3	3	3	3	3	3	-	3	-	-	-	2	3
CO4	3	3	3	2	3	2	3	3	3	2	3	3

Course Name: Digital Image Processing Lab
Course Code: ECS791A
Contact: 0:0:3
Credits: 1.5
Prerequisite: Applied mathematics

Course Outcome(s):

Learner will be able to:

CO1: Acquire the fundamental concepts of a digital image processing system such as image acquisition, enhancement, segmentation, transforms compression, morphology, representation and description.

CO2: Analyze images in the spatial domain.

CO3: Analyze images in the frequency domain through the Fourier transform.

CO4: Design and implement with MATLAB/C/Labview algorithms for digital image processing operations such as point processing, histogram processing, spatial and frequency domain filtering,

denoising, transforms, compression, and morphological processing.

List of Laboratory Experiments:

1. Point Processing techniques (At least 4 experiments).
2. Spatial domain Filtering.
3. Histogram Processing (Histogram Stretching and Equalization).
4. Frequency Domain Filtering (Plotting 2D-DFT, Low pass and High Pass- Ideal, Butterworth and Gaussian Filters).
5. Segmentation-Gradient operators.
6. Transforms-DCT.
7. Morphology-Dilation Erosion.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	-	-	3	-	-	-	2	3
CO2	3	3	2	2	3	-	3	3	3	1	3	3
CO3	2	3	1	3	3	-	3	-	-	-	2	3
CO4	2	3	3	2	3	-	3	3	3	1	3	3

Course Name: Cloud Computing Lab
Couse Code: ECS791B
Contact: 0:0:3
Credits: 1.5

Prerequisites:
Networking, Operating System, Web Technology.

Course Objectives:
The objective of the course is to learn and apply the concept of cloud computing in real worldapplication

Course Outcome:
At the end of the course students will be able to:

CO1 Apply the concept to solve practical application
CO2 Analyzing different service in cloud computing

CO3 Evaluate different available service with Amazon and Azure
CO4 Design Cloud based application

Course Content:

Module 1: Virtual Machine:

Creation of vpc, vnet, virtual machine, Private and Public IP configuration

Module 2: Application Development:

Implementation of SOAP Web services in JAVA Applications. Use Azure to launch the web applications. Test Simple Application

Module 3: Security:

Identity and access management , Multifactor Authentication.

Module 4: Bot and AI service:

Test AWS and AZURE Bot and AI services

Text Books

1. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, LeeGillam, Springer, 2012

Reference Books:

1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg,Andrzej M. Goscinski, Wile, 2011
2. https://aws.amazon.com/
3. https://azure.microsoft.com/en-us/

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO	PO9	PO10	PO11	PO12
CO1	2	3	-		-	1	-	-	-	-	1	3
CO2	3	3	3	2	2	2	-	-	-	-	2	2
CO3	3	3	3	2	3	2	-	-	-	-	1	1
CO4	3	3	3	4	2	-	-	-	-	-	1	1

Course Name: Power Electronics Lab
Couse Code: ECS793A
Contact: 0:0:3
Credits: 1.5

Course Objective:

1. To expose students to operation and characteristics of power semiconductor devices and passive components, their practical application in power electronics.
2. To provide a practical exposure to operating principles, design and synthesis of different power electronic converters.
3. To introduce students to industrial control of power electronic circuits as well as safe electrical connection and measurement practices.

Course Outcome:

At the end of the course, a student will be able to:
CO1 : Identify relevant information to supplement to the Power Electronics course & set up testing strategies and select proper instruments to evaluate performance characteristics of Power devices and power electronics circuits and analyze their operation under different loading conditions.
CO2: Realize the limitations of computer simulations for verification of circuit behavior, apply
these techniques to different power electronic circuits and evaluate possible causes of discrepancy
in practical experimental observations in comparison to theory.
CO3: Prepare professional quality textual and graphical presentations of laboratory data and computational results, incorporating accepted data analysis and synthesis methods, mathematical software,and word-processing tools.
CO4: Primarily via team-base laboratory activities, students will demonstrate the ability to interact effectively ona social and interpersonal level with fellow students, and will demonstrate the ability to divide up and share task responsibilities to complete assignments.

Experiments:

1. Study of Characteristics of an SCR and a TRIAC.
2. Study of Diode-Resistance, Diode-Resistance-Capacitance, Resistance-Capacitance and UJT Triggering Circuits for SCR.
3. Study of the operation of a single phase fully controlled bridge converter supplying R-L load and freewheeling diode, including generation of triggering pulses for the devices for both continuous and discontinuous modes of conduction.
4. Study of a self commutation circuit for commutating an SCR operating on a DC supply.
5. Simulation of DC to DC step down chopper.
6. Simulation of PWM bridge inverter using MOSFET/IGBT with R/R-L load.
7. Simulation of Single phase AC regulator.

8. Study of a control circuit for a stepper motor and its operation./ Study of a single quadrant chopper controlled PM dc motor.
9.Innovative Experiment

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	3	3	-	-	-	-	-	-	2	1
CO2	2	2	2	2	2	3	2	-	-	-	2	2
CO3	2	2	1	1	2	3	1	-	-	-	2	1
CO4	3	3	3	-	2	1	2	-	-	-	1	2

Course Name: Virtual Instrumentation Lab
Couse Code: ECS793B
Contact: 0:0:3
Credits: 1.5

Course Objective:

The course Objectives are:
1. To develop basic VI programming skills
2. To develop the skills for application of VI programs in signal processing and control systems.

Course Outcome:

On completion of this course students will be able to:
CO1: operate LabVIEW software.
CO2: explore the various programming techniques of LabVIEW software
CO3: design different type of program based on data acquisition systems and control systems
CO4: apply knowledge of VI into different real time applications,

List of Experiments:

1. To familiarize with array, Charts and graphs in LabVIEW
2. To study the various loops available in LabVIEW
3. To study the Case and sequence structures in LabVIEW
4. To familiarize with the applications of Formula Node in LabVIEW in solving complex mathematical formulas
5. To measure and plot temperature using LabVIEW with DAQ cards
6. To measure strain and load using LabVIEW with DAQ cards
7. To design a temperature control Loop using LabVIEW with DAQ cards
8. To deploy a LabVIEW interface with a embedded board (Arduino or

Raspberry Pi) and study it's response.
9. To design a program of Signal Generation using DAQ Cards in Labview platform.
10. To design a simple PID controller using LabVIEW
11. Innovative Experiment.

CO-PO matrices:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	1	1	3	3	-	-	2	2	1	2
CO2	2	1	3	3	2	2	-	-	2	2	2	2
CO3	2	3	1	2	2	2	-	-	2	1	1	1
CO4	1	3	2	3	2	1	-	-	2	1	-	-

Course Name: Artificial Intelligence Lab
Couse Code: ECS793C
Contact: 0:0:3
Credits: 1.5

Perquisite: Knowledge of programming languages.

Course Objective:

Apply knowledge of computing and mathematics appropriate to the discipline. Analyze a problem, and identify and define the computing requirements appropriate to its solution. Design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs Understand current techniques, skills, and tools necessaryfor computing practice.

Course Outcome:

After completion of this course student will be able to:

CO1: Understand and recognize various AI search algorithms and AI tools.

CO2: Apply the fundamentals of knowledge representation, inference and theorem proving using

CO3: Analyze working knowledge of reasoning in the presence of incomplete and/oruncertain information.

CO4: Evaluate and create knowledge representation, reasoning, and machine learning techniques for the solutions of real-world problems.

List of Experiments:

A. Write the following programs using PROLOG

1. Study of PROLOG facts and rules.

2. Write a program to compute factorial of a number.

3. Write a program to compute GCD of two numbers.

4. Write a program to represent facts and rules.

5. Write a program to represent a family tree.

6. Write a program to diagnosis intelligently.

7. Write a program to check whether a given line segment is vertical or horizontal.

8. Write a program for list processing.

B. Write the following programs using PROLOG

1. Write a program to solve 8 queens problem

2. Solve any problem using depth first search.

3. Solve any problem using best first search.

3. Solve 8-puzzle problem using best first search

4. Solve Robot (traversal) problem using means End Analysis

6. Solve traveling salesman problem.

C. Write some programs on recent trend in AI (It may be recent real world problems)
Jupyter Notebook(iPython): Medical diagnosis. Design an Expert System

Projects assigned by instructor to model and solve real world problems.

TEXT BOOKS:

1. Artificial Intelligence: A Modern Approach, Russell & Norvig, Prentice Hall.
2. Artificial Intelligence, Elain Rich and Kevin Knight, TMH.

REFERENCE BOOK:

3. Prolog Programming for Artificial Intelligence Paperback by Ivan Bratko
4. Jacek M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishers

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2	2	-	-	-	-	1	2	2
CO2	3	3	2	2	1	-	-	-	-	2	2	2
CO3	1	2	3	1	1	-	-	-	-	1	1	1
CO4	3	3	2	2	1	-	-	-	-	1	1	1

Course Name: Entrepreneurship and Innovation skill
Course Code: MC781
Contacts: 2L:0T:0P
Total Contact Hours: 24
Credit: 0

Course Outcomes: After the completion of the course, the students will be able to:

CO1: Comprehend the role of bounded rationality, framing, causation and effectuation in entrepreneurial

decision making.

CO2: Demonstrate an ability to design a business model canvas.

CO3: Evaluate the various sources of raising finance for startup ventures.

CO4: Explain the fundamentals of developing and presenting business pitching to potential investors.

Course Content

Module 1: **4 L**

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioral; entrepreneurial challenges. Entrepreneurial Opportunities: Opportunities. discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering.

Module 2: **4 L**

Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, Effectuation and Causation; Advantage and Limitations of Entrepreneurship; Process of Entrepreneurship.

Module 3: **4 L**

Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

Module 4: **4 L**

Organizing Business and Entrepreneurial Finance: Forms of business organizations; organizational structures; Evolution of Organisation, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

Module 5: **4 L**

Entrepreneurs as problem solvers: Innovations and Entrepreneurial Ventures – Global and Indian; Role of Technology – E-commerce and social media; Social Entrepreneurship – Concept; Entrepreneurship – The Indian Scenario

Module 6: **4 L**

Project/Case Study: (Any One)

1. Visit of the District Industries Centre and prepare a report of activities and programs undertaken by them
2. Conduct a case study of any entrepreneurial venture in your nearby area.
3. Field Visit: Visit any business firm near your locality; interact with the owner of the business firm and prepare a field report on parameters like: type of business, scale of business, product/service dealing in, target customer, problems faced and measures to solve the faced challenges. 4. Know your State Handicraft and Handlooms as a means of economic activity

Text Books:

1. Bessant, J. (2003) High Involvement Innovation: Building and Sustaining Competitive Advantage Through Continuous Change. Chicester: John Wiley & Sons.
2. Bygrave, W and Zackarakis, A (2013) Entrepreneurship, 3rd Edition, John Wiley and Co. Drucker, P. (1999) Innovation and Entrepreneurship, Butterworth Heinemann, Oxford.
3. Fagerberg, J, Mowery, DC and Nelson, RR (2005) The Oxford Handbook of Innovation, Oxford University Press, NY.
4. Hisrich, R.D., Peters, M.P., and Shepherd, D. (2013) Entrepreneurship, McGraw-Hill Irwin, Boston.
5. Kuratko, D. (2013) Entrepreneurship: Theory, Process, and Practice, 9th Edition, Wiley online

library.
6. Moore, Geoffrey, (1999) Crossing the Chasm, Harper & Collins.
7. Porter, ME, Competitive Advantage: Creating and Sustaining Superior Performance, Free Press, New York, NY, 1985

CO-PO Mapping:

CO	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
CO 1	3	-	1	2	3	-	-	2	-	2	3	3	1	2	3
CO 2	3	1	-	1	-	-	1	-	1	-	3	3	-	1	-
CO 3	3	-	2	-	2	3	2	-	-	2	3	3	2	-	2
CO 4	3	2	-	1	-	-	-	2	2	-	3	3	-	1	

4th Year 2nd Semester

Sl No	Course Code	Paper Code	Theory	Contact Hours /Week				Credit Points
				L	T	P	Total	
A. THEORY								
1	PE	ECS801A	Real Time System	3	0	0	3	3
		ECS801B	Low power VLSI Design					
		ECS801C	Multimedia and Virtual Reality					
2	OE	ECS802A	MEMS Technology	3	0	0	3	3
		ECS802B	Simulation and Modelling					
		ECS802C	Biomedical Electronics					
3	OE	ECS803A	Mobile Communication	3	0	0	3	3
		ECS803B	Big Data Analytics					
		ECS802C	Nanoelectronics					
B. PRACTICAL								
4	PROJECT	PR891	Major Project-II	0	0	0	12	6
5	PROJECT	PR892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
8	MC	MC881	Essence of Indian Knowledge Tradition	2	0	0	2	0
TOTAL CREDIT								16

Course Name: Real Time System
Course Code: ECS801A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

1. Concepts of Operating systems and Algorithm.
2. Knowledge of Distributed System basics.

Course Objective(s):

- To understand the real-time systems
- Obtain a broad understanding of the technologies and applications for emerging and exciting domain of real-time systems.
- Get in-depth hands-on experience in designing and developing a real time system.

Course Outcome(s):

CO1: Understand the concepts of Real-Time systems
CO2: Recognize the characteristics of a real-time system
CO3: Understand and develop document on an architectural design of a real-time system.
CO4: Develop and document Task scheduling, resource management, real-time operating systems and fault tolerance applications of real-time systems.

Course Contents:

Module-1: Introduction

Definition, Typical Real Time Applications: Digital control, High Level Controls, Signal processing etc. , Release Times, Deadline period and time constraints, Hard and soft real time systems, Reference models for RTOS: Processors and Resources, Temporal parameters of Real-time workload, Periodic Task Model, Precedence Constraints and Data Dependency. **[8L]**

Module-2: Real Time Scheduling.

Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-

Deadline-First (EDF) and Least-Stack-Time-First (LST) algorithms, Rate Monotonic algorithm, Offline versus Online Scheduling

[8L]

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Module-3: Resources Sharing.

Effect of Resource Contention and Resource Access Control (RAC), Non-pre-emptive Critical Sections, Basic Priority- Inheritance and Priority-Ceiling Protocols, Stack based Priority Ceiling Protocol, Use of Priority Ceiling Protocol in Dynamic priority systems, Pre-emption Ceiling Protocol, Access control in Multiple Module Resources, Controlling Concurrent Accesses to Data Objects.

[8L]

Module-4: Real Time Communication.

Basic Concepts of Real time Communication, Soft and Hard real-time Communication systems, Model of Real-time Communication, Priority based service and Weighted Round Robin Service disciplines for switched Networks, Medium Access control protocols for broadcast networks, Internet and resource reservation protocols **[6L]**

Module-5: Real Time Operating Systems and Databases.

Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of temporal data, temporal consistency, on-currency Control, and Overview of Commercial Real Time databases.

[6L]

Text Books

1. Real Time Systems – Jane W. S. Liu, Pearson Education Publication

Reference Books

1. Real Time Systems – Mall Rajiv, Pearson Education
2. Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	2	-	-	-	-	-	-	-
CO2	3	2	3	3	-	-	-	-	-	-	-	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-
CO4	3	2	3	3	2	-	-	-	-	-	-	-

Course Name: Low power VLSI System
Course Code: ECS801B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Concept of courses Solid State Devices; Analog Electronic Circuit; Digital Electronic and Circuit

Course Objective(s):

Objective of the course is:

1. To understand the basic concepts of designing combinational and sequential circuits and the design of VLSI ICs
2. To motivate students to design VLSI circuits in the area of digital, analog
3. To encourage for the design of IC with low power and high speed.
4. To study various programmable logic devices like PLDs and FPGA.

Course Outcomes:

The Students will be able to

CO1: Understand scale of integration and VLSI design flow and VLSI Design steps.

CO2: Calculate and analyze the different parameters related to the different MOS devices and to design the combinational and sequential logic circuits.

CO3: Describe fabrication steps of IC and construct stick diagram & layout of CMOS inverter and basic gates based on Layout design rules.

CO4: Understand the VHDL basics and to construct the combinational and sequential logic circuits.

Module –1: Introduction to VLSI Design:

Historical perspective development of VLSI from discrete electronic circuit to VLSI. IC, MSI, LSI, Microelectronics & VLSI.

Types of VLSI Chips (General purpose, ASIC, PLA, FPGA),photo-resist Basic CMOS Technology – (Steps in fabricating CMOS), Basic n-well CMOS proc VLSI Design Concepts, Moor's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI – basic idea only), Types of VLSI Chips (Analog & Digital VLSI chips, General purpose, ASIC, PLA, FPGA), Design principles (Digital VLSI – Concept of Regularity, Granularity etc), Design Domains (Behavioral, Structural, Physical), Y-Chart, Digital VLSI Design Steps. [9L]

Module-2: MOS structure:
E-MOS & D-MOS, Charge inversion in E-MOS, Threshold voltage, Flat band voltage, Potential balance & Charge balance, Inversion, MOS capacitances. Three Terminal MOS Structure: Body effect. Four Terminal MOS Transistor: Drain current, I-V characteristics. Current-voltage equations (simple derivation). Scaling in MOSFET, General scaling, Constant Voltage & Field scaling.] CMOS: CMOS inverter, Simple Combinational Gates - NAND gate and NOR Gate using CMOS. [2L]

Module-3: Micro-electronic Processes for VLSI Fabrication:
Silicon Semiconductor Technology- An Overview, Wafer processing, Oxidation, Epitaxial deposition, Ion-implantation & Diffusion, Cleaning, Etching, Photo-lithography – Positive & Negative ess, p-well CMOS process, Twin tub process, Silicon on insulator Layout Design Rule: Stick diagram with examples, Layout rules.
[10L]

Module –4: Hardware Description Language:
VHDL or Verilog Combinational & Sequential Logic Circuit Design. [6L]

Text Books:

1. Digital Integrated Circuit , J.M.Rabaey, Chandrakasan, Nicolic, Pearson Education
2. CMOS Digital Integrated Circuits Analysis and Design , S.M.Kang & Y.Leblebici,TMH.
3. CMOS Analog Circuit Design , Allen & Holberg , Oxford
4. Design of Analog CMOS Integrated Circuits , Behzad Razavi , TMH .

Reference Books:

1. Microelectronic Circuits , Sedra & Smith , Oxford
2. Introduction to VLSI Circuits and System , Uyemura , Wiley
3. VLSI Design , Debaprasad Das , Oxford
4. VLSI Design and EDA Tools , Angsuman Sarkar , Swapnadip De , C.K. Sarkar , Scitech
5. VLSI Design Techniques for Analog and Digital Circuits , Geiger , Allen , Strader , TMH

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	2	-	-	2	3	1	2	1
CO2	3	2	1	2	1	-	-	1	2	2	1	2
CO3	3	3	3	2	1	-	-	1	2	1	1	2
CO4	2	2	1	1	1	-	-	1	2	1	1	2

Course Name: Multimedia and Virtual Reality
Course Code: ECS801C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3
Prerequisites: Computer Programming, Mathematics

Course Objectives:

The objective of the course is to provide comprehensive introduction about computer graphics system, design algorithms and two-dimensional transformations; to make the students familiar with techniques of clipping, three-dimensional graphics and three-dimensional transformations and become familiar with various software programs used in the creation and implementation of multimedia and to gain knowledge about hardware devices and software used.

Course Outcome:

At the end of the course students will be able to:

CO1: Understand the basic computer graphics and Identify different media representations of differentmultimedia data and data formats, windows, clipping and view-ports object representation.

CO2: Analyze geometric, mathematical and algorithmic concepts necessary for programming computer graphics.

CO3: Apply different coding technique for solving real world problems.

CO4: Evaluate the software utilized in constructing computer graphics and multimedia applications.

Course Content:

Module1: Overview of Computing Paradigm

Recent trends in Computing Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing Evolution of cloud computing Business driver for adopting cloud computing.

[3L]

Module2: TWO-DIMENSIONAL GRAPHICS

Two dimensional geometric transformations, Matrix representations and homogeneous coordinates, composite transformations, Two dimensional viewing, viewing pipeline, viewing coordinate reference frame, window-to-viewport coordinate transformation, Two dimensional viewing functions, clipping operations, point, line, and polygon clipping algorithms. [7L]

Module 3: ILLUMINATION AND COLOR MODELS

Height sources, basic illumination models, halftone patterns and dithering techniques, Intuitive colour concepts, RGB colour model, YIQ colour model, CMY colour model, HSV colour model, HLS colour model, colour selection. Output primitives, points and lines, line drawing algorithms, loading the frame

buffer, line function; circle and ellipse generating algorithms, Pixel addressing and object geometry [7L]

Module 4: THREE-DIMENSIONAL GRAPHICS

Three dimensional concepts, Three dimensional object representations, Polygon surfaces, Polygon tables, Plane equations, Polygon meshes, Curved Lines and surfaces, Spline representations, Bezier curves and surfaces, B-Spline curves and surfaces. TRANSFORMATION AND VIEWING: Three dimensional geometric and modelling transformations, Translation, Rotation, Scaling; Three-dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping [7L]

Module 5: MULTIMEDIA SYSTEM DESIGN & MULTIMEDIA FILE HANDLING

Multimedia basics, Multimedia applications, Multimedia system architecture, evolving technologies for multimedia, Defining objects for multimedia systems, Multimedia data interface standards, Multimedia databases. Compression and decompression, Data and file format standards, Multimedia I/O technologies, Digital voice and audio, Video image and animation, Full motion video, Storage and retrieval technologies [6L]

Module 6: HYPERMEDIA

Multimedia authoring and user interface, Hypermedia messaging, Mobile messaging, Hypermedia message component, Creating hypermedia message, Integrated multimedia message standards, Integrated document management, Distributed multimedia systems [6L]

Text Books

1. Hearn Baker Carithers, - “Computer Graphics with Open GL”, Pearson New International Edition
2. Donald Hearn and Pauline Baker M, ―Computer Graphics”, Prentice Hall, New Delhi, 2007
3. Andleigh, P. K and Kiran Thakrar, ―Multimedia Systems and Design|, PHI, 2003

Reference Books:

1. Judith Jeffcoate, ―Multimedia in practice: Technology and Applications, PHI, 1998.
2. Foley, Vandam, Feiner and Hughes, ―Computer Graphics: Principles and Practice, 2nd Edition, Pearson Education, 2003.
3. Jeffrey McConnel, ―Computer Graphics: Theory into Practice, Jones and Bartlett Publishers, 2006.
4. Hill F S Jr., “Computer Graphics”, Maxwell Macmillan, 1990.
5. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, ―Fundamentals of Computer Graphics, CRC Press, 2010.
6. William M. Newman and Robert F.Sproul, ― Principles of Interactive Computer Graphics, Mc Graw Hill 1978.

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	2	1	2	1	1	-	-	-	-
CO2	2	2	1	1	3	1	2	1	-	-	-	-
CO3	2	2	3	3	1	1	1	1	-	-	-	-
CO4	3	1	2	2	2	1	1	1	-	-	-	-

Course Name: MEMS Technology
Course Code: ECS802A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Course Objectives:

1. To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
2. To educate on the rudiments of Micro fabrication techniques.
3. To introduce various sensors and actuators
4. To introduce different materials used for MEMS

Course Outcomes:

CO1: Ability to understand the operation of micro devices, micro systems and their applications
CO2 : Ability to design the micro devices, micro systems using the MEMS fabrication process.
CO3 : Gain a knowledge of basic approaches for various sensor design
CO4 : Gain a knowledge of basic approaches for various actuator design

Module 1: INTRODUCTION
Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication – Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.
[12L]

Module 2: SENSORS AND ACTUATORS-I
Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph – Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys. [12L]

Module 3: SENSORS AND ACTUATORS-II

Piezoresistive sensors – Piezoresistive sensor materials – Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

[12L]

TEXT BOOKS:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

CO-PO Mapping

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	2	1	2	1	1	-	-	-	-
CO2	2	2	1	1	3	1	2	1	-	-	-	-
CO3	2	2	3	3	1	1	1	1	-	-	-	-
CO4	3	1	2	2	2	1	1	1	-	-	-	-

Course Name: Simulation and Modelling
Course Code: ECS802B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

Programming and Data Structures, Discrete Mathematics and Probability, Numerical Analysis,Basic Electronics

Course Objective:

The objective of the course is to conceptualize basics of simulation and modeling for applying dynamic and probability concept of simulation and discrete simulation system; to enable students to analyze Continuous Uniformly Distributed Random Numbers and to assess the strengths and weaknesses of various methods and to analyze their behavior.

Course Outcome

After completion of this course student will be able to

CO1: Summarize the issues in Modeling and Simulation

CO2: Explain the System Dynamics & Probability concepts in Simulation.

CO3: Solve the Simulation of Queuing Systems

CO4: Analyze the Simulation output

CO5: Identify the application area of Modeling and Simulation and apply in thecorresponding fields

Course Contents:

Module 1: Introduction to Modeling and Simulation:

Nature of Simulation. Systems, Models and Simulation, Continuous and Discrete Systems, system modeling, Components of a simulation study, Introduction to Static and Dynamic System simulation , Application areas, Advantages, Disadvantages and pitfalls of Simulation [10L]

Module 2: System Dynamics & Probability concepts in Simulation:

Exponential growth and decay models, Generalization of growth models, Discrete and Continuous probability functions, Continuous Uniformly Distributed Random Numbers,Generation of a Random numbers, Generating Discrete distributions, Non-Uniform ContinuouslyDistributed Random Numbers, Rejection Method. [10L]

Module 3: Simulation of Queuing Systems and Discrete System Simulation:

Poisson arrival patterns, Exponential distribution, Service times, Normal Distribution Queuing Disciplines, Simulation of single and two server queue. Application of queuing theory in computer system. Discrete Events, Generation of arrival patterns, Simulation programming tasks, Gathering statistics, Measuring occupancy and Utilization, Recording Distributions and Transit times [10L]

Module 4: Analysis of Simulation output:

Sensitivity Analysis, Validation of Model Results [6L]

Text Books:

1. Geoffrey Gordon, “System Simulation”, PHI.
2. Jerry Banks, John Carson, B.L.Nelson and D.M.Nicol “ Discrete Event System Simulation”, Fifth Edition, Pearson
3. Narsingh Deo, 1979, System Simulation with Digital Computers, PHI.

Reference Books:

1. Averill M. Law and W.David Kelton, "Simulation Modelling and Analysis", Third Edition, McGraw Hill
2. J. N. Kapoor.. Mathematical Modelling, Wiley eastern Limited.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	1
CO2	3	2	3	2	3	-	-	-	-	-	-	2
CO3	3	3	2	2	3	-	-	-	-	-	-	2
CO4	3	3	2	2	3	-	-	-	-	-	-	2
CO5	2	3	2	2	3	-	-	-	-	-	-	2

Course Name: Biomedical Electronics
Course Code: ECS802C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Sensors & Transducers, Signal Processing

Course Objectives:

1. To understand the various systems of the human physiology and signals of biological origin obtained from various systems,
2. To analyse various biosensors, transducers and bio-potential electrodes used to acquire various bio- potentials.
3. To understand various methods of measurement of blood pressure, blood flow, heart sounds and pacemaker
4. To familiarize with various amplifiers for measuring biopotentials.
5. To acquire knowledge about Electrical safety of medical devices and their protective measures.

Course Outcome

After completion of this course, the students will be able to

CO1: Able to understand the detailed physiology of various human anatomical systems.
CO2: Able to identify proper transducer for acquisition of a particular bioelectric potential.
CO3: Able to analyse various biological conditions from the measured bioelectric potentials.
CO4: Able to design biotelemetry systems for acquiring bioelectric potentials from long distance
.

Module I: Physiology of various anatomical systems:

Introduction to the physiology of cardiac, nervous, muscular and respiratory systems
[6L]

Module II: Bioelectric potential and measuring transducers:

Bioelectric potentials: Definitions, types, range, basic characteristics. resting and action potential
Different types of transducers and electrodes: construction, selection for acquiring various bio-potentials [8L]

Module III: Measurements on cardiovascular and respiratory system

Blood pressure - characteristics of blood flow - Heart sounds - ECG - Measurement of blood pressure, blood flow, heart sounds and Cardiac pace-maker: types and its detail instrumentation
[12L].

Module IV: Electrical activities in brain and muscles:

Electromyography and Electroencephalograph: characteristics, measurements and signal analysis.
[2L]

Module V: Medical Imaging Techniques

Ultrasound imaging and IR Imaging: image acquisition technique and analysis, MRI [4L]

Module VI: Biotelemetry

Transmission and Reception aspects of Biological signals over long distances. [2L]

Module VII: Measurement Errors and safety issues

Errors in bio-potential measurement, types and methods to minimize errors
Electrical- Safety codes and standards, basic approaches to protection against shock, power distribution protection, equipment protection [2L]

Text Books:

1. Cromwell L – Biomedical Instrumentation and Measurement, Pearson
2. Khandpur R.S., Hand book of Biomedical Instrumentation, Tata McGraw Hill
3. Webster J S – Medical Instrumentation – Application and Design
4. Astor B R – Introduction to Biomedical Instrumentation and Measurement, McMillan.
5. Chatterjee Miller – Biomedical Instrumentation, Cengage Learning

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12

CO1	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**3**	**2**	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**

Course Name: Mobile Communication
Course Code: ECS803A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3
Prerequisite: Analog and Digital Communication System

Course Objective:

1. To make students familiar with basics of mobile communication systems.
2. To choose system (TDMA/FDMA/CDMA) according to the cost of installation, complexity, speed of propagation, channel properties etc.
3. To compare between mobile communication and static communication.
4. To identify the advantages, limitations and design techniques of 2G and 3G wireless mobile communications.

This subject can be considered as a prerequisite for the course in Wireless LANs.

Course Outcome:

CO1: By the end of the course, the student will be able to analyze and design wireless and mobile cellular systems.
CO2: By the end of the course, the student will have the ability to work in advanced research wireless and mobile cellular programs.
CO3: By the end of the course, the student will be able to realize all the applications of wireless protocols
CO4: By the end of the course, the student will be able to design the mobile networks.

Module 1 [3L]
Introduction: Vision of mobile communication. Historical perspective in the development of mobile communication - 1G to 4G and beyond (5G). Wireless standards.

Module 2 [9L]
Cellular system principle and planning: Cellular concepts - cell structure, frequency reuse, cell splitting and channel assignments, cellular network architecture. Location updating and Call setup. Hand off techniques and power control. Selection of uplink and downlink frequencies.

Module 3 [6L]
Global System of Mobile communication (GSM): System overview, GSM architecture. Mobility management. Network signaling.

Module 4 [6L]
GSM system architecture and function partitioning. Introduction to Mobile System (MS). Base Station System (BSS). Home Location Register (HLR), Visiting Location Register (VLR), Equipment Identity Register (EIR).

Module 5 [6L]
GSM radio aspects: Wireless medium Access Control – FDMA, TDMA, CDMA, WCDMA. GSM radio standards. Frequency band and channel allocation.

Module 6 [4L]
Mobile data communication. Wireless LANS (WLANS). IEEE 802.11 Standards, Mobile IP

Module 7 [2L]
Introduction to GPS systems and its applications in real life.

Text Books:

1. Mobile Cellular Telecommunications – Analog & Digital Systems, William C. Y. Lee, McGraw Hill, 1995
2. Mobile Communications Design Fundamentals, William C. Y. Lee, A Wiley-lnterscience Publication
3. Mobile. Communications, J. Schiller, Pearson Education

Reference Books:

1. Wireless Communications, T. S. Rappaport, Prentice Hall International, 2002.
2. Wireless Network Evolution, V. K. Garg - Pearson Ed

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	1	3	3	1	2	2	1	1
CO2	2	2	1	1	3	0	1	0	2	3	3	2
CO3	2	2	1	2	0	1	2	1	3	2	3	3
CO4	2	2	1	3	0	1	3	2	2	2	3	3

Course Name: Big Data Analytics
Course Code: ECS803B

Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites**:**

Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence, Programming skills of Python

Course Objective(s):

1. Comprehend the fundamental concepts of the Big Data Analytics exploring machine learning strategies such as Supervised and Unsupervised Learning etc. for analyzing various types of large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework).
2. Formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions
3. Apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data distributed across multiple locations.
4. Excogitate and Implement ideas to address the challenging issues of Big Data Analytics.
5. Analyze the effectiveness of various Big Data Analytics Frameworks.

Course Outcome(s):

After completion of the course students will be able to

CO1 : Understand and explain the fundamental concepts of the Big Data Analytics which are primarily explored for making automated decisions using machine learning strategies on analyzing large scale structured as well as unstructured data distributed across multiple locations (Map Reduce, Hadoop and NoSQL Framework) underscoring the utilitarian importance in current technological context for further exploration leading towards lifelong learning.

CO2 : Identify and formulate an engineering problem of analyzing large scale data distributed across multiple locations to make automated meaningful decisions within the scope of Big Data Analytics Frameworks.

CO3 : Explore relevant literature and apply the concepts of Big Data Analytics to solve problems of making automated decisions dealing with large scale structured as well as unstructured data using Map Reduce, Hadoop and advanced SQL Frameworks.

CO4 : Excogitated as for proposing solutions to the challenging problems of Big Data Analytics.

CO5 : Implement ideas of Big Data Analytics through developing feasible algorithms or frameworks and investigate their effectiveness in solving the relevant problems by analyzing the performances using proper techniques.

Course Content:

Module – 1: Introduction to Basic Analytics [10L]

Introduction: Big data overview, Analyst's perspective on data repositories, Current analytical architecture, Drivers of big data, Examples of big data analytics.
Life Cycle of Data Analytics: Phase 1: Discovery, Phase 2: Data preparation, Phase 3: Model planning, Phase 4: Model building, Phase 5: Communication of results, Phase 6: Making operational.

Basic Analytic Methods: Visualization, Dirty data, Data exploration versus presentation, Statistical methods for evaluation – hypothesis testing, difference of means, rank sum test, type I and type II errors, ANOVA.

Module - 2: Advanced Analytic Methods I [8L]
Clustering: Overview, K-means, Determining the number of clusters, Diagnostics.
Association Rules: Overview, Apriori algorithm, Evaluation of candidate rules, Application of association rules, Validation and testing, Diagnostics.
Regression: Linear regression - model description, Logistic regression – model description, Other regression models.
Classification: Decision trees – overview, General algorithm, Decision tree algorithms, Evaluating a decision tree, Naïve Bayes – Bayes theorem, Naïve Bayes classifier, Diagnostics of classifiers.

Module – 3: Advanced Analytic Methods II [8L]
Time Series Analysis: Overview, Box-Jenkins methodology, Autocorrelation function (ACF), Autoregressive model, moving average model, ARMA and ARIMA model, Building and evaluating an ARIMA model.
Text Analysis: Steps in text analysis, collecting raw text, representing text, Term Frequency-Inverse Document Frequency (TFIDF), Categorizing documents by types, Determining sentiments.
Map Reduce and Hadoop: Analytics for unstructured data – map reduce, Apache Hadoop, Hadoop Ecosystem – Pig, Hive, Hbase, Mahout.

Module – 4: Advanced Analytic Methods III [10L]
Technology and Tools: SQL essentials - Join, Set, grouping extensions, Advanced SQL – Window functions, User-defined functions, Ordered aggregates, MADlib, NoSQL.
Integration of Techniques: Communicating and operationalizing an analytic project.
Creating final deliverables – Developing core materials, project goals, Main findings, Approach, Model description and model details, Recommendations, Providing technical specifications and code.

Data visualization basics - Key points, evolution of a graph, common representation methods, how to clean up a graphic.

Textbook:

1. EMC Education Services (Editor), Data Science and Big Data Analytics. John Wiley & Sons, 2015.
2. Mike Barlow, Real-Time Big Data Analytics: Emerging Architecture. O'Reilly, 2013.

ReferenceBooks:

1. Nathan Marz and James Warren, Big Data: Principles and Best Practices for Scalable Real-time

Data Systems. Manning Publications, 2015.
2. Venkat Ankam, Big Data Analytics. Packt Publishing Ltd., UK, 2016.

CO–POMapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	3	3	2	-	-	-	-	-
CO2	2	3	1	1	1	1	1	-	-	-	-	-
CO3	2	2	3	2	1	1	1	-	-	-	-	-
CO4	2	2	2	3	1	1	1	-	-	-	-	-
CO5	2	2	3	3	2	2	2	-	-	-	-	-

Course Name: Nanoelectronics
Course Code: ECS803C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
The candidates should have the basic knowledge of materials physics and charge transport phenomena inelectronic devices.

Course Outcome:
After successful completion of this course, students should be able to:
CO1: develop a fundamental knowledge of nanomaterial
CO2: understand the recent trends of microelectronics and nano-Electronics.
CO3: know about the fabrication and analytical techniques of nanomaterials.
CO4: understand the quantum transport phenomena and working principles of nano-electronic devices.

Course Contents:

Module 1 **[8L]**
Introduction to nano-electronics, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics. Mesoscopic physics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence. Classification of Nano structures, Low dimensional structures: Quantum wells, wires and dots, Density of states and dimensionality. Basic properties of two-dimensional semiconductor nanostructures, carbon nano tube and graphene.

Module 2 **[8L]**

Introduction to methods for fabrication of nano-layers, different approaches, physical vapor deposition, chemical vapor deposition. Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods. Fabrication of nano particle- grinding with iron balls, laser ablation, reduction methods, sol gel, self-assembly, precipitation of quantum dots. MEMS/NEMS design, processing, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition etc.

Module 3 **[6L]**

Introduction to characterization of nanostructures, tools used for of nano materials' characterization, Microscope- optical and electron microscope. Principle of operation of Scanning Tunneling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope. X-Ray Diffraction analysis, UV-Vis spectroscopy, Particle size analyzer.

Module 4 **[8L]**

Introduction to MEMS and NEMS, working principles, as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation–micro gripers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis, active and passive micro fluidic devices, Piezoresistivity, Piezoelectricity and thermoelectricity,

Module 5 **[6L]**

Introduction – Scaling of physical systems – Geometric scaling & Electrical system scaling. The Single- Electron Transistor: Single-Electron Transistor Logic, Other SET and FET Structures, Carbon NanotubeTransistors (FETs and SETs), Semiconductor Nanowire FETs and SETs, Coulomb Blockade in a Nanocapacitor, Hot electro transistors, Molecular SETs and Molecular Electronics

Text Books

1. Stephen D. Sentaria, Microsystem Design, Kluwer Academic Press
2. Marc Madou, Fundamentals of microfabrication & Nanofabrication.
3. T. Fukada & W.Mens, Micro Mechanical system Principle & Technology, Elsevier.
4. Julian W.Gardnes, Vijay K. Varda, Micro sensors MEMS & Smart Devices.

Reference Books

1. Nano Terchnology and Nano Electronics – Materials, devices and measurementTechniques by WR
Fahrner – Springe
2. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology by T.Pradeep;Tata Mc.Graw Hill.
3. Nanotechnology: Synthesis to Applications by Roy, Ghosh and Sarkar, CRC Press, 2017.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	**3**	**1**	**1**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**2**	**1**
CO2	**3**	**2**	**2**	**1**	**1**	**-**	**2**	**1**	**1**	**1**	**1**	**2**
CO3	**2**	**3**	**1**	**2**	**1**	**1**	**1**	**2**	**-**	**-**	**1**	**1**
CO4	**2**	**3**	**3**	**2**	**2**	**2**	**1**	**-**	**2**	**2**	**-**	**-**

Total for ECS	
Without MOOCS	**With MOOCS**
34.0	**34.0**
26.0	**30.0**
25.0	**29.0**
21.5	**25.5**
22.5	**26.5**
18.0	**22.0**
16.0	**16.0**
163	**183 (for honors/minor)**

Total:

Credit Distribution

Subject Category	Subjects	Credit Distribution as per AICTE (%)	Suggested Breakup of Credits (Total 160) as per AICTE	

Humanities and Social Sciences including Management courses (HSMC)	**Humanities & Social Science:** (i)English (ii)Language / English Lab **Management courses** (i) Universal Human Values 2: Understanding Harmony (ii) Gender Culture and Development (iii) Principle of Management, (iv) Economics for Engineers	5 to 10%	**12**	**9+3** **5.63%**
Basic Sciences (BS)	**Physics** (i)Introduction to Electromagnetic Theory (ii)Introduction to Mechanics (iii)Quantum Mechanics for Engineers (iv)Oscillation, Waves and Optics (v)Semiconductor Optoelectronics (vi)Semiconductor Physics	**15 to 20%**	**25**	**25** **15.00%**
	Chemistry & Biology (i)Chemistry – I (Concepts in chemistry for engineering) (ii)Chemistry Laboratory **Elective Courses** (i)Chemistry-II (Chemical Applications) (ii)Polymer Chemistry (iii)Experiments in Polymer Chemistry **Biology**			
	Mathematics **(i)Mathematics (Option 1)** Mathematics 1 Mathematics 2 Mathematics 3			
Engineering	(i)Workshop / Manufacturing Practice	15 to 20%	**24**	**22.5**

Sciences and Skills (ES)	(ii)Drawing / Engineering Graphics & Design, (iii)Basics of Electrical (iv)Computer / Programming for Problem Solving (v)Numerical Methods (vi)Circuit theory			**14.06%**
Professional core courses (PC)	Courses relevant to chosen branch	30 to 40%	**48**	**48.0** **30.37%**
Professional Elective (PE)	Elective courses relevant to chosen specialization/branch	10 to 15%	**18**	**22** **13.80%**
Open Elective(OE)	Elective Courses from other technical programs and /or emerging subjects: 1. Artificial Intelligence 2.Introduction to Data Science 3. Introduction to Robotics 4. MEMS Technology 5. Simulation and Modelling 6. Biomedical Electronics 7. Mobile Communication 8. Big Data Analytics 9. Nanoelectronics 10. Power Electronics 11. Virtual Instrumentation 12. Electromagnetic Wave 13. Cyber Law and Ethics 14. Cryptography and Network Security 15.Soft Computing	5 to 10%	**18**	**16** **10.00%**
Project work, seminar and internship in industry or elsewhere	(i)PROJECT (PR….91): Project work (ii)PROJECT (PR….92): (iii) PROJECT (PR …93): (iv)Grand Viva - 1	10 to 15%	**15**	**17.5** **10.94%**
Mandatory	**MC Courses:**	**No**	Minimum 2	

Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]	(i)Environmental Science, (ii)Foreign language, (iii)Constitution of India (iv)Behavioral & Interpersonal skills (v)Essence of Indian Knowledge Tradition **& Others as mentioned in AICTE guidelines** **MC Activities:** (i)Induction Programming (ii)NSS/NCC/Yoga (iii)Technical Lecture Presentation **& Others as mentioned in AICTE guidelines**	**Credit Course**	units per semester min. Max: 28 Units/Program	

Summary

Sub	Credit	%	AICTE %
HSMC	9	5.63	5to10
BSHU	25	15.62	15to20
ES	22.5	14.06	15to20
PC	48	30.00	30to40
PE	22	13.75	10to15
OE	16	10.00	5to10
Project	17.5	10.94	10to15
	160	100.00	

Professional Electives (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)			
	Option 1	**Option 2**	**Option 3**
Professional Elective I	Object Oriented Programming with JAVA	Information Theory and Coding	Sensors and Applications
Professional Elective II	Industrial Automation	Introduction to IoT	Python Programming
Professional Elective III	Artificial Intelligence	Optical and Satellite communicatio n	Digital Signal Processing
Professional Elective IV	Embedded System Design	Digital Image Processing	Cloud Computing
Professional Elective V	Quantum Computing	Information theory and Coding	Wireless Sensor Network
Professional Elective VI	Real Tme System	Low power VLSI Design	Multimedia and Virtual Reality

Open Electives (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)			
	Option 1	**Option 2**	**Option 3**
Open Elective I	Introduction to Data Science	Introduction to Robotics	Soft Computing
Open Elective II	Power Electronics	Virtual Instrumentation	Artificial Intelligence
Open Elective III	Electromagnetic Wave	Cyber Law and Ethics	Cryptography and Network Security
Open Elective IV	MEMS Technology	Simulation and Modelling	Biomedical Electronics
Open Elective V	Mobile Communication	Big Data Analytics	Nanoelectronics

Proposed Honors courses:

Sl. No.	Option 1
1.	Artificial Intelligence and Machine Learning
2.	Internet of Things (IoT)

Proposed minor Courses:

Sl. No.	Option 1
1.	VLSI Design
2.	Data Science

MOOCs (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)						
	Sem	Credit	Option 1	Option 2	Option 3	Option 4
MOOCS COURSE-I	III	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-II	IV	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-III	V	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-IV	VI	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-V	VII	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors

**Please define your Honors/Minor program credit point of 20 to be earned by the student. Related BOS would endorse the selection of these courses followed by the necessary intimation at the Academic Council of the Institute.