R23 (B. Tech ECE)

Curriculum & Syllabus for B. Tech under JIS Autonomy

Electronics and Communication Engineering

(Effective From 2023-24 Admission Batch)

R23 (All B. Tech.)

Curriculum & Syllabus for B. Tech Under Autonomy

Incorporation of NEP 2020

First Year Curriculum Structure (Effective from 2023-24 admission batch)
Group A: CSE, CSE (AIML), CST, DS, FT, AGR, BME
Group B: ECE, EE, IT, ECS, CE, ME

1st Year 1st Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/ Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC101	Basic Electrical and Electronics Engineering	3	0	0	3	3
2	ENGG	Minor	CS(EC)101	Programming for Problem Solving	3	0	0	3	3
3	SCI	Multidisciplinary	PH(EC)101	Engineering Physics	3	0	0	3	3
4	SCI	Multidisciplinary	M(EC)101	Engineering Mathematics- I	3	0	0	3	3
5	HUM	Value Added Course	HU104	Environmental Science	2	0	0	2	2
6	HUM	Value Added Courses	HU105	Indian Knowledge System	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	EC191	Basic Electricaland Electronics Engineering Lab	0	0	3	3	1.5
2	SCI	Skill Enhancement Course	PH(EC)191	Engineering Physics Lab	0	0	3	3	1.5
3	ENGG	Skill Enhancement Course	CS(EC)191	Programming for Problem Solving Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	ME(EC)191	EngineeringGraphics & Design Lab	0	0	3	3	1.5
5	HUM	Ability Enhancement Course	HU(EC)191	Soft Skill and Aptitude	0	0	2	2	1
Total of Theory, Practical								29	22

1st Year 2nd Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	EC201	Circuit Theory & Network	3	0	0	3	3
2	SCI	Multidisciplinary	CH(EC)201	Engineering Chemistry	2	0	0	2	2
3	SCI	Multidisciplinary	M(EC)201	Engineering Mathematics –II	3	0	0	3	3
4	HUM	Ability Enhancement Course	HU201	Professional Communication	2	0	0	2	2
5	ENGG	Value Added Course	HU202	Values and Ethics	2	0	0	2	2
6	ENGG	Value Added Course	HU203	Constitution of India	1	0	0	1	1
B. PRACTICAL									
1	SCI	Skill Enhancement Course	CH(EC)291	Engineering Chemistry Lab	0	0	2	2	1
2	ENGG	Skill Enhancement Course	ME(EC)291	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
3	ENGG	Major	EC291	Circuit Theory & Network Lab	0	0	3	3	1.5
4	HUM	Ability Enhancement Course	HU291	Professional Communication Lab	0	0	2	2	1
Total of Theory, Practical								**23**	**18**

2nd Year 3rd Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	EC301	Digital Electronics	3	0	0	3	3
2	ENGG	Major	EC302	Solid State Devices	3	0	0	3	3
3	ENGG	Major	EC303	Analog Circuits	3	0	0	3	3
4	ENGG	Minor	CS(EC)301	Data Structure	3	0	0	3	3
5	SCI	Minor	M(EC)301	Numerical Methods	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	EC391	Digital Electronics Lab	0	0	3	3	1.5
2	ENGG	Major	EC393	Analog Circuits Lab	0	0	3	3	1.5
3	ENGG	Minor	CS(EC)391	Data Structure Lab	0	0	3	3	1.5
4	HUM	Ability Enhancement Course	HU(EC)391	Technical Seminar Presentation & Group Discussion	0	0	2	2	1
Total of Theory, Practical								25	19.5

2nd Year 4th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC401	EM Theory & Antenna	3	0	0	3	3
2	ENGG	Major	EC402	Signals & Systems	3	0	0	3	3
3	ENGG	Major	EC403	Analog & Digital Communication	3	1	0	4	4
4	ENGG	Minor	IT(EC)401	Database Management System	3	0	0	3	3
5	ENGG	Minor	M(EC)401	Probability and Statistics	3	0	0	3	3
B. PRACTICAL									
1	ENGG	Major	EC491	EM Theory & Antenna Lab	0	0	3	3	1.5
2	ENGG	Major	EC493	Analog & Digital Communication Lab	0	0	3	3	1.5
3	ENGG	Minor	IT(EC)491	Database Management System Lab	0	0	3	3	1.5
Total of Theory, Practical								25	20.5

3rd Year 5th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC501	Digital Signal Processing	3	0	0	3	3
2	ENGG	Major	EC502	Microprocessor & Microcontroller	3	0	0	3	3
3	ENGG	Major	EC503	Computer Network	3	0	0	3	3
4	ENGG	Major	EC504A	Mobile Communication & Network	3	0	0	3	3
			EC504B	Embedded Systems					
			EC504C	RF & Microwave Engineering					
5	ENGG	Minor	CS(EC)501A	Object Oriented Programming using JAVA	3	0	0	3	3
			CS(EC)501B	Introduction to Quantum Computing					
			CS(EC)501C	Cloud Computing					
6	HUM	Ability Enhancement Course	HU(EC)501	Business Communication	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	EC591	Digital Signal Processing Lab	0	0	3	3	1.5
2	ENGG	Major	EC592	Microprocessor & Microcontroller Lab	0	0	3	3	1.5
3	ENGG	Major	EC594A	Mobile Communication & Network Lab	0	0	3	3	1.5
			EC594B	Embedded Systems Lab					
			EC594C	RF & Microwave Engineering Lab					
4	ENGG	Minor	CS(EC)591A	Object Oriented Programming using JAVA Lab	0	0	3	3	1.5
			CS(EC)591B	Introduction to Quantum Computing Lab					
			CS(EC)591C	Cloud Computing Lab					
5	ENGG	Skill Enhancement Course	IT(EC)591	IT Workshop Lab (SciLab/MATLAB/C++)	0	0	2	2	1
Total of Theory, Practical								30	23

3rd Year 6th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC601	VLSI Design	3	0	0	3	3
2	ENGG	Major	EC602	Control System	3	0	0	3	3
3	ENGG	Major	EC603A	IoT for Communication	3	0	0	3	3
			EC603B	Digital Image Processing					
			EC603C	Soft Computing					
			EC603D	Low Power IC Design					
4	ENGG	Minor	CS(EC)601A	Artificial Intelligence	3	0	0	3	3
			CS(EC)601B	Web Technology					
			CS(EC)601C	Software Engineering					
B. PRACTICAL									
1	ENGG	Major	EC691	VLSI Design Lab	0	0	3	3	1.5
2	ENGG	Major	EC692	Control System Lab	0	0	3	3	1.5
3	ENGG	Major	EC693A	IoT for Communication Lab	0	0	3	3	1.5
			EC693B	Digital Image Processing Lab					
			EC693C	Soft Computing Lab					
			EC693D	Low Power IC Design Lab					
4	ENGG	Minor	CS(EC)691A	Introduction to AI Lab	0	0	3	3	1.5
			CS(EC)691B	Web Technology Lab					
			CS(EC)691C	Software Engineering Lab					
5	ENGG	Internship	EC681	Industrial Training (Min. 2 Weeks)	0	0	0	0	1
Total of Theory, Practical								24	19

4th Year 7th Semester									
Sl. No.	**Broad Category**	Category	Paper Code	Sub ject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC701	Satellite Communication	3	0	0	3	3
2	ENGG	Major	EC702A	Information Theory & Coding	3	0	0	3	3
			EC702B	Fiber Optic Communication					
			EC702C	Remote Sensing & GIS					
3	ENGG	Major	EC703A	Computer Architecture	3	0	0	3	3
			EC703B	Machine Learning					
			EC703C	IC Technology					
4	ENGG	Minor	CS(EC)701 A	Data Analytics	3	0	0	3	3
			CS(EC)701 B	Deep Learning					
			CS(EC)701 C	Cyber Security & Cryptography					
5	HUM	Skill Enhancem ent Course	HU(EC) 701	Economics for Engineers	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	EC791	Satellite Communication Lab	0	0	2	2	1
2	ENGG	Internship	EC781	Internship (Min. 1 Month)	0	0	0	0	1
3	PRJ	Project	EC782	Project-I	0	0	0	6	6
Total of Theory, Practical								22	22

4th Year 8th Semester									
Sl. No.	Broad Category	Category	PaperCode	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC801 A	nd Wireless Sensor Networks	3	0	0	3	3
			EC801B	Introduction to EDA					
			EC801C	Speech and Audio Signal Processing					
2	ENGG	Major	EC802A	Adaptive Signal Processing	3	0	0	3	3
			EC802B	Electronic System Design					
			EC802C	Industrial Automation & Robotics					
3	ENGG	Minor	CS(EC)801A	Mining and DataWarehouse	3	0	0	3	3
			BM(EC)801B	Biomedical Electronics					
			CS(EC)801C	Block Chain					
4	HUM	Ability Enhancement Course	HU(EC)801	Principles of Management	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Internship	EC881	Grand Viva	0	0	0	0	1
2	PRJ	Project	EC882	Project-II	0	0	0	12	6
Total of Theory, Practical								23	18

Credit distribution

Category	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	Total Credit to obtain UG Degree (Category Wise)	Credit Allocation as per NEP to obtain UG Degree	7th Semester	8th Semester	Total Credit (Category Wise)	Credit Allocation as per NEP
Major (Core)	4.5	4.5	10.5	14.5	16.5	13.5	64	60	10	6	80	80
Minor Stream	-	3	6.5	7.5	4.5	4.5	26	24	3	3	32	32
Multidisciplinary	5	6					11	9			11	9
Ability Enhancement Courses (AEC)	3	1		1	1		6	8		2	8	8
Skill Enhancement Courses (SEC)	4	3			1		8	9	2		10	9
Value Added Courses common for all UG	3	3					6	6 to 8			6	6 to 8
Internship						1	1	2 to 4	1	1	3	2 to 4
Research Project								-	6	6	12	12
Total Credit (Semester Wise)	19.5	20.5	17	23	23	19	122	120	22	18	162	160

Distribution of Subjects under Different Categories

Major Courses					
Sl. No.	**Name of the Subject**	**Subject Code**	**Semester**	**L:T:P**	**Credit**
1	Basic Electrical and Electronics Engineering	EC101	1st	3:0:0	3
2	Basic Electrical and Electronics Engineering Lab	EC191	1st	0:0:3	1.5
3	Circuit Theory & Network	EC201	2nd	3:0:0	3
4	Circuit Theory & Network Lab	EC291	2nd	0:0:3	1.5
5	Digital Electronics	EC301	3rd	3:0:0	3
6	Solid State Devices	EC302	3rd	3:0:0	3
7	Analog Circuits	EC303	3rd	3:0:0	3
8	Digital Electronics Lab	EC391	3rd	0:0:3	1.5
9	Analog Circuits Lab	EC393	3rd	0:0:3	1.5
10	EM Theory & Antenna	EC401	4th	3:0:0	3
11	Signals & Systems	EC402	4th	3:0:0	3
12	Analog & Digital Communication	EC403	4th	3:1:0	4
13	EM Theory & Antenna Lab	EC491	4th	0:0:3	1.5
14	Analog & Digital Communication Lab	EC493	4th	0:0:3	1.5
15	Digital Signal Processing	EC501	5th	3:0:0	3
16	Microprocessor & Microcontroller	EC502	5th	3:0:0	3
17	Computer Network	EC503	5th	3:0:0	3
	Mobile Communication & Network	EC504A			
	Embedded Systems	EC504B			
18	RF & Microwave Engineering	EC504C	5th	3:0:0	3
	Mobile Communication & Network Lab	EC594A			
	Embedded Systems Lab	EC594B			
19	RF & Microwave Engineering Lab	EC594C	5th	0:0:3	1.5
20	Digital Signal Processing Lab	EC591	5th	0:0:3	1.5
21	Microprocessor & Microcontroller Lab	EC592	5th	0:0:3	1.5
22	VLSI Design	EC601	6th	3:0:0	3
23	Control System	EC602	6th	3:0:0	3
	IoT for Communication	EC603A			
	Digital Image Processing	EC603B			
24	Soft Computing	EC603C	6th	3:0:0	3
25	VLSI Design Lab	EC691	6th	0:0:3	1.5
26	Control System Lab	EC692	6th	0:0:3	1.5
	IoT for Communication Lab	EC693A			
	Digital Image Processing Lab	EC693B			
27	Soft Computing Lab	EC693C	6th	0:0:3	1.5
	Total for Major Courses up to 3rd Year				**64**

Major Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1	Satellite Communication	EC701	7th	3:0:0	3
	Information Theory & Coding	EC702A			
	Fiber Optic Communication	EC702B			
2	Remote Sensing & GIS	EC702C	7th	3:0:0	3
	Computer Architecture	EC703A			
	Machine Learning	EC703B			
3	IC Technology	EC703C	7th	3:0:0	3
4	Satellite Communication Lab	EC791	7th	0:0:2	1
	Ad-Hoc and Wireless Sensor Networks	EC801 A			
	Introduction to EDA	EC801B			
5	Speech and Audio Signal Processing	EC801C	8th	3:0:0	3
	Adaptive Signal Processing	EC802A			
	Electronic System Design	EC802B			
6	Industrial Automation & Robotics	EC802C	8th	3:0:0	3
	Total for Major Courses up to 4th Year				**80**

Minor Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1	Programming for Problem Solving	CS(EC)101	1st	3:0:0	3
2	Data Structure	CS(EC)301	3rd	3:0:0	3
3	Numerical Methods	M(EC)301	3rd	2:0:0	2
4	Data Structure Lab	CS(EC)391	3rd	0:0:3	1.5
5	Database Management System	IT(EC)401	4th	3:0:0	3
6	Probability and Statistics	M(EC)401	4th	3:0:0	3
7	Database Management System Lab	IT(EC)491	4th	0:0:3	1.5
8	Object Oriented Programming using JAVA	CS(EC)501A	5th	3:0:0	3
	Introduction to Quantum Computing	CS(EC)501B			
	Cloud Computing	CS(EC)501C			
9	Object Oriented Programming using JAVA Lab	CS(EC)591A	5th	0:0:3	1.5
	Introduction to Quantum Computing Lab	CS(EC)591B			
	Cloud Computing Lab	CS(EC)591C			
10	Artificial Intelligence	CS(EC)601A	6th	3:0:0	3
	Web Technology	CS(EC)601B			
	Software Engineering	CS(EC)601C			
11	Introduction to AI Lab	CS(EC)691A	6th	0:0:3	1.5
	Web Technology Lab	CS(EC)691B			
	Software Engineering Lab	CS(EC)691C			
	Total for Minor Courses up to 3rd Year				**26**

Minor Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1	Data Analytics	CS(EC)701 A	7th	3:0:0	3
2	Deep Learning	CS(EC)701 B			
3	Cyber Security & Cryptography	CS(EC)701 C			
4	Data Mining and Data Warehouse	CS(EC)801A	8th	3:0:0	3
5	Biomedical Electronics	BM(EC)801B			
6	Block Chain	CS(EC)801C			
	Total for Minor Courses up to 4th Year				**32**

Multidisciplinary Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1	Engineering Physics	PH(EC)101	1st	3:0:0	3
2	Engineering Mathematics- I	M(EC)101	1st	3:0:0	3
3	Engineering Chemistry	CH(EC)201	2nd	2:0:0	2
4	Engineering Mathematics –II	M(EC)201	2nd	3:0:0	3
	Total for Multidisciplinary Courses up to 3rd Year				**11**

Ability Enhancement Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1	Business Communication	HU(EC)501	5th	1:0:0	1
2	Soft Skill and Aptitude	HU(EC)191	1st	0:0:2	1
3	Technical Seminar Presentation & Group Discussion	HU(EC)391	3rd	0:0:2	1
4	Professional Communication	HU201	2nd	2:0:0	2
5	Professional Communication Lab	HU291	2nd	0:0:2	1
	Total for Ability Enhancement Courses up to 3rd Year				**6**
6	Principles of Management	HU(EC)801	8th	2:0:0	2
	Total for Ability Enhancement Courses up to 4th Year				**8**

Skill Enhancement Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1	Engineering Physics Lab	PH(EC)191	1st	0:0:3	1.5
2	Programming for Problem Solving Lab	CS(EC)191	1st	0:0:3	1.5
3	Engineering Graphics & Design Lab	ME(EC)191	1st	0:0:3	1.5
4	IT Workshop Lab (SciLab/MATLAB/C++)	IT(EC)591	5th	0:0:2	1
5	Engineering Chemistry Lab	CH(EC)291	2nd	0:0:2	1
6	Workshop & Manufacturing Practices Lab	ME(EC)291	2nd	0:0:3	1.5
	Total for Skill Enhancement Courses up to 3rd Year				**8**

Skill Enhancement Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1	Economics for Engineers	HU(EC) 701	7th	2:0:0	2
	Total for Skill Enhancement Courses up to 4th Year				**10**

Value Added Courses

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1	Environmental Science	HU104	1st	2:0:0	2
2	Values and Ethics	HU202	2nd	2:0:0	2
3	Constitution of India	HU203	2nd	1:0:0	1
4	Indian Knowledge System	HU105	1st	1:0:0	1
	Total for Value Added Courses up to 3rd Year				**6**

Internship

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1	Industrial Training (Min. 2 Weeks)	EC681	6th	0:0:0	1
	Total for Internship up to 3rd Year				**1**
2	Internship (Min. 1 Month)	EC781	7th	0:0:0	1
3	Grand Viva	EC881	8th	0:0:0	1
	Total for Internship up to 4th Year				**3**

Project

Sl. No.	Name of the Subject	Subject Code	Semester	L:T:P	Credit
1	Project-I	EC782	7th	0:0:0	6
2	Project-II	EC882	8th	0:0:0	6
	Total for Project up to 4th Year				**12**

Recommended MOOCs courses for attaining the Honours for AICTE UG programmes as per MAKAUT

Dated: 05.08.2021

प्रा. मनिष र. जोशी
सचिव
Prof. Manish R. Joshi
Secretary

सत्यमेव जयते

विश्वविद्यालय अनुदान आयोग
University Grants Commission
(शिक्षा मंत्रालय, भारत सरकार)
(Ministry of Education, Govt. of India)

F.No.1-8/2017(SWAYAM Board) **30th October, 2023 / 8 कार्तिक, 1945**

Subject : List of 1247 approved MOOCs for the January 2024 semester on the SWAYAM Platform (www.swayam.gov.in) & also registration open for UGC four Buddhist MOOCs for the January 2024 Semester on the SWAYAM Platform (www.swayam.gov.in/UGC).

Dear Madam/Sir,

I would like to inform you that the SWAYAM Board, in its 23rd Meeting held on 25.09.2023 under the Chairmanship of Secretary (HE), D/o Higher Education, Ministry of Education, has approved ***1247 MOOCs*** (list attached) for the **January 2024 semester** on the SWAYAM Platform (www.swayam.gov.in). These 1247 courses may please be shared with the Deans and Heads of the Department of your respective University/Institution and may be adopted for credit transfer through your concerned statutory bodies as per the University Grants Commission (Credit Framework for Online Learning Courses through Study Webs of Active Learning for Young Aspiring Minds) Regulations, 2021.

As you are also aware, considering the recommendation of the meeting of Committees of Secretaries (Cos), Cabinet Secretariat for the revival of India as a Global Centre of Buddhist Culture and Tourism. UGC has developed 4 MOOCs on "Buddhist Culture and Tourism" and offered these 4 MOOCs in the January & July 2023 semester. These four MOOCs were initially offered in the January and July 2023 semesters, and due to their significant popularity among learners and the academic community both in India and worldwide, these courses are once again open for registration for January 2024 Semester on the SWAYAM Platform at (www.swayam.gov.in/UGC).

The **examination dates** for all 1247 MOOCs are fixed for the **18th, 19th, 25th, and 26th of May 2024.** Therefore, you are requested to factor in these dates while finalising your university/institution examination calendar.

I would like to request all HEIs to take benefit of these 1247 MOOCs and encourage their students and faculty members to enroll in large numbers, so that students may avail the benefit of credit transfer from their concerned HEIs.

With kind regards,

Yours sincerely,

(Manish Joshi)

Encl: As above

To,
The Vice Chancellors of all Universities and Principals of all Colleges

बहादुरशाह जफ़र मार्ग, नई दिल्ली-110002 | Bahadur Shah Zafar Marg, New Delhi-110002
Ph.: 011-23236288/23239337 | Fax : 011-2323 8858 | E-mail : secy.ugc@nic.in

Mandatory Additional Requirements (MAR) Activity List w.e.f. 2023-2024

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
(FORMERLY KNOWN AS WEST BENGAL UNIVERSITY OF TECHNOLOGY)
Main Campus : Haringhata, Nadia, Pin-741249
Kolkata Campus : BF-142, SECTOR-I, SALTLAKE CITY, KOLKATA-700 064, (INDIA)
Website : www.wbut.ac.in

Ref. No. : Date :

Mandatory Additional Requirements (MAR)

Activity List w.e.f. 2023-2024

Activity		Points per Activity	Permissible Points (max)
1. MOOCS (SWAYAM/NPTEL/Spoken Tutorial/any technical, non-technical course) (per course)			
a)	For 12 weeks duration/40 Hours	20	40
b)	For 8 weeks duration/30 Hours	15	
c)	For 4 weeks duration/20 Hours	10	
d)	For 2 weeks duration/10 Hours	5	
2. Tech Fest/Fest/Teachers Day/Fresher's Welcome			
a)	Organizer	5	10
b)	Participant	3	6
3. Rural Reporting		5	10
4. Tree plantation and Up-keeping (per tree)		1	10
5. Relief/Charitable Activities			
a)	Collection of fund/ materials for the Relief Camp or Charitable Trusts	5	40
b)	To be a part of the Relief Work Team	20	
6. Participation in Debate/Group Discussion/Workshop/Tech quiz /Music/Dance/Drama/Elocution/Quiz/Seminar/Painting/ any Performing Arts/Photography/Film Making/		10	20
7. Publication in News Paper, Magazine, Wall Magazine & Blogs		10	20
8. Research Publication (per publication)		15	30
9. Innovative Projects (other than course curriculum)		30	60
10	Blood donation	8	16
	Blood Donation Camp Organization	10	20
11. Sports/Games/Adventure Sports/Trekking/Yoga Camp			
a)	Personal Level	10	20
b)	College level	5	10
c)	University Level	10	20
c)	District Level	12	24
e)	State Level	15	30
f)	National/International Level	20	20
12. Activities in a Professional Society/Student Chapter		10	20
13. Relevant Industry Visit & Report/Hotel-Event Management Training & Report (Minimum 3 days with submitted report)		10	20
14. Community Service & Allied Activities like: Caring for the Senior Citizens, Under-privileged/Street Children/ Animal Care etc/ Training to Differently Able		10	20
15. Self-Entrepreneurship Programme			
a)	To organise entrepreneurship programmes and workshops	10	20
b)	To take part in entrepreneurship workshop and get certificate	5	10
c)	Video film making on entrepreneurship	10	20
d)	Submit business plan on any project	10	20
e)	To work for start-up/as entrepreneur	20	40

Date: 04.12.23

Syllabus under Autonomy effective from Academic Year 2023-2024 (R23)

R23 (All B. Tech.)

Curriculum & Syllabus for B.Tech under JIS Autonomy
Electronics and Communication Engineering

1st Year 1st Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC101	Basic Electrical and Electronics Engineering	3	0	0	3	3
2	ENGG	Minor	CS(EC)101	Programming for Problem Solving	3	0	0	3	3
3	SCI	Multidisciplinary	PH(EC)101	Engineering Physics	3	0	0	3	3
4	SCI	Multidisciplinary	M(EC)101	Engineering Mathematics- I	3	0	0	3	3
5	HUM	Value Added Course	HU104	Environmental Science	2	0	0	2	2
6	HUM	Value Added Courses	HU105	Indian Knowledge System	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	EC191	Basic Electrical and Electronics Engineering Lab	0	0	3	3	1.5
2	SCI	Skill Enhancement Course	PH(EC)191	Engineering Physics Lab	0	0	3	3	1.5
3	ENGG	Skill Enhancement Course	CS(EC)191	Programming for Problem Solving Lab	0	0	3	3	1.5
4	ENGG	Skill Enhancement Course	ME(EC)191	Engineering Graphics & Design Lab	0	0	3	3	1.5
5	HUM	Ability Enhancement Course	HU(EC)191	Soft Skill and Aptitude	0	0	2	2	1
Total of Theory, Practical								29	22

Course Name: BASICS ELECTRICAL AND ELECTRONICS ENGINEERING
Course Code:EC101
Contact: 3:0:0
Total Contact Hours: 36 Credit:3

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

Course objective: The objective of this course is to understand the laws of electrical engineering and to apply it in simple electronics circuit analysis.

Course outcomes:
The Graduates of the ECE program will be able to:
CO1: Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO2: Solve simple ac circuits in steady state
CO3: Impart the knowledge of Basic Electronics Devices
CO4: Analyze the simple electronics circuits

MODULE 1: Elementary Concepts of Electric Circuits 6L

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with independent sources only (Steady state)
Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

MODULE 2: Electrical machine 6L

Transformer: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.
DC Machines: Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation.

MODULE 3:Fundamentals of Semiconductor Devices: 6L
Introduction to Semiconductor: Concept of energy band diagram; Comparison among metal, insulator, semiconductor; Semiconductors-classifications and Fermi energy level; Charge neutrality and Mass-Action law in semiconductor; Current flow in semiconductor due to drift & diffusion process; Einstein relation.

MODULE 4: PN Junction Diode and its applications: 8L
Principle of operation; V-I characteristics; principle of avalanche & Zener breakdown; V-I characteristics of Zener diode.
Working principle of half wave and full wave rectifier; Rectifiers-Average output current

and voltage, ripple factor, power conversion efficiency; LC filters; working principle of Zener voltage regulator; Block diagram description of DC power supply; Clipper and Clamper circuit.

MODULE 5: Bipolar Junction Transistors: 4L

PNP and NPN structures; Principle of operation; Current gains in CE, CB and CC mode; input and output characteristics; Biasing & Stability Analysis-Concept of Fixed Bias, Collector to base Bias & voltage divider bias.

MODULE 6: Field Effect Transistors: 6L

JFET and MOSFET- P Channel & N Channel structures; Principle of operation; CS, CD and CG configurations; Transfer Characteristics and Drain characteristics; FET parameters.

Textbooks:

1. A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering) & Volume II(Ac & DC Machines)-B. L Theraja & A.K. Teraja, S. Chad,23rd Edition, 1959
2. D. Chattopadhyay, P.C Rakshit, "Electronics Fundamentals and Applications", New AgeInternational (P) Limited Publishers, Seventh Edition,2006
3. Basic Electrical & Electronics Engineering by J.B. Gupta , S.K. Kataria& Sons,2013

Reference Books:

1. DC Kulshreshtha,"Basic Electrical Engineering",TataMcGrawHill,2010.
2. Hughes,"Electrical and ElectronicTechnology",Pearson Education", 12th edition, 2016
3. Parker and Smith,"Problems in Electrical Engineering",CBS Publishers and Distributors, 9thedition ,2018.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	2	1	1	2	2
CO2	3	3	2	1	2	-	-	2	1	-	2	2
CO3	3	2	2	1	-	-	-	2	3	2	1	2
CO4	2	3	2	1	4	-	-	2	1	-	2	1

Course Name: PROGRAMMING FOR PROBLEM SOLVING
Course Code: CS(EC)101Contact: 3:0:0
Total Contact Hours: 36Credits: 3

Pre-requisite: None
Course objective: The objective of this course is to:
1. Design solutions to simple engineering problem by applying the basic programming principles of C language and basic mathematical knowledge.

2. Choose a suitable C-construct to develop C code for a given problem.
3. Apply the C-language syntax rules to correct the bugs in the C program.
4. Develop simple C programs to illustrate the applications of different data types such as arrays, pointers, functions.

Course Outcome:
The Graduates of the ECE program will be able to:

CO1: Identify the working principle of input and output devices of Computers memorize the basic terminology used in computer programming.
CO2: Express programs in C language and use different data types for writing the programs.
CO3: Implement programs using the dynamic behaviour of memory by the use of pointers.
CO4: Explain the difference between call by value and call by address.
CO5: Write programs using basic data files and developing applications for real world problems.

CO-PO Mapping:

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

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 ofsigned and unsigned numbers in singed magnitude singed 1's complement system and signed 2's complementsystem.

Arithmetic–AdditionandSubtraction(using1'scomplementand2'scomplement). Representation of Characters-ASCII Code, Basics of Compiler, Interpreter and Assembler
Problem solving–Basic concept of Algorithm. Representation of algorithm using flowchart and pseudocode, 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 characters identifiers and keywords, data type & sizes, variable names, declaration, statements.
Operators & Expressions: Arithmetic operators, relational operators, Logical operators, increment and decrement operators, bitwise operators, Assignment operators, conditional operators, special operators-type conversion, C expressions, precedence and associativity.

Input and Output: Standard input and output, formatted output–printf, formatted input scanf.

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 and continue; 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 lifetime of variables.
C pre-processor: Pre-processing directive and macro, parameterized macro.

Module-5: Array and Pointer [7L]

Arrays: One dimensional array, Two-dimensional arrays
Passing an array to a function Pointers: Pointers, Pointer and Array, 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, bitfields. 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, fopen, fclose, fgetc, fputc, fprintf, fscanf function.

Textbook:

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

Reference Books:

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

Course Name: Engineering Physics
Course Code: PH(EC)101
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Knowledge of Physics up to 12th standard.

Course Objectives:

The aim of course is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies.

Course Outcomes (COs):
The Graduates of the ECE program will be able to:
CO1: Explain basic principles of laser and optical fibers.

CO2: Understand the properties of Nano material.

CO3: Understand the macro state for thermodynamic system, thermodynamic probability and phase space.

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

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

CO-PO Mapping:

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

Course Content:

Module 1 (12L)
Modern Optics
1.01- 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. 6L

1.02-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

1.03-Holography-Theory of holography, viewing of holography, applications 3L

Module 2 (6L)

Solid State Physics

2.01 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

2.02 Semiconductor: Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-n junction. 3L

Module 3 (8L)

Quantum Mechanics

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, related numerical problems. 4L

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

4L

Module 4 (4L)

Physics of Nanomaterials

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, graphene, electronic, environment, medical).

Module 5 (6L)

Statistical Mechanics

Concept of energy levels and energy states, phasespace, microstates, macrostates and thermodynamic probability, MB, BE, FD, statistics (Qualitative discussions)-physical significance, conception of bosons, fermions, classical limits of quantum statistics, Fermi distribution at zero & non-zero temperature, Concept of Fermi level, relevant problems, Position of Fermi level for a semiconductor (intrinsic & extrinsic) - Qualitative discussion.

Recommended Text Books for Engineering Physics:

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. Concepts of Modern Physics-Arthur Beiser, McGraw Hill
Solid State Physics:

1. Solid state physics-Puri&Babbar(S. Chand publishers)
2. Materials Science & Engineering-KakaniKakani
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.)
Quantum Mechanics:

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)

Course Name: Engineering Mathematics - I
Paper Code: M(EC)101
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites:

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

Course Objectives:

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

Course Outcomes:
The Graduates of the ECE program will be able to:

CO1: Recall the properties related to matrix algebra and calculus.

CO2: Determine the solutions of the problems related to matrix algebra and calculus.

CO3: Apply the appropriate mathematical tools of matrix algebra and calculus for the solutions of the problems.

CO4: Analyze different engineering problems linked with matrix algebra and calculus.

CO-PO Mapping:

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

CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	2	3	1	2	-	-	-	-	-	-	-	1

Course Content:

Module I: Liner 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 matrix, Cayley-Hamilton theorem.

Module II: Single Variable Calculus (5L)
Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Power series; Taylor's series.

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.

Module IV: Multivariable Calculus (Integration) (7L)
Double Integral, Triple Integral; Change of order in multiple integrals; Line Integral, Surface Integral, Volume Integral. Change of variables in multiple integrals.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New age International Publishers.
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. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
5. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
6. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.

Course Name: ENVIRONMENTAL SCIENCE
Course Code: HU104
Contact hours: 2:0:0
Total contact hours: 24

Credit: 2

Prerequisites: None

Course Objective:

- Realize the importance of environment and its resources.
- Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
- Know about environmental laws and regulations to develop guidelines and procedures for health and safety issues.
- Solve scientific problem-solving related to air, water, land and noise pollution.

Course Outcomes:

Graduates of ECE program will be able to:

CO1: Understand the natural environment and its relationships with human activities.

CO2: Apply the fundamental knowledge of science and engineering to assess environmental and health risk.

CO3: 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.

CO-PO Mapping:

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

Module 1 - Resources and Ecosystem (6L)

1. Resources (2L)
2. Types of resources, resistance to resources, Human resource, Population Growth models: Exponential Growth, logistic growth
3. Ecosystem (3L)
4. Components of ecosystem, types of ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Food chain, Food web.
5. Energy and Environment(1L)
6. Conventional energy sources, coal and petroleum, Green energy sources, solar energy, tidal energy, geothermal energy, biomass

Module 2 – Environmental Degradation (9L)

a) Air Pollution and its impact on Environment (3L)
Air Pollutants, primary & secondary pollutants, Criteria pollutants, Smog, Photochemical smog and London smog, Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion.

b) Water Pollution and its impact on Environment (3L)
Water Pollutants, Oxygen demanding wastes, heavy metals, BOD, COD, Eutrophication, Hardness, Alkalinity, TDS and Chloride, Heavy metal poisoning and toxicity.

c) Land Pollution and its impact on Environment (2L)

Solid wastes, types of Solid Waste, Municipal Solid wastes, hazardous wastes, bio-medical wastes, E-wastes

d) Noise Pollution and its impact on Environment (1L)

Types of noise, Noise frequency, Noise pressure, Noise intensity, Noise Threshold limit, Effect of noise pollution on human health.

Module 3 – Environmental Management (6L)

a) Environmental Impact Assessment (1L)

Objectives of Environmental management, Components of Environmental Management, Environmental Auditing, Environmental laws and Protection Acts of India

b) Pollution Control and Treatment (2L)

Air Pollution controlling devices, Catalytic Converter, Electrostatic Precipitator, etc., Waste Water Treatment, Noise pollution control.

c) Waste Management (3L)

Solid waste management, Open dumping, Land filling, incineration, composting, E-waste management, Biomedical Waste management.

Module 4 – Disaster Management (3L)

a) Study of some important disasters (2L)

Natural and Man-made disasters, earthquakes, floods drought, landside, cyclones, volcanic eruptions, tsunami, Global climate change. Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

b) Disaster management Techniques (1L)

Basic principles of disasters management, Disaster Management cycle, Disaster management policy, Awareness generation program

Text Books:

1. A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education Private Limited, 2nd edition, 2017

References Books:

1. Environmental Studies, Dr. J P Sharma, University Science Press, 3rd edition, 2009
2. Environmental Engineering, J K Das Mohapatra, Vikas Publication, 2nd edition, 2018

Paper Name: Indian knowledge System
Paper Code: HU 105
Contact: 1:0:0
No. of lectures: 12
Credit: 1

Prerequisite: Nil

Course outcomes:

CO1: To recall & state thought process of social setting in ancient India to identify the roots and details of some contemporary issues faced by Indians.

CO 2: The students are able to identify & inspect the importance of our surroundings& culture to design & formulate sustainable developmental solutions.

CO 3: To develop the ability to understanding the issues related to 'Indian' culture, tradition and its composite character to apply the same in the socio-technological developments in present scenario.

CO 4: The students are able to relate & assess Indian Knowledge System in the health care, architecture, agriculture & other systems.

Module-1 3L

An overview of Indian Knowledge System (IKS): Importance of Ancient Knowledge - Definition of IKS - Classification framework of IKS - Unique aspects of IKS.
The Vedic corpus: Vedas and Vedangas - Distinctive features of Vedic life.
Indian philosophical systems: Different schools of philosophy.

Module-2 3L

Salient features of the Indian numeral system: Importance of decimal representation - The discovery of zero and its importance - Unique approaches to represent numbers.

Highlights of Indian Astronomy: Historical development of astronomy in India

Module-3 3L

Indian science and technology heritage: Metals and metalworking - Mining and ore extraction –Physical structures in India - Irrigation and water management - Dyes and painting technology - Surgical Techniques - Shipbuilding

Module-4 3L

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, Traditional Knowledge in agriculture, Traditional societies depend on it for their food and healthcare needs.

Text Book:

1) Introduction to Indian knowledge system: concepts and applications-Mahadevan B.Bhat, Vinayak Rajat, Nagendra Pavana R.N.,PHI

Reference Books:

1. Traditional Knowledge system in India, Amit Jha, Atlantic Publishers
2. S. N. Sen and K. S. Shukla, History of Astronomy in India, Indian National Science Academy, 2nd edition, New Delhi, 2000

CO and PO mapping:

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

Paper Name: BASICS ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY
Paper Code:EC191
Credit:1.5
Total Lecture: 36

Course Outcomes:
The Graduates of the ECE program will be able to:

CO1: Analyze a given network by applying KVL and KCL.
CO2: Examine the Operation of DC Motor.
CO3: Examine the Operation of Basic Electronics Devices
CO4: Design simple electronics circuits.

List of Experiments: -

1. Familiarization with different passive and active electrical & electronic components.
2. Familiarization with different Electrical & Electronics Instruments.
3. Verification of KVL and KCL.
4. Forward and reversal of DC shunt motor.
5. Speed control of DC shunt motor.
6. Study of the P-N junction diode V-I characteristics (Forward & Reverse
7. Bias).
8. Study of the Characteristics of Zener diode (Forward & Reverse
9. Bias).
10. Study of half wave and full wave rectifier.
11. Study of clipper and clamper circuit.
12. Study of the Input and Output characteristics of BJT in CE mode.
13. Study of transfer and drain characteristics of JFET.
14. Extramural Experiment.

Textbooks:

1. Handbook of Laboratory Experiments in Electronics Engineering Vol. 1, Author Name: A.M. Zungeru, J.M. Chuma, H.U. Ezea, and M. Mangwala, Publisher -Notion Press Electronic Devices and Circuit Theory by Robert Boylestad Louis Nashelsky,7th Edition, Prentice Hall
2. Experiments Manual for use with Grob's Basic Electronics 12th Edition by Wes Ponick, Publisher-McGraw Hill,2015
3. Laboratory Manual for 'Fundamentals of Electrical & Electronics Engineering': A

handbook for Electrical & Electronics Engineering Students by ManojPatil (Author), Jyoti Kharade (Author), 2020

Reference Books

1. Basic Electrical and Electronics Engineering, Author:S. K. Bhattacharya, Publisher: Pearson Education India,2011
2. Practical Electrical Engineering
3. Electronics Lab Manual (Volume 2) By Navas, K. A. Publisher: PHI Learning Pvt. Ltd. 2018

CO-PO Course Articulation Matrix Mapping:

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

Course Name: Engineering Physics Lab
Code: PH(ECE)191
Contact Hours: 0:0:3
Credit: 1.5

Prerequisites: Knowledge of Physics up to 12th standard.

Course Objectives:

The aim of course is to provide adequate exposure and develop insight about the basic principles of physical sciences and its practical aspects which would help engineers to learn underlying principles of various tools and techniques they use in core engineering and related industrial applications. The course would also inculcate innovative mindsets of the students and can create awareness of the vital role played by science and engineering in the development of new technologies.

Course Outcomes:
The Graduates of the ECE program will be able to:

CO1 : demonstrate experiments allied to their theoretical concepts
CO2 : conduct experiments using LASER, Optical fiber.
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 experiment.
CO5: Design solutions for real life challenges.

CO-PO Mapping:

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

Course Content:

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.

Experiments on Classical Physics (Any 4 to be performed from the following experiments):

1. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.
2. Determination of Young's moduli of different materials.
3. Determination of Rigidity moduli of different materials.
4. Determination of wavelength of light by Newton's ring method.
5. Determination of wavelength of light by Laser diffraction method.
6. Optical Fibre-numerical aperture, power loss.

Experiments on Quantum Physics (Any 2 to be performed from the following experiments):

7. Determination of Planck's constant using photoelectric cell.
8. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
9. Determination of Stefan's Constant.
10. Study of characteristics of solar cell.

Perform at least one of the following experiments:

11. Determination of Q factor using LCR Circuit.
12.Study of I-V characteristics of a LED/LDR

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

Innovative experiments:

1. Study of dispersive power of material of a prism.
2. Study of viscosity using Poiseuille's capillary flow method/using Stoke's law.
3. Determination of thermal conductivity of a bad/good conductor using Lees-Charlton / Searle apparatus.
4. Determination of the angle of optical rotation of a polar solution using polarimeter.
5. Any other experiment related to the theory.

Recommended Text Books for Engineering Physics Lab:

Waves & Oscillations:

1. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit Classical & Modern Optics:

2. A text book of Light- K.G. Mazumder&B.Ghosh (Book & Allied Publisher)
Quantum Mechanics-I

1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
Solid State Physics:

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

Course Name: PROGRAMMING FOR PROBLEM SOLVING LAB
Course Code: CS191
Contact Hours: 3L/Week
Total Contact Hours: 36
Credits: 1.5

Prerequisites: None

Course Outcomes:
The Graduates of the ECE program will be able to:

CO1: Identify the working of different operating systems like DOS, Windows, Linux
CO2: Express programs in C language
CO3: Implement programs connecting decision structures, loops
CO4: Experiment with user defined functions to solve real time problems
CO5: Write C programs using Pointers to access arrays, strings, functions, structures and files

CO-PO Mapping:

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

CourseContent:

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 andexecutionofC program.IntroductiontoCodeblock.

Module-2: Problembasedon

a) Basicdatatypes
b) Differentarithmeticoperators.
c) Printf() and scanf() functions.

Module-3: Problem based on conditional statements using

a) if-elsestatements
b) differentrelationaloperators
c) differentlogicaloperators

Module-4: Problembasedon

a) for loop
b) whileloop
c) do-whileloop

Module-5: Problembasedon

a) Howtowritea menu drivenprogramusingswitch-casestatement
b) Howtowriteafunctionandpassingvaluestoafunction
c) Howto writearecursivefunction.

Module-6: Problembasedon

a) Howtouse array(bothI-Dand2-D).
b) Howtopassanarraytoafunction.

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

Module-8: Problem based on

a) HowtohandlecompoundvariablesinC

b) HowtohandlefileinC
c) HowtousecommandlineargumentinC

Textbook:

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

Reference Books:

1. BrianW.Kernighan and Dennis M.Ritchie, The C Programming Language, PrenticeHall of India, KRVenugopal&SRPrasad–MASTERINGC,TMH,2ndEdition

COURSE NAME: ENGINEERING GRAPHICS & DESIGN LAB
COURSE CODE: ME(EC) 191
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisites: Basic knowledge of geometry

Course Outcomes: Upon successful completion of this course, the student will be able to:

CO1: Learn the basics of drafting
CO2: Understand the use of drafting tools which develops the fundamental skills of industrialdrawings.
CO3: Apply the concept of engineering scales, dimensioning and various geometric curvesnecessary to understand design of machine elements.
CO4: Analyse the concept of projection of line, surface and solids to create the knowledge base of orthographic and isometric view of structures and machine parts.
CO5: Evaluate the design model to different sections of industries as well as for research &development.

Course Contents:

Basic Engineering Graphics: 3P

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 6P

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 6P

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 6P

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: 3P

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 3P

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 6P

Set up of drawing including scale settings, ISO and ANSI standards for dimensioning and tolerance; Using various methods to draw straight lines, circles, applying dimensionsand 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 3P

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

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, KhannaPublishing 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, PearsonEducation

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

CO-PO Mapping:

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

Paper Name: Soft Skill and Aptitude Training
Paper Code: HU(EC)191
Contact: 0:0:2
Total Contact Hours: 12
Credit: 1

Prerequisites: None
Course Objective: To train the students in acquiring workplace-specific interpersonal communication skills.

Course Outcomes:
The Graduates of the ECE program will be able to:
CO1: identify, define, apply workplace interpersonal communication modalities in aneffective manner.
CO2: employ, infer, relate group behavioral and personal interview skills.CO3: organize, differentiate, employ reading proficiency skills.
CO4: identify, classify, organize and relate question types and aptitude test patterns inplacement tests.

Course Content:

Module 1 – Introduction to Soft Skills

1.The Skills of Interpersonal Communication. 2. Team Behavior. 3. Time Management Skills

Module 2- Verbal Ability: Reading

Enhancing reading speed and vocabulary enhancement through intensive practice of placement test-based reading passages.

Module 3 – Verbal Ability Test Patterns

Introducing Verbal Ability tests—Test Question Types: Synonyms and Antonyms, Error Spotting/Sentence Improvement, Analogies and Para Jumbles.

Module 4 – Group Discussion and Personal Interview

Basics of Group Discussion—Intensive practice on answering interview-based questions

common in placement interviews.

CO-PO Mapping:

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

R23 (All B. Tech.)

Curriculum & Syllabus for B.Tech under JIS Autonomy
Electronics and Communication Engineering

1st Year 2nd Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A.THEORY									
1	ENGG	Major	EC201	Circuit Theory & Network	3	0	0	3	3
2	SCI	Multidisciplinary	CH(EC)201	Engineering Chemistry	2	0	0	2	2
3	SCI	Multidisciplinary	M(EC)201	Engineering Mathematics –II	3	0	0	3	3
4	HUM	Ability Enhancement Course	HU201	Professional Communication	2	0	0	2	2
5	ENGG	Value Added Course	HU202	Values and Ethics	2	0	0	2	2
6	ENGG	Value Added Course	HU203	Constitution of India	1	0	0	1	1
B. PRACTICAL									
1	SCI	Skill Enhancement Course	CH(EC)291	Engineering Chemistry Lab	0	0	2	2	1
2	ENGG	Skill Enhancement Course	ME(EC)291	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
3	ENGG	Major	EC291	Circuit Theory & Network Lab	0	0	3	3	1.5
4	HUM	Ability Enhancement Course	HU291	Professional Communication Lab	0	0	2	2	1
Total of Theory, Practical								**23**	**18**

Course Name: Circuit Theory & Network
Course Code: EC 201
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Properties of series and parallel connections, concept of KCL, KVL, complex number, current- voltage phasor diagram, DC and AC, Charging and discharging of capacitor, Energizing and decaying of inductor.

Course Objective: Objective of this course is to Understand basic concepts of DC and AC circuit behavior. Develop and solve mathematical representations for simple RLC circuits. Understand the use of circuit analysis theorems and methods.

Course Outcomes: Graduates of the ECE program will be to:
CO1: Analyze series and parallel resonance circuit based on parameters: resonance frequency, band-width, upper & lower cut-off frequency, quality factor and impedance for the designingof single tuned circuit
CO2: Determine current, voltage and power at different branch for DC and AC circuit using networks theorems.
CO3: Solve branch current and branch voltage with the help of planner graph of a circuit using cut-set and tie set matrix.
CO4: Apply Laplace Transform technique for the determination of current, voltage and power in magnetically coupled and transient circuits.
CO5: Estimate parameters of two port network through open circuit & short circuit test for the development of the model of the circuit.

CO-PO mapping:

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

Course Content:

Module I: Methods of Analysis and Network Theorems. [10L]

Node and Mesh analysis in DC and AC circuits with independent and dependent sources, super node &super mesh; Star-Delta transformation technique in DC &AC circuits; Solving problems using network theorems- Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem in DC & AC Circuits with independent and dependent sources; Sinusoidal steady state analysis, complex power.

Module II: Application of Laplace Transform in Circuit Analysis [4L]

Laplace transform: Step function, GATE function, Impulse function, Delta function, Periodic functions - Rectangular & Triangular wave, strain of pulses; initial & final value theorem; Circuit analysis & solution of numerical problems in S-domain.

Module III: Transient Analysis in RC, RL and RLC Circuit [5L]

Transient analysis in RC, RL, RLC circuit with DC excitations – determination of circuit parameters at time (t=0, t=0+, t=0-, t > 0) with numerical examples; RC, RL, RLC circuit with sinusoidal excitation (concept only).

Module IV: Resonance in RLC Circuit [4L]
RLC series and parallel resonance circuit - condition of resonance, resonance frequency, impedance & admittance characteristics, quality factor, half power points, bandwidth, phasor diagrams, properties of series and parallel resonance; Solution of problems.

Module V: Two Port Network [5L]
Two port network analysis – Z, Y, h and ABCD parameters; conditions of reciprocity and symmetry in terms of two port parameters; equivalent circuit in terms of Z, Y and h parameters; Interrelation between different two port parameters (concept only); Solutions of circuit problems using two port parameters.

Module VI: Magnetically Coupled Circuit [4L]
Self & Mutual inductance; Polarity of induced voltage in magnetically coupled circuit; Determination of equivalent inductance in series and parallel magnetically coupled network; Numerical examples for the determination current, voltage and power of a magnetically coupled network.

Module VII: Graph of a Network [4L]
Development of graph of a network -planner and non-planner graph, branch, tree, twigs; Incidence Matrix, Cut Set Matrix, Tie Set Matrix for a graph of circuit; Application of graph to solve problems in circuit.

Textbooks:

1. A.Chakrabarti - Circuit Theory: Analysis and Synthesis , Dhanpat Rai & Co. 7th edition 2018
2. Valkenburg M. E. Van, “Network Analysis”, Prentice Hall. /Pearson Education , 3rd edition 2019
3. D. Roy Chowdhury -Networks and Systems, New Age International, 4th edition 2017
4. Reference Books:
5. B.L. Thereja and A.K. Thereja - A Textbook of Electrical Technology: Basic Electrical Engineering in S. Units (Volume - 1), S-Chand , 2nd edition 2005
6. Sudhakar: Circuits & Networks: Analysis & Synthesis” 2/e TMH, 5th edition 2017
   D.A.Bell- Electrical Circuits- Oxford, 7th edition 2009

Course Name: ENGINEERING CHEMISTRY
Course Code: CH (ECS) 201
Total Contact Hours: 24
Credit: 2

Prerequisites: 10+2 knowledge of Chemistry

COURSE OBJECTIVE

- To understand the basic principles of elements, organic reactions, drug synthesis and computational chemistry
- To apply the knowledge of different engineering materials, advanced polymers, and nanomaterials to solve complex engineering problems
- To analyse and evaluate quality parameters of water and its treatment
- Apply the knowledge of free energy, energy storage device, semiconductors and corrosion to design environment friendly & sustainable devices
- Apply the knowledge of different instrumental techniques to analyse unknown engineering materials.

COURSE OUTCOME

CO1. Able to understand the basic principles of elements, organic reactions drug synthesis and computational chemistry
CO2. Able to apply the knowledge of different engineering materials, advanced polymers, and nanomaterials to solve complex engineering problems
CO3. Able to analyse and evaluate water quality parameters and its treatment
CO4. Able to the knowledge of free energy, energy storage device and corrosion to design environment friendly & sustainable devices
CO5. Able to apply the knowledge of different instrumental techniques to analyse unknown engineering materials

CO-PO MAPPING

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

COURSE CONTENT:

Module 1 - Elements and their properties (6L)

1. Elements and their properties (3L)

Bohr's theory for one electron system,Hydrogen spectrum, Quantum numbers, Atomic orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle,Electronic configuration and Magnetic properties.

2. Periodic Table for Engineers (3L)

Modern Periodic table, Periodic properties, study ofadvanced functionalmaterials likeSilicones, Silicates, Zeolite and alloys like steel, mischmetall, Neodymium alloy and their applications

Module 2 - Energy devices and Semiconductors (6L)

1. Use of free energy in chemical equilibria (3L)

Laws of Thermodynamics, Enthalpy, Entropy, Spontaneity, Electrochemical Cell, Dry Cell, Mercury Cell, Lead Storage batteries, Ni-Cd Cells, Fuel Cells, Solar Cells, Nernst equation and applications, Electrochemical sensors

2. Crystals and Semiconductors (3L)

Crystals and their defects, Stoichiometric and Non-stoichiometric defects, Band theory and Doping, n-type and p-type semiconductors, Superconductors

Module 3 –Industrial Applications of Chemistry (8L)

1. Advanced Polymeric materials (3L)

Classification, Engineering Plastics, conducting polymers, bio polymers, polymer composites

2. Industrial corrosion (2L)

Classification, Effects of corrosion, Preventive measures

3. Analysis of Water Quality (1L)

Water quality parameters and treatment

4. Nano materials (1L)

Synthesis of Nano materials, Applications in modern devices

5. Basic Computational Chemistry (1L)

Introduction of computational chemistry and their applications

Module 4 – Organic Reaction Products and their spectroscopic analysis (4L)

1. Organic Reactions (2L)

Substitution, Elimination and Addition reactions

2. Drug designing and synthesis (1L)

Paracetamol, Aspirin

3. Spectroscopic Analysis (1L)

UV – Visible Spectra, IR spectra

Text Books

1. Fundamentals of Engineering Chemistry, Dr. Sudip Bandopadhyay& Dr. Nirmal Hazra, latest edition, Chhaya Prakashani Pvt. Ltd.
2. Chemistry –I, Gourkrishna Das Mohapatro, 3rd Edition,Vikas Publications, 2016
3. A text book of Engineering Chemistry, 2nd Edition, Dr. Rajshree Khare, S.K. Kataria & Sons, 2022
4. Engineering Chemistry, N Acharjee & P. Dhar, Latest Edition, U. N. Dhar & Sons Pvt. Ltd., 2020
5. Physical Chemistry, P.C. Rakshit, 7th edition, Sarat Book House, 2018

Reference Books

1. Engineering Chemistry, Jain & Jain, 16th Edition, Dhanpat rai Publishing Company, 2016
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishna, 2019
3. Text book of Engineering Chemistry, Jaya Shree Anireddy, 1st Edition, Wiley, 2018

Course Name: Engineering Mathematics - II
Paper Code: M(EC)201
Contact : 3 : 0 : 0
Total Contact Hours: 36
Credit: 3

Prerequisites:

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

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations, Laplace transform and numerical methods. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes (COs):

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

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

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

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

CO4: Analyze engineering problems by using ordinary differential equation, Laplace transform and numerical Methods.

CO-PO Mapping:

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

Course Content:

Module I: First Order Ordinary Differential Equations (ODE) (9L)
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 and solvable for $x$and Clairaut's equation.

Module II: Second Order Ordinary Differential Equations (ODE) (8L)
Solution of second order ODE with constant coefficients: C.F. &P.I., Method of variation ofparameters, Cauchy-Euler equations.

Module III: Laplace Transform (LT)
(12L)
Concept of improper integrals; Definition and existence of LT, LT of elementary functions, First and second shifting properties, Changeof scale property, LT of $tf(t)$, LT of $\frac{f(t)}{t}$, LT of derivatives of $f(t)$, LT of integral of $f(t)$, Evaluation of improperintegrals 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 oflinear ODE with constant coefficients (initial value problem) using LT.

Module IV: Numerical Methods (7L)

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

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New age International Publishers.

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. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.
5. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
6. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.

Course Name: Professional CommunicationPaper
Code: HU 201
Contact : 2:0:0
Total Contact Hours: 24Credit:
2

Pre-requisites: Basic(10+2)levelof knowledgeofEnglishgrammar,vocabularyreading andwritingskills.
Course Objectives: The course aims to impart domain and industry-specific communication skillsinaglobalizedcontextandto promote the understandingofbusiness communicationpracticesandcross culturaldynamics.
Course Outcomes:

CO1: Define, describe and classifythemodalitiesandnuancesofcommunicationin aworkplacecontext.
CO2: Review, appraise and understand the modes, contexts and appropriacy ofcommunicatingacrosscultures and societies.
CO3: Identify, interpret and demonstratethebasicformats,templatesof business and officialcommunication.
CO4: Identify, compare and illustrate reading strategies and basic writing strategies. CO5: Interpret, analyze and evaluate semantic-structural,interpersonaland multiculturaldynamics in businesscommunication.
CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	2	1	1	2	3	-	2
CO2	-	-	-	-	-	1	1	2	2	3	-	3
CO3	-	-	-	-	-	3	3	1	1	3	2	3
CO4	-	-	-	-	1	3	3	1	-	3	-	3
CO5					1	2	2	2	2	3	-	3

Module 1: Verbal and Non verbal communication 4L

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

Module 2: Workplace Communication Essentials and Cross Cultural Communication 4L

Communication at the Workplace—Formal and Informal Situations
Language in Use—Jargon, Speech Acts/Language Functions, Syntactical and Grammatical Appropriacy Cultural Contexts in Global Business: High Context and Low Context Cultures Understanding Cultural Nuances and Stereotyping Achieving Culturally Neutral Communication in Speech and Writing

Module 3: Reading Strategies and Basic Writing Skills 4L

Reading: Purposes and Nature of Reading
Reading Sub-Skills—Skimming, Scanning, Intensive Reading
Reading General and Business Texts(Reading for Comprehension and DetailedUnderstanding)Basic Writing Skills—Paragraph and Essay writing, writing technical document
Writing Technicalities—Paragraphing, Sentence Structure and Punctuation

Module 4: 4L

Report Writing

Nature and Function of ReportsTypes
of Reports
Researching for a Business ReportFormat,
Language and Style Report
Documentation

Module 5: Employment Communication

8L

a. Writing Business Letters—(Enquiry,Order, Sales,Complaint, Adjustment, Job Application,Offer)
b. Creating an Employee Profile-- Preparing a CV or Résumé.
   Creating a Digital/Online Profile – LinkedIn (Résumé/Video Profile)
c. Writing Other Interoffice Correspondence--E-mails: types, convention, and etiquette, Memo, Notices and Circulars
d. Preparing Meeting Documentation—Drafting Notice and Agenda of Meetings, Preparing Minutes of Meetings.

Text 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. MarkIbbotson. Professional English in Use: Engineering. Cambridge: CambridgeUP,2009.

Reference Books:

1. Lesikar. Business Communication: Connectingin a Digital World. New Delhi:

TataMcGraw-Hill,2014.
2. John Seeley. Writing Reports. Oxford: Oxford UniversityPress,2002.
3. DianaBooher.E-writing:21st CenturyTools forEffectiveCommunication.Macmillan,2007.
4. Michael Swan. Practical English Usage. Oxford: OUP, 1980.

Course Name: Value & EthicsCourse
Code: HU 202 Contact: 2:0:0
Credit: 2
No. of lectures: 24

Prerequisite: Nil

Course outcome:
CO1: Understand the core values that shape the ethical behavior of an engineer and Exposed awareness on professional ethics and human values.
CO2: understand the basic perception of profession, professional ethics, various moral issues& uses of ethical theories
CO3: understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field
CO4: Aware of responsibilities of an engineer for safety and risk benefit analysis, professionalrights and responsibilities of an engineer
CO5: Acquire knowledge about various roles of engineers in variety of global issues and ableto apply ethical principles to resolve situations that arise in their professional lives

Module 1:
Value: Definition- Importance and application of Value in life- Formation of Value- Process of Socialization- self and integrated personality.
Types of values-Social, Psychological, Aesthetic, Spiritual, and Organizational-Value crisis in contemporary society: individual, societal cultural and management level. (4)

Module-2 :
Effects of Technological Growth- Rapid Technological growth and depletion of resources,Reports of the Club of Rome.
Problems of Technology transfer- Technology assessment impact analysis.

Human Operator in Engineering projects and industries- Problems of man, machine- interaction- Impact of assembly line and automation-Human centred Technology. (4)

Module-3
Impact of Ethics on Business Policies and Strategies – Utilitarianism – Principles of Utilitarianism - Criticism of Utilitarianism - Impact on Business Culture - Role of CEO in shaping Business Culture – Ethical Leadership – Characteristics (4)

Module-4
Types of Ethical issues - Internal Ethics of Business – Hiring Employees – Promotion - Wages – Job discrimination - its nature and extent- Exploitation of Employees – Discipline and Whistle Blowing (2)

Module-5
Markets and consumer Protection – Consumer rights – Unethical Practices in Marketing – Ethics of Competition and Fair Prices – Ethics in Advertising and False Claims - Environmental Protection and Ethics –Pollution Control – Ecological ethics (4)

Module-6
Social Responsibilities of Business – Definition and case study of Corporate Compliance; Responsibilities towards Customers, shareholders, employees – Social Audit – Objectives andNeed for Social Audit – Methods of Social Audit – Benefits – Obstacles – Social Audit in India. (6)

Text Books:

1) A N Tripathi, Human values in the Engineering Profession, Monograph published byIIM, Calcutta 1996
2) . S. K. Chakraborty: Values and Ethics in Organization, OUP

Reference Books:

1) U.C.Mathur, Corporate Governance & Business Ethics, Macmillan, 2005

2. Fernando. A. C., Business Ethics – An Indian Perspective, Pearson Publication, 2009.

3) Prem Vir Kapoor, Professional Ethics & Human Values, Khanna Publishing House, NewDelhi

CO and PO Mapping

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

Course Name: Constitution of IndiaCourse
Code: HU 203
Contact: 1:0:0
Credit: 1
No. of lectures: 12

Prerequisite: Nil

Course Outcome: On Completion of this course student will be able to

CO1: To Identify and explore the basic features and modalities of Indian constitution.

CO2: To Differentiate and relate the functioning of Indian parliamentary system at the centreand state level.

CO3: To Differentiate the various aspects of Indian Legal System and its related bodies.

Module 1: History of Making of the Indian Constitution: History. Drafting Committee,(Composition & Working)

Philosophy of the Indian Constitution: Preamble Salient Features 3L

Module 2: Fundamental Rights, Fundamental Duties, Directive Principles of State Policy: 6L

The Right to Equality
The Right to Freedom: I (Article 19)
The Right to Freedom: II (Articles 20, 21 and 22)

The Right against Exploitation The Right to freedom of ReligionCultural and Educational rights The Right to Property
The Right to Constitutional Remedies

Fundamental Duties

Module-3: Organs of Governance: 3L

Parliament - Composition - Qualifications and Disqualifications -Powers and Functions – Executive-President -Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions

Text Book:

1) Indian Constitution by D.D.Basu, The Publisher, LexisNexis
2) PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

Reference Books:

1) Constitution of India by Subhas C Kasyap, Vitasta Publishing
2) The Constitution of India, P.M Bakshi, Universal Law Publishing Co.Ltd, New Delhi,2003.
3) Indian Constitution Text Book - Avasthi, Avasthi, Publisher: LAKSHMI NARAIN AGARWAL
4) Introduction to the Constitution of India, Brij Kishore Sharma, PHI

CO-PO mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12

CO1	-	-	-	-	-	2	-	3		1	-	
CO2	-	-	-	-	-	1	-	2		3	-	
CO3	-	-	-	-	-	3	-	2		1	-	

Course Name: ENGINEERING CHEMISTRY LAB
Paper Code: CH (ECS)291Total
Contact Hours: 24 Credit: 1

Prerequisites: 10+2
Course Objective

- Study the basic principles of pH meter and conductivity meter for different applications
- Analysis of water for its various parameters & its significance in industries
- Learn to synthesis Polymeric materials and drugs
- Study the various reactions in homogeneous and heterogeneous medium

Course Outcome

CO1: operate different types of instruments for estimation of small quantities chemicals usedin industries and scientific and technical fields.
CO2: analyse and determine the composition and physical property of liquid and solidsamples when working as an individual and also as a team member
CO3: analyse different parameters of water considering environmental issuesCO4: synthesize drug and sustainable polymer materials.
CO5: design innovative experiments applying the fundamentals of modern chemistry.

CO-PO Mapping:

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

Course Content:

1. Synthesis of Silver Nanoparticles doped organic thin film for organic transistors.
2. Preparation of Si-nano crystals for future memory devices.
3. Determination of the concentration of the electrolyte through conductance measurement.
4. Green Synthesis of ZnO based Polymer Nano composites.

5. Determination of the concentration of the electrolyte through pH measurement.
6. Determination of water quality measurement techniques.

7. Isolation of graphene from dead dry batteries and their use for temporary soldering.
8. Synthesis of polymers for electrical devices and PCBs.
9. Determination of Partition Coefficient of acetic acid between two immiscible liquids.
10. Computational optimization of molecular geometry
11. Drug design and synthesis
12. Rheological properties of the Newtonian fluids
13. Innovative Experiments

Course Name: Workshop and Manufacturing Practices LabCourse
Code: ME(EC) 291
Contact: 0:0:3
Credits: 1.5

Prerequisite: Physics & Mathematics(10+2Level)

Course Objective: The objective of this course is to impart knowledge and skill to use tools, machines, equipment, and measuring instruments.

Course Outcome:

CO1: Gain basic knowledge of Workshop Practice and Safety useful for our daily living.

CO2: Understand the use of Instruments of a pattern shop like Hand Saw, Jack Plain, Chiselsetc.

CO3: Apply and performing operations like such as Marking, Cutting etc used in manufacturingprocesses.

CO4: Analyse the various operations in the Fitting Shop using Hack Saw, various files, Scriber, etc to understand the concept of tolerances applicable in all kind of manufacturing.

CO5: Get hands on practice of in Welding and apply various machining processes which give alot of confidence to manufacture physical prototypes in project works.

Course Content:

3P

(i) Theoretical discussions:
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, 3D Printing
8. Plastic moulding & Glass Cutting

(ii) Workshop Practice:

At least 6 modules should be covered

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 ina shaping and / ormilling machine.

Module 2 - Fitting shop 6P
Typical jobs that may be made in this practice module: To make a Gauge from MS plate.

Module 3 – Carpentry Shop 6P
Typical jobs that may be made in this practice module: To make wooden joints and/or apattern or like.

Module 4 - Welding & Soldering shop 6P
Typical jobs that may be made in this practice module:

i. Arc Welding: To join two thick (approx 5mm) MS plates by manual metal arc welding.
ii. Gas Welding: To join two thin mild steel plates or sheets by gas welding.
iii. House wiring, soft Soldering

Module 5 – Smithy & Casting 6P
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.
ii. One/ two green sand moulds to prepare, and a casting be demonstrated.

Module 6 – CNC Machining & Laser Cutting 6PTypical jobs that may be made in this practice module:
i. At least one sample shape on mild steel plate should be made using CNC Milling /CNC Lathe Machine
ii. At least one sample shape on glass should be made using laser cutting machine.

Module 7 – 3D Printing 6P
i) Exposure to a 3D printing machine,
ii) 3D printing of at least one sample model using available materials.

Examinations could involve the actual fabrication of simple components,utilizing one or more ofthe 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, ManufacturingTechnology – 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, ManufacturingEngineering 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:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO1 2
CO1	3	-	-	-	-		2		2	2		
CO2	3	-	-	-	-		2		2	2		
CO3	3	-	-	-	-		2		2	2		
CO4	3	-	-	-	-		2		2	2		
CO5	3	2	2				2		2	2		

Course Name: Circuit Theory and Networks LabCourse code: EC 291
Contact: 0-0-3
Credit: 1.5

Prerequisites: Concept of series and parallel connections, concept of KCL, KVL, circuit with electrical components, DC, and AC source

Course Objective: The objective of this course is to understand current and electric circuitsis critical to understanding how electricity works.

Course Outcomes: The Graduates of the ECE program will be able to:

CO1: Determine current, voltage and power in a DC and AC circuit with the help of network Theorems, Superposition theorem, Thevenin's & Norton's theorem, Maximum power transfer theorem, Compensation theorem and Millman's theorem.
CO2: Measure Z, Y, h & ABCD parameters of a two-port network following open circuit and short circuit test and conclude whether the network is symmetrical or reciprocal or both.
CO3: Construct RLC series & parallel resonance circuit and analyze its performance though the determination of resonance frequency, bandwidth, upper& lower cut-off frequency, quality factor and impedance at audio frequency range.

CO4: Estimate transient & steady state value of current & voltage in RC, RL & RLC circuitwith DC excitations range up to 25 V from the transient response curve.

CO-PO Mapping:

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

List of Experiments:

1. Verification of Superposition theorem, Thevenin's Theorem, Norton' sTheorem.
2. Study of maximum power transfer theorem
3. Study of reciprocity theorem.
4. Determination of Z & Y parameters of a two-port network.
5. Determination of h & ABCD parameters of two port networks.
6. Study of series RLC resonance circuit.
7. Study of Parallel RLC resonance circuit.
8. Transient response in RC circuit.
9. Transient response in RL circuit.
10. Transient response in RLC circuit.
11. Innovative experiment.

Paper Name: Professional Communication Lab
Paper Code: HU191/291
Contact: (0:0:2)
Total Contact Hours: 26 Credit: 1

Prerequisites: Basic knowledge of LSRW skills.

Course Objectives: To train the students in acquiring interpersonal communication skills by focusing on language skill acquisition techniques and error feedback.

Course Outcome:
By pursuing this course the students will be able to:
CO1: Recognize, identify and express advanced skills of Technical Communication in Englishthrough Language Laboratory.
CO2: Understand, categorize, differentiate and infer listening, speaking, reading and writingskills in societal and professional life.
CO3: Articulate and present the skills necessary to be a competent Interpersonal communicator.
CO4: Deconstruct, appraise and critique communication behaviours.
CO5: Adapt, negotiate and facilitate with multifarious socio-economical and professionalarenas with effective communication and interpersonal skills.

CO-PO Mapping

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

Course Contents:

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. Listening in Business Telephony

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 ClosedPair Drilling, Student Recordings (using software)
e. Group Discussion: Principles and Practice
f. Giving a Presentation—Learning Presentation Basics and Giving Micro Presentations

Module 4: Lab Project Work
a. Writing a Book Review
b. Writing a Film Review
c. Scripting a Short Presentation (2 minutes)
d. Making a short video CV (1-2 minutes)

Reference Books:
1. Sasikumar et al. A Course in Listening and Speaking. New Delhi: Foundation Books, 2005.
2. Tony Lynch, Study Listening. Cambridge: Cambridge UP, 2004.
3. Ann Baker, Ship or Sheep. Cambridge: Cambridge UP, 1998.

R23 (All B. Tech.)

Curriculum & Syllabus for B.Tech under JIS Autonomy
Electronics and Communication Engineering

2nd Year 3rd Semester									
Sl. No.	**Broad Category**	**Category**	**Paper Code**	**Subject**	**Contact Hours/Week**				**Credit Points**
					L	**T**	**P**	**Total**	
A. THEORY									
1	ENGG	Major	EC301	Digital Electronics	3	0	0	3	3
2	ENGG	Major	EC302	Solid State Devices	3	0	0	3	3
3	ENGG	Major	EC303	Analog Circuits	3	0	0	3	3
4	ENGG	Minor	CS(EC)301	Data Structure	3	0	0	3	3
5	SCI	Minor	M(EC)301	Numerical Methods	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Major	EC391	Digital Electronics Lab	0	0	3	3	1.5
2	ENGG	Major	EC393	Analog Circuits Lab	0	0	3	3	1.5
3	ENGG	Minor	CS(EC)391	Data Structure Lab	0	0	3	3	1.5
4	HUM	Ability Enhancement Course	HU(EC)391	Technical Seminar Presentation & Group Discussion	0	0	2	2	1
Total of Theory, Practical								25	19.5

Course Name: Digital Electronics
Course Code: EC301
Contact: 3:0:0
Total Contact Hours:36
Credits: 3

Prerequisites: A basic course in Electronics and Communication Engineering Progresses from the fundamentals of electricity, direct current (DC) devices and circuits, series and parallel circuits to the study of active and passive components, Ohm's Law, Kirchhoff's Law i.e. KVL, KCL, Ampere's Law etc.

Course Objectives:

- To present the Digital fundamentals, Boolean algebra and its applications in digital systems.
- To familiarize with the design of various combinational digital circuits using logic gates.
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits to explain the various semiconductor memories and related technology.
- To introduce the electronic circuits involved in the making of logic gates.

Course Outcome:
Graduates of the ECE program will be able to:

CO1: Acquiring knowledge about solving problems related to number systems conversions and Boolean algebra and design logic circuits using logic gates to their simplest forms using De-Morgan's Theorems; Karnaugh Maps.

CO2: Design of combinational circuits and application

CO3: Design of various synchronous and asynchronous sequential circuits using State Diagrams & Tables.

CO4: Applying the knowledge of DAC&ADC technique to design corresponding circuits

CO5: Analyze logic family interfaces, switching circuits to plan and execute projects.

Course Content:

Module I: [8L]

Binary, Octal and Hexadecimal number system representation and their conversions; BCD, ASCII, EBDIC, Gray codes and their conversions. Signed binary number representation with 1's, 2's, 9'sand 10's complement methods, Binary arithmetic. Boolean algebra; Various Logic gates- their truth tables and circuits; Implementation of various logic Gates using Universal Logic Gate, Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method, Quine-McCluskey minimization technique (Tabular Method).

Module II: [9L]

Combinational circuits-Half Adder, Full Adder, Serial & Parallel Adder, Carry Look

Ahead Adder, BCD Adder , Half Subtractor, Full Subtractor circuits, Adder-Subtractor Circuit. Encoder, priority encoder, Decoder, Multiplexer, De-Multiplexer, Adder & Subtractor Design using decoder &multiplexer, Boolean Function representation by MUX, Comparator and Parity Generator-Checker.

Module III: **[11L]**

Sequential Circuits-latch & FlipFlops-S-R,J-K,D and T, Conversion of FlipFlops, Various types of Shift Registers-SISO, PISO, SIPO, PIPO, Bi-directional & Universal Shift Register ,Modulus Counters-Synchronous, Asynchronous, Irregular, Self-Correcting Ring & Johnson Counter. Application of Counter (Stepper motor control), Finite state machine, state transition diagrams and state transition tables.

Module IV: **[8L]**

Parameters of D/A & A/D Converters. Different types of A/D -Flash Type, Successive Approximation and Dual Slope and D/A-R-2R Ladder & Binary Weighted Resistor Type. Logic families-TTL, CMOS, NMOS, PMOS & their operation and specifications. TTL Equivalent Circuit.

Textbooks:

1. A. Anand Kumar, Fundamentals of Digital Circuits-PHI
2. Morries Mano-Digital Logic Design-PHI
3. S. Salivahanan &S. Arivazhagan, Digital Circuit & Design-Bikas Publishing
4. A.K. Maini - Digital Electronics-Wiley-India

Reference:

1. Floyed &Jain- Digital Fundamentals-Pearson.
2. R.P. Jain—Modern Digital Electronics,2/e , Mc Graw Hill
3. H. Taub & D. Shilling, Digital Integrated Electronics-Mc Graw Hill.
4. D. Ray Chaudhuri-DigitalCircuits-Vol-I&II,2/e-Platinum Publishers
5. Kharate-Digital Electronics-Oxford
6. Tocci, Widmer, Moss- DigitalSystems,9/e-Pearson

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	1	1	1					2	2	1	2
CO2	3	3	1	3	1	1	1					1	3	2	3
CO3	3	3	1	3	1	1	1					2	3	3	3
CO4	3	3	1	3	1	1	1					1	3	2	3
CO5	3	3	1	3	1	1	1					2	3	2	3
AVG	3	3	1	3	1	1	1					1.6	2.6	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) =Not matched.

Course Name: Solid State Devices
Course Code: EC302
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Electronic structure of atoms, crystalline and non-crystalline solids, unit cells, Miller index, conductors, semiconductors and insulators, electrical properties, basic concept of electronic devices.

Course Objectives:

1. To understand the fundamentals of semiconductor behavior and the operation of basic semiconductor devices.
2. Understanding of a 'top-down' view of traditional electronic device.
3. Understanding of a vast array of other more advanced semiconductor devices.
4. Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance.
5. Develop the basic tools with which newly developed devices and other semiconductor applications can be studied.

Course Outcomes: Graduates of the ECE program will be able to:

CO1: Apply the energy band diagram based on nearly free electron model to quantify charge carrier transport phenomenon, recombination generation process of different types of semiconductor materials.
CO2: Develop models of semiconductor devices like Diode, BJT, MOSFET to provide terminal current vs voltage and capacitance vs voltage characteristics.
CO3: Analyze performance of devices based on the physical design parameters and secondary phenomena for application in circuits.
CO4: Analyze performance of photonic devices for energy and sensor applications.
CO5: Design basic device structures and simulate in EDA tools.

Course Contents:

Module I: Charge Carriers in Semiconductors: [12L]

Introduction to semiconductor physics: review of quantum mechanics, electrons in periodic lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; intrinsic & extrinsic semiconductor. Effect of temperature and energy gap on intrinsic concentration, effect tof temperature on extrinsic semiconductor, derivation of equilibrium electron and hole concentration in terms of effective density of states and intrinsic level, derivation of electron and hole concentration in a compensated semiconductor, basic concept on optical absorption, photo luminescence, carrier lifetime, carrier generation and recombination, continuity equation (expression and significance only). Degeneracy and non- degeneracy

of semiconductors.

Non-equilibrium condition: Effect of temperature and doping concentration on mobility, Effective mobility due to scattering effect, drift & diffusion of carriers, high field effect on drift velocity, Hall effect and piezo electric effect, generation and recombination, quasi-Fermi energy level (concept only).

P-N Junction Diode applications: Diode Equivalent Circuits, Static, Small signal model, Large signal model and SPICE models of diode, diode capacitances, temperature dependencies of V-I characteristics of diode, reverse recovery transients, voltage multipliers, diode as gate.

Module II: Bipolar Junction Transistor [8L]

punch-through and avalanche effect, expression for punch through voltage and avalanche break down voltage (no derivation), Solution of continuity equation and Poisson's equation for BJT, Ebers - Moll, Static, large-signal, small- signal models, Temperature and area effects. Equivalent circuits, h-parameter model, origin of parameters in hybrid-pi model, time delay factors in BJT, alpha and beta cut-off frequency, Numerical Problems.

Module III: MOS Transistors: [10L]

Metal Oxide Field Effect Transistor (MOSFET): Types of MOSFET ,structure of E-MOSFET, MOS structure under external bias-accumulation, depletion and inversion phenomenon with energy band diagram, threshold voltage and flat band voltage; working of E-MOSFET with characteristics ;drain current equation for linear and saturation region with condition (expression only); channel length modulation ;derivation of threshold voltage of ideal and non-ideal MOSFET Capacitance-Different types of MOSFET Capacitances, MOS capacitance variation with gate to source voltage under low frequency & High Frequency; large and small signal model of MOSFET(explanation with diagram). Basics of MESFET, Numerical Problems.

Module IV: Advanced Devices [6L]

Photo Devices: Solar cell – photo-voltaic effect, constructional features of solar cell, conversion efficiency and fill factor; LED; Photo Diode and phototransistor basics.

Metal-Semiconductor Junction

Schottky Contact

Hetero Junction

Energy band diagram, Classification of Heterojunction;2D Electron Gas (Isotype Heterojunction), n-isotype Heterojunction, I-V Characteristics.

Textbooks:

1. Ben G Streetman, S K Banarjee, Solid State Electronic Devices, 6th edition, PHI India, New Delhi, 2007
2. S. M. Sze, K. K. Ng, Physics of Semiconductor Devices, 3rd edition, John Wiley, New Jersey, 2007.
3. R S Muller, T.I. Kamins, Device Electronics for Integrated Circuits, 3rd edition, Wiley India, New Delhi, 2012.
4. D. Neamen, -Semiconductor Physics and Devices TMH.

Reference Books:

1. Milman, Halkias–Integrated Electronics–TMH.
2. Sedra & Smith-Microelectronic Circuits-Oxford.
3. S.M.Kang andY. Leblebici.-CMOS Digital Integrated Circuits, Tata Mc Graw-Hill.

CO-PO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3											3	2	1	3
CO2		3	3									3	2	2	3
CO3			3		3							3	3	3	3
CO4				3	3							3	3	2	3
CO5			3		3		3				3	2	3	2	3

Subject Name: Analog Circuits
Subject code:EC303
Contact: 3:0:0
Credit: 3
Total Contacts: 36

Prerequisites: Basic knowledge about components (R, L, C). Network Theorems (Kirchhoff's law, Theremin's theorem, Norton's theorem, etc.). Basic knowledge about the operation of semiconductor devices (Diode, BJT, JFET etc.), Basic knowledge of Differentiation, Integration, Differential equation.

Course Objectives: Students will learn to design, test and examine simple circuits with diode, transistor, op-amp, etc. They will have clear knowledge of basic circuit analysis andits functions and their limitations. Most importantly they will be able to understand, modify and repair the majority of circuits used in professional equipment design. They will also beable to take- up new design exercises.

Course Outcomes (COs)

Graduates of the ECE program will be able to:

CO1: Design small and large signal amplifiers using the fundamental knowledge of BJTand JFET.
CO2: Implement the feedback concept in different amplifiers and oscillators.
CO3: Analyze the performance of small and large signal amplifiers.
CO4: Design various applications using OP-AMP and multivibrators.

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-					3	2	3
CO2	2	3	3	3	3	-	-	-					3	1	3
CO3	2	3	3	3	2	-	-	-					2	3	3
CO4	3	3	3	3	3	-	-	-					3	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly

matched, (-) = Not matched.

Module I:

SMALL SIGNAL AMPLIFIERS: [9L]

Transistor (BJT) Biasing techniques, Fixed Bias, Collector to feedback Bias, self-bias configuration, Q-point & its Stability, Thermal Runaway, Bias Compensation techniques, Expression for voltage gain, current gain, input and output impedance, power gain using h-parameter model of transistors, Transistor Amplifier frequency response characteristics using hybrid-∏ model, bandwidth, Concept of multistage amplifier, Different coupling techniques, RC coupled amplifier, functions of all components, Emitter follower circuit.

Module II: [7L]

FEEDBACK AMPLIFIERS: Feedback concept, negative & positive feedback, Gain calculation for positive and negative feedback condition, Gain stability and bandwidth in feedback amplifier, Feedback topology, Effect of feedback on input and output impedances.

OSCILLATORS: Concept of oscillator, Barkhausen criterion, RC Oscillators-Phase shift and Wien bridge oscillators, LC Oscillator-Colpitts, Hartley's, and crystal oscillators.

Module III: [7L]

LARGE SIGNAL AMPLIFIERS: Power amplifier-Class A, Class B, Class AB operation, Power Conversion efficiency and distortion, Class C Operation-Tuned amplifier.

JFET SMALL SIGNAL AMPLIFIERS: Biasing techniques, Fixed Bias, Self-Bias, Potential Divider bias, Common-source amplifier, Common drain amplifier, Common gate amplifiers. Expression of voltage gain, input impedance, output impedance using electrical equivalent circuit.

Module IV: [11]

OPERATIONAL AMPLIFIER & IT'S APPLICATIONS: Differential amplifier configurations using BJT, DC analysis. Internal block diagram of OPAMP, Characteristics of OPAMP, Electrical equivalent circuit, Ideal & Non-Ideal OPAMP, Configuration of inverting and non-inverting amplifier, Summing amplifier, Differential amplifier, integrator & differentiator circuit, Log & Anti-log amplifiers, Comparator & Schmitt Trigger circuit, Low pass, high pass, and band pass active filters.

Module V: [2]

MULTIVIBRATORS: Astable and Monostable operation using I.C-555 timer.

Textbooks:

1. Sedra & Smith-Microelectronic Circuits-Oxford Up
2. Millman & Halkais- Integrated Electronics, McGraw Hill.
3. Boylested & Nashelsky-Electronic Devices and Circuit Theory-Pearson/PHI
4. Rashid-Microeletronic Circuits-Analysis and Design- Thomson (Cenage Learning).
5. Franco- design with Operational Amplifiers & Analog Integrated Circuits, 3/e, McGraw Hill.
6. Gayakwad R.A – OpAmps and Linear IC's, PHI

References:

1. Razavi- Fundamentals of Microelectronics-Wiley
2. J.B. Gupta- Electronic Devices and Circuits- S.K. Kataria & Sons
3. Malvino- Electronic Principles, 6/e, McGraw Hill

Subject: Data Structure
Code: CS(EC) 301
Contact: 3:0:0
Credit: 3
Total lecture: 36

Prerequisite: Basic programming skills

Course objectives:

Data structures teach efficient data organization through arrays, linked lists, and trees, boosting algorithm performance. Mastery aids in problem-solving, scalability in software design, and informed decision-making for optimized computational efficiency.

Course outcomes:

CO1: Able to understand the Big-O notation and apply arrays and linked list to represent the row major, column major and sparse matrix.

CO2: Able to analyze stack and queue to classify the infix to postfix and prefix notations.
CO3: Able to create binary search tree, threaded binary tree, max & min heap, AVL tree and greedy algorithm to represent and access the data from memory.

CO4: Able to evaluate data using BFS, DFS, Prim's and Kruskal's algorithms.

CO5: Able to apply searching and sorting on the data using Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Radix sort, Sequential search, Binary search and Interpolation Search.

CO- PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	-	-	-	-	-	-	-	2	2	1	3
CO2	2	3	2	2	1	-	-	-	-	-	-	2	2	2	3
CO3	3	2	3	3	2	-	-	-	1	-	-	2	3	3	3
CO4	2	3	3	3	1	-	-	-	1	-	-	2	3	2	3
CO5	3	2	3	3	2	-	-	-	2	-	-	2	3	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Content:

Module I: Introduction [4L]

Data and data structure (Linear & Non-linear), abstract Data Type. Algorithms and programs, basic idea of pseudo-code, Algorithm efficiency and analysis, time and space analysis of algorithms, Big-O notations.

Module-II: Arrays & Linked List [5L]

Different representations - row major, column major, Sparse matrix - its implementation and usage, Array representation of polynomials, singly linked list - operations, doubly linked list – operations, Circular linked list - operations, Linked list representation of polynomial and applications.

Module III: Stack and Queue [7L]

Stack and its implementations (using array and linked list), Applications (infix to Postfix, Postfix Evaluation), Queue, circular queue de-queue, Implementation of queue- linear and circular (using array and linked list). Principle of recursion using stack, Tower of Hanoi, loop vs recursion, tail recursion.

Module IV: Trees [8L]

Basic terminologies, forest, tree representation (using array and linked list), Binary trees - binary tree traversal (pre- , in-, post- order), Threaded binary tree, Binary search tree- operations (creation, insertion, deletion, searching), Concept of Max-Heap and Min-Heap (creation, deletion), Height balanced binary tree - AVL tree (insertion with examples only), Height balanced binary tree - AVL tree (deletion with examples only), m -Way Search Tree, B+ Tree - operations (insertion, deletion).

Module V: Graphs [4L]

Graph theory review, 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), Minimal spanning tree - Prim's algorithm, Kruskal's algorithm (basic idea of greedy methods).

Module VI: Searching & Sorting [8L]

Bubble sort, Insertion sort, Selection sort- with notion of complexity, Quick sort, Merge sort - with complexity, Radix sort - with complexity, Sequential search - with complexity, Binary search, Interpolation Search- with complexity.

Reference books:

1. "Data Structures" by S. Lipschutz.
2. "The Art of Computer Programming" by DonaldKnuth.
3. "Data Structures, Algorithms, and Software Principles in C" by Thomas A. Standish.
4. "Data Structures and Program Design In C, 2nd Edition" by Robert L. Kruse, Bruce P. Leung.
5. "Data Structures in C" by Aaron M. Tenenbaum.

Course Name: Numerical Methods
Course Code: M(EC)301
Contact: 3:0:0
Total Contact Hours: 24
Credit: 2

Prerequisite:

The students to whom this course will be offered must have the concept of (10+2) standard number system, algebra and calculus and basic knowledge of numerical analysis.

Course Objectives:

This course aims to enhance comprehension of numerical methods and finite precision arithmetic by applying them to solve engineering problems. Through this study, students will gain a deeper understanding of the derivation of a practical application of numerical techniques in addressing real-world engineering challenges.

Course Outcomes (COs):

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

CO	DESCRIPTIONS
CO1	Apply numerical methods used to obtain approximate solutions of intractable mathematical problems such as the solution of linear and nonlinear equations, and the solution of ordinary and partial differential equations.

CO2	Compare numerical results in the context of the given problem, including limitations and advantages, through reports and presentations.
CO3	Apply numerical methods to obtain the solution of boundary value problems and initial value problems, showcasing an understanding of how numerical methods can be extended to address the real-world problems with specific boundary conditions and initial conditions.
CO4	Analyze the convergence rates of various numerical methods, understanding the underlying principles that influence convergence behavior.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	1	2	2	-	1	2	2	-	-	3	2	2
CO2	3	2	-	3	2	2	1	3	2	2	-	-	2	1	3
CO3	3	2	-	2	3	3	2	2	3	3	-	-	3	3	3
CO4	3	3	-	3	3	3	1	3	3	3	-	-	3	2	2

Course Content

MODULE I: ***Solution of Algebraic Polynomial and Transcendental Equations (8 Lectures)***

Bisection method, Regula-Falsi, Secant method, Fixed Point Iteration method, Newton-Raphson method.

MODULE II: ***Matrix and Numerical Solution of System of Linear Equations (8 Lectures)***

Matrix: Eigenvalues and eigenvectors of matrix: Power method. ***(2 Lectures)***

Numerical Solution of a System of Linear Equations: Gauss-Elimination method, LU Factorization method, Tridiagonal system, Gauss-Seidel iterative method. ***(6 Lectures)***

MODULE III: ***Numerical Solution of Differential Equation (8 Lectures)***

Numerical Solution of Ordinary Differential Equation: Taylor series method, Adams- Bashforth-Moulton and Milne's Predictor-Corrector methods, Finite Difference method. ***(5 Lectures)***

Numerical solution of partial differential equation: Finite Difference method, Crank–Nicolson method.

(3 Lectures)

Project Domains:

1. Application of PDE and ODE in Engineering Field.
2. Application of numerical methods for the relevant field.
3. Application of Dynamical system and Mathematical modeling.

Text Books:

1. Shishir Gupta & S. Dey, Numerical Methods, McGraw hill Education Pvt. Ltd.
2. C. Xavier: C Language and Numerical Methods, New age International Publisher.
3. Dutta & Jana: Introductory Numerical Analysis. PHI Learning
4. J. B. Scarborough: Numerical Mathematical Analysis. Oxford and IBH Publishing
5. Jain, M. K., Iyengar, S. R. K. and Jain, R. K. *Numerical Methods (Problems and Solution)*. New age International Publisher.
6. Prasun Nayek: Numerical Analysis, Asian Books

Reference Books:

1. Balagurusamy, E. *Numerical Methods*, SciTech. TMH.
2. Dutta, N. *Computer Programming & Numerical Analysis*, Universities Press.
3. Guha, S. and Srivastava, R. *Numerical Methods*, Oxford Universities Press.
4. Shastri, S. S. *Numerical Analysis*, PHI.
5. Mollah, S. A. *Numerical Analysis*, New Central Book Agency.
6. Numerical Methods for Mathematics, Science & Engg., Mathews, PHI.
   Rao, G. S. *Numerical Analysis*, New Age International.

Course Name: Digital Electronics Lab
CourseCode:EC391
Contact: 0:0:3
Credit:1.5

Prerequisites: A basic course in Electronics and Communication engineering Progresses from the fundamentals of electricity, active and passive components, basic electronics laws like Ohm's law, Ampere's law.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Able to understand the fundamental concepts and techniques used in digital electronics.

CO2: Able to understand and examine the structure of various number system De- Morgan's law, Boolean algebra, and its application in digital design.

CO3: Able to understand, analyse the timing properties (input setup and hold times, minimum clock period, output propagation delays) and design various combinational and sequential circuits using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power.

CO4: Able to understand different TTL logic.

CO5: Able to design digital circuits by their own.

List of Experiments:

1. Realization of basic gates and universal logic gates .
2. Realization of basic gates using Universal logic gates.
3. Design the circuit of Grey to Binary and vice versa.
4. Design a circuit for BCD to7-segment display.
5. Design of Half Adder &Full Adder Circuit using Logic Gates.
6. Design Half Subtractor &Full Subtractor Circuit using Logic Gates.
7. Four-bit parity generator and Two-bit comparator circuits.
8. Construction of simple Encoder & Decoder circuits using logic gates.
9. Construction of simple Multiplexer & De Multiplexer circuits using logic gates.
10. Realization of RS,D, JK and T flip-flops using logic gates.
11. Realization of SISO/SIPO Register using flip-flops and logic gates.
12. Realization of synchronous Up/Down counters.
12. Realization of logic gates using TTL.
13. One Innovative design of Digital Circuits.

Textbooks:

1. A.Anand Kumar, Fundamentals of Digital Circuits-PHI
2. Morries Mano-Digital Logic Design-PHI
3. S.Salivahanan&S.Arivazhagan,DigitalCircuit&Design-BikasPublishing
4. A.K.Maini-Digital Electronics-Wiley-India

Reference:

1. Floyed &Jain- Digital Fundamentals-Pearson.
2. R.P.Jain—ModernDigitalElectronics,2/e ,McGraw Hill
3. H.Taub & D.Shilling, Digital Integrated Electronics-McGraw Hill.
4. D.RayChaudhuri-DigitalCircuits-Vol-I&II,2/e-Platinum Publishers
5. Kharate-Digital Electronics-Oxford
6. Tocci,Widmer,Moss- DigitalSystems,9/e-Pearso

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	1	1	1			1	3	3	1	1
CO2	3	3	3	1	3	1	1		1	1	1	3	2	3	3
CO3	3	3	3	3	3	2	2	1		1	2	3	3	3	3
CO4	3	3	3	3	3	2	2	1		2	1	3	3	3	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3	3	3	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Analog Circuits Lab

Course Code: EC 393
Contact: 0:0:3
Credit: 1.5

Prerequisites: A basic course in Electronics and Communication engineering Progresses from the fundamentals of electricity, active and passive components, basic electronics laws like Ohm's law, Ampere's law.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Students will be able to design transistor based single stage R-C coupled voltage amplifier, differential amplifier, and different classes of power amplifier circuit with given specification.

CO2: Students will be able to design transistor-based RC oscillator (Wien bridge and RC phase shift oscillator) circuit.

CO3: Students will be able to construct astable and mono-stable mode timer circuit using IC 555.

CO4: Students will be able to design Integrator, differentiator, Schmitt Trigger and low pass & high pass active filter circuit using Op-Amp (I.C-741)

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	2	3	-	-	3	3	2	1
CO2	3	3	2	2	2	-	2	-	3	-	2	3	3	3	3
CO3	3	3	2	1	2	2	1	2	3	1	-	2	3	3	3
CO4	3	3	3	3	2	-	2	-	3	-	1	3	3	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

List of Experiments:

1. Design of RC coupled amplifier in CE mode & study of its frequency response using BJT.
2. Design of RC Phase shift oscillator using BJT and measurement of its output frequency.
3. Design of Wien bridge oscillator using BJT and measurement of its output frequency.
4. Design of class A & class B push-pull power amplifiers and measurement of its power conversion efficiency.
5. Study of single stage voltage amplifier & study of its frequency response using JFET.
6. Design of Integrator using OPAMP (IC-741) and study of its frequency response.
7. Design of Differentiator using OPAMP (IC-741) and study of its frequency response.
8. Design of low pass active filter using OPAMP (IC-741) and study of its frequency response.
9. Design of high pass active filter using OPAMP (IC-741) and study of its frequency response.
10. Design of Schmitt trigger circuit using OPAMP (IC-741) and study of its voltage

transfer characteristic.

11. Design of astable multivibrator using timer (IC-555) and measurement of its duty cycle.
12. Design of monostable multivibrator using timer (IC-555) and measurement of its duty cycle.
13. Innovative Experiments

Subject: Data Structures Lab
Course Code: CS(EC)391
Contact: 0:0:3
Credits: 1.5

Prerequisites: Fundamentals of Computer & C Programming Course Outcome:

CO1: Able to understand the theoretical workings of numerical techniques with the help of C/ Matlab.

CO2: Able to remember basic commands and scripts in a mathematical programming language.
CO3: Able to create the binary search tree and traversing algorithms to represent and access the data from memory.

CO4: Able to analyze graph theory and linked list.

CO5: Able to apply searching and sorting algorithms.

CO-PO Mapping:

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	-	-	-	-	-	-	2	3	3	1
CO2	3	1	2	1	1	-	-	-	-	-	-	2	3	3	3
CO3	3	3	3	3	2	-	-	-	1	-	-	2	3	3	3
CO4	3	3	3	3	1	-	-	-	1	-	-	2	3	3	3
CO5	3	3	3	3	1	-	-	-	1	-	-	2	2	1	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Content:

1. Write a C program that uses functions to perform the following: a. Create a singly linked list of integers.
   b. Delete a given integer from the above linked list.
   c. Display the contents of the above list after deletion.
2. Write a C program that uses functions to perform the following: a. Create a doubly linked list of integers.

   b. Delete a given integer from the above doubly linked list.

c. Display the contents of the above list after deletion.

3. Write a C program to implement Polynomial addition and Polynomial multiplication using Linked List.
4. Write a C program that uses stack operations to convert a given infix expression into its postfix Equivalent,

   Implement the stack using an array.

5. Write C programs to implement a queue ADT using i) array and ii) doubly linked list respectively.
6. Write a C program that uses functions to perform the following: a. Create a binary search tree of characters.
   b. Traverse the above Binary search tree recursively in Post order.
7. Write a C program that uses functions to perform the following: a. Create a binary search tree of integers.
   b. Traverse the above Binary search tree non recursively in order.
8. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:

   a. Insertion sort. b. Merge sort.

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

   a. Quick sort.
   b. Selection sort.

   10. Write C programs for implementing the following searching methods: a. Linear Search.
   b. Binary Search.

   11. Write C programs for implementing the following graph traversal algorithms:

   a. Depth first search.
   b. Breadth first search.

Technical Seminar Presentation and Group Discussion
Code: HU(EC)391
Contact: 0:0:2
Contacts: 2P
Credit: 1
Total no. of lectures: 12P

Prerequisite: Basic spoken English skills and presentation skills.
Course Outcome
The Graduates of the IT program will be able to:

CO1: identify, define, apply workplace interpersonal communication modalities in an effective manner.

CO2: employ, infer, relate group behavioral and personal interview skills.
CO3: organize, differentiate, employ reading proficiency skills.
CO4: identify, classify, organize and relate question types and aptitude test patterns in placement tests.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	2	2	1	3	2	3	-	3	3	1	3
CO2	3	2	2	-	2	1	-	3	3	3	-	3	3	3	3
CO3	3	-	-	-	2	-	-	-	-	3	2	3	3	2	3
CO4	3	3	1	1	3	-	-	-	3	3	3	3	3	3	3

Course Content

Module 1: – Fundamentals of Technical Communication **3L**
1.The Skills of Technical Communication, 2. Team Behavior. 3. Time Management Skills
Module 2: - Verbal ability **3L**
1.Reading skill Development, Enhancing reading speed and vocabulary enhancement through intensive practice of placement test-based reading passages.
Module 3: Presentation Strategy **4L**
Presentation: Forms; interpersonal Communication; Classroom presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module 4: – Group Discussion and Personal Interview **2L**
Basics of Group Discussion—Intensive practice on answering interview-based questions common in placement interviews.

List of recommended 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: CambridgeUniversity Press, 2008.
3. Mark Ibbotson. Professional English in Use: Engineering. Cambridge: Cambridge UP, 2009.
Reference Books:
1. Lesikar. Business Communication: Connecting in a Digital World. New Delhi: Tata Mc Graw-Hill, 2014.
2. John Seeley. Writing Reports. Oxford: Oxford UniversityPress,2002.
3. DianaBooher.E-writing:21stCenturyTools forEffectiveCommunication.Macmillan,2007.
4. Michael Swan. Practical English Usage. Oxford: OUP, 1980.

R23 (All B. Tech.)

Curriculum & Syllabus for B.Tech under JIS Autonomy
Electronics and Communication Engineering

2nd Year 4th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	EC401	EM Theory & Antenna	3	0	0	3	3
2	ENGG	Major	EC402	Signals & Systems	3	0	0	3	3
3	ENGG	Major	EC403	Analog & Digital Communication	3	1	0	4	4
4	ENGG	Minor	IT(EC)401	Database Management System	3	0	0	3	3
5	ENGG	Minor	M(EC)401	Probability and Statistics	3	0	0	3	3
B.PRACTICAL									
1	ENGG	Major	EC491	EM Theory & Antenna Lab	0	0	3	3	1.5
2	ENGG	Major	EC493	Analog & Digital Communication Lab	0	0	3	3	1.5
3	ENGG	Minor	IT(EC)491	Database Management System Lab	0	0	3	3	1.5
Total of Theory, Practical								25	20.5

Course Name: EM Theory & Antenna
Course Code:EC401
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

The candidates should learn basic knowledge of vector calculus, electrostatic, magnetostatics.

Course Objectives:

1. To understand the basic properties of Plane wave propagation in different medium.
2. To learn EM wave propagation in transmission line.
3. To know the fundamentals of antenna and its characteristics.
4. To understand radio wave propagation phenomena in communication system.

Course Outcome:
Graduates of the ECE program will be able to:
CO1: Understand and apply Maxwell's equation to determine static fields and time-varying electromagnetic fields in different media.
CO2: Analyze various transmission lines for application in high-speed Digital design and signal integrity of PCBs.
CO3: Apply fundamentals of antenna theory to different types of antennas to determine their radiation properties.
CO4: Design basic antenna with EM simulation software.

Course Content:
Module I: Electrodynamics [10L]
Electric & magnetic boundary conditions between media interfaces, Review of time varying Maxwell's equation, magnetic vector potential, Helmholtz's equation, plane wave in lossy dielectric, free-space, lossless dielectric, good conductor: skin depth, surface resistance.; Poynting theorem, reflection of plane waves at normal and oblique incidence; diffraction and scattering phenomena.

Module II: Transmission Line [12L]

Concept of lumped parameters, transmission line equation & their solution, propagation constant, characteristic impedance, wavelength, velocity of propagation for distortion less line and loss-less line; reflection and transmission coefficients, standing wave, VSWR, input impedance; Smith chart; some impedance techniques- quarter wave matching, matching with lumped elements (L-networks), T-line in time domain, lattice diagram calculation, pulse propagation on T-line.

Module III: Antenna & wave propagation [12L]

Antenna characteristics: radiation pattern, beamwidth, radiation efficiency, directivity, gain, efficiency, input impedance, polarization, effective area; Friis transmission equation.

Radiation characteristics of Hertzian dipole antenna.

Properties and typical application: - half-wave dipole, monopole, loop antenna, parabolic & corner reflector antenna, micro-strip patch antenna, array: Yagi-Uda, log-periodic.

Module IV: Application of antenna [2L]

Design of Antenna with EM software for specific applications: e.g micro-strip patch antenna design for hand-held application.

Text books:

1. Principles of Electromagnetics, 6th Edition, Matthew O H Sadiku, Oxford University Press.
2. Antenna Theory: Analysis & Design, Constantine A. Balanis; Wiley, 4th Edition.
3. Electromagnetics with applications, 5th ed, J. D. Kraus and D. Fleisch, McGraw Hill,1999.

Reference Books:

2. Engineering Electromagnetics, Hayt and Buck,7th edition, McGraw Hill.
3. Fields & Wave in Communication Electronics, S. Ramo, J.R. Whinnery& T. Van Duzer, John Wiley.
4. Electromagnetics, 2ed Edition– JA Edminister, Tata-McGraw-Hill.
5. Engineering Electromagnetics, 2ed Edition- NathanIda, Springer India.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1			2			2	2	1	3	2	2
CO2	3	3	2	1	2	2	1			1	2	2	2	3	3
CO3	2	2	1	3		3			2			2	1	2	2
CO4	2	2		1		2	2			2	2	1	2	2	2

Weightage Values: 3 =Strongly matched, 2= Moderately Matched, 1=Weakly matched, (-) = Not Matched

Subject Name: Signals & Systems
Subject Code: EC 402
Contact: 3:0:0
Credits: 3
Total Contact Hours: 36
Semester: 3rd

Course Objectives:

1. To explain the basic properties of signals & systems and the various methods of

classification.

2. To define the Fourier series, Fourier transform, and Z transform and their properties
3. To illustrate LTI systems and random processes.

Course Outcome:

CO1: Define the fundamental concepts of signals and systems including continuous-time and discrete-time signals, linear time-invariant (LTI) systems, and their properties.

CO2: Interpret the relationship between signals and systems through concepts like linearity, time-invariance, causality, and stability.

CO3: Analyze the behavior of signals and systems by applying mathematical principles to understand how signals are transformed through systems and the resulting output.

CO4: Evaluate the performance and characteristics of systems through concepts like impulse response, frequency response, transfer functions and appropriateness of different signal and system analysis techniques in solving specific engineering problems.

CO5: Design and create models of systems that fulfil specific requirements using signals and systems theories, demonstrating an ability to synthesize knowledge and principles into practical solutions.

Prerequisites:

The candidates should learn mathematics and basic knowledge of differential equations and difference equations.

Module I

Introduction to signals and systems: **[15]**

Continuous and discrete time signals: Definition and Classification of signals, Types of sampling, Sampling theorem, Reconstruction of a Signal from its samples, Definitions and Numerical on Unit step, Unit Impulse, Unit Ramp, Definitions of Exponential and Sinusoid both for continuous and discrete, Rectangular Pulse function, Triangular pulse function, Signum function, Sinc function, Gaussian function. Representation of signals using graphical, tabular and sequential form, Operations on signals. [6]

LTI systems:

Definition, Relationship between LTI system properties and Impulse Response. [1]

Classification and convolution of Signals: Definitions and numerical of Periodic and aperiodic signals, Even and odd signals, Energy and power signals, Deterministic & Random signals, Causal, Anti causal and Non causal signals, convolution of two signals using graphical and matrix method. [3]

Systems and its classifications: Definition of systems and its representation, Definition and numerical of Linear & Non linear system, Causal & non causal system, Time variant & invariant system, Pole Zero plot, BIBO Stability of the system, Systems with memory and without memory, Invertible and noninvertible Systems. Examples of discrete-time system model [3]

Correlation of Two Sequences:

Cross-correlation, Auto-correlation, Computation of correlation, Correlation of power and periodic signals. [2]

Module –II

Fourier series of Continuous-time and Discrete-time Signals [6]

Fourier series analysis and derivation of Fourier Coefficients Equation (Exponential form only), Fourier Series Properties, Symmetry Properties of the Fourier Series, Diminishing of Fourier Coefficients, Dirichlet Conditions, Fourier Spectrum, Gibbs's Phenomena, Parseval's relation (statement only), Problems on Fourier series & Basic concept of Discrete-time Fourier series. [6]

Module III

Signal Transformation [6]

Introduction to Continuous-time Fourier Transform (CTFT): Definition, Importance, Relation with Fourier series, Examples, Computation of Fourier transform of different signals. [2]

Properties of Fourier Transform

Linearity, Time shifting, Conjugation, Differentiation, Integration, Time scaling, Parseval's theorem, Duality, Convolution. [1]

Discrete-time Fourier Transform (DTFT):

Introduction, Definition, and Computation of DTFT of different sequences. [1]

Ideal filters, Signal Bandwidth, and Relationship between bandwidth and Rise Time. [2]

Module IV

Z-Transforms [6]

Introduction to Z-Transforms: Definition, Relationship between Fourier transform and Z-transform, Region of convergence (ROC), Properties of ROC, Properties of Z-transform, transfer function, concept of Poles and zeroes, Z-transform of different sequences. [4]

Inverse Z-transform: Inverse Z -transform using residue theorem, power series expansion and partial fraction method. [2]

Module V

Introduction to Random Variables [3]

Definition of Random Signal, Random Variables and Probability Distributions, Examples. [1] Statistical Properties of Random Signal: Independent and conditional random variables, Standard Deviation, mean, variance, Examples. [1] Independent and Dependent Random Variables, Arithmetic Mean. [1]

Text books:

1. Linear Signals and Systems by B.P. Lathi-OXFORD university Press
2. Signals &Systems by A.V. Oppenheim, A.S. Willsky and S.H. Nawab - Pearson
3. Signals and Systems by P.Ramesh Babu & R.Anandanatarajan - Scitech

References:

1. Signals &Systems by A.Anand Kumar-PHI
2. Signals and Systems by S.Haykin & B.V.Veen-John Wiley
3. Signals and Systems by A.Nagoor Kani- McGraw Hill
4. Signals and Systems by S Ghosh- Pearson
5. Digital Signal Processing by M.H.Hays- TMH
6. Signals and Systems by Salivahanan
7. Signals and Systems with MATLAB by Wŏn-yŏng Yang-Springer
8. Signals and Systems by A. Nagoor Kani- McGraw Hill
9. Digital Signal Processing by P.Ramesh Babu & R.Anandanatarajan - Scitech

Mapping of CO with PO:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	1	2	1	-	-	-	3	3	2	3
CO2	3	3	3	1	3	1	1	1	-	-	-	2	1	3	3
CO3	3	2	3	3	3	2	2	1	-	-	-	3	2	3	1
CO4	2	3	3	3	3	2	2	1	-	-	-	3	1	3	1
CO5	3	2	3	2	3	1	2	1	-	-	-	2	3	3	2

Course Name: Analog & Digital Communication
Course Code: EC 403
Contact: 3:1:0
Total Contact Hours: 36
Credit: 4
Prerequisite: Trigonometric Fourier series, Exponential Fourier series, Fourier transform and its properties, Energy and power signal, Probability & Statistics.

Course Objectives:

1. To introduce the concepts through various issues related to analogue communication such as modulation, demodulation, transmitters and receivers and noise performance.
2. To present the fundamentals of modern digital communication system design and to evaluate the performance of digital signaling schemes on realistic communication

channels.

3. To elaborate the concept on physical layer digital communications, including waveform analysis, transmitter design and receiver design.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Demonstrate the importance of AM and Angle modulation and demodulation schemes.

CO2: Analyse probability and random process in signal transmission.

CO3: Describe the concepts of sampling, Pulse Modulation techniques, different types of Source encoding techniques and their properties.

CO4: Analyse signal vector representation of various digitally modulated signals by using Signal constellation.

CO5: Illustrate various types of coherent digital modulation techniques and calculate their error Probabilities.

Course Content:

MODULE I: Introduction to Analog Communication [6]:

Elements of communication system - Transmitters, Transmission channels & receivers, Concept of modulation, need of modulation, properties of Fourier Transform, Frequency domain representation of signals, Principles of Amplitude Modulation (DSB-FC): Modulation index, Power content and bandwidth requirement,- DSB-SC & SSB-SC(Balanced Modulator for DSB-SC, Phase Shift method for SSB-SC), VSB modulations and demodulation ,AM demodulator: Synchronous detection for DSB-SC, Super Hetero Dyne receiver, Image frequency, Angle Modulation: Single Tone expression for FM and PM, modulation index of FM, concept of direct and indirect method of FM generation, NBFM and WBFM, FM modulator : Armstrong method, FM demodulator : PLL

MODULE-II: Random Processes: [6L]

Review of probability and random process. Gaussian and white noise characteristics, Rayleigh's energy theorem, Parseval's theorem, Fourier transform pair Power spectral density vs Autocorrelation likelihood functions.

MODULE-III: Pulse modulation: [6L]

Basic block diagram of Digital Communication system, advantages of digital communication system over analog communication system, sampling theorem. Quantization, quantization error Pulse modulation techniques: PAM, PWM, PPM. Line coding, Inter symbol Interference and Nyquist criterion, Source encoding : Pulse code modulation (PCM); Differential Pulse code Modulation (DPCM); Delta modulation;

Adaptive Delta Modulation, concept of Time Division multiplexing & Frequency Division multiplexing, PCM-TDM.

MODULE-IV: Signal Vector Representation: [8L]

Analogy between signal and vector, distinguishability of signal, orthogonality and orthonormality, basis function, orthogonal signal space, message point , signal constellation, geometric interpretation of signals, Schwartz inequality, Gram- Schmidt orthogonalization procedure, optimum correlation receiver; probability of error, error function, complementary error function, matched Filter.

MODULE-V: DIGITAL MODULATION TECHNIQUES: [10L]

Types of Digital Modulation, coherent ASK, FSK and PSK, geometrical representation of ASK;BPSK and BFSK signal, error probability of ASK;BPSK and BFSK, generation and detection of ASK;BPSK and BFSK Signal, power spectrum of ASK;BPSK and BFSK, Concept of M-ary Communication, M-ary phase shift keying, the average probability of symbol error for coherent M-ary PSK, power spectra of MPSK, Quadrature Phase Shift Keying (QPSK), error probability of QPSK signal, generation and detection of QPSK signals, power spectra of QPSK signals, basic concept of Offset (OQPSK) vs. Non-offset (NOQPSK) Quadrature Phase shift keying, QAM, Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal.

TEXT BOOKS:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Principles of Communication Systems, H. Taub and D. Schilling, TMH Publishing Co.
3. Wireless Communication and Networks: 3G and Beyond, I. Asha Misra, TMH Education.
4. Communication Systems, A. Bruce Carlson, Paul B. Crilly TMH Education.

REFERENCE BOOKS:

1. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
2. Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, Oxford University Press.
3. Digital Communication, A. Bhattacharya, TMH Publishing Co.
4. Digital Communications by Dr. Sanjay Sharma S K Kataria and Sons

CO- PO Mapping:

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	-	-	-	-	-	-	-	2	3	2	2
CO2	2	3	1	2	1	-	-	-	-	-	-	2	3	3	2
CO3	3	2	2	3	2	-	-	-	-	-	-	2	2	2	3
CO4	1	3	3	3	1	-	-	-	-	-	-	2	1	2	2
CO5	3	2	3	3	2	-	-	-	-	-	-	2	3	1	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: DATABASE MANAGEMENT SYSTEM
Course Code: IT(EC)401
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

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

Course Objective:

The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.

Course Outcomes:

CO1: Understand a given database application scenario to use ER model for conceptual design of the database.

CO2: Design entity relationship and convert entity relationship diagrams into RDBMS

CO3: Apply SQL to find solutions to a broad range of queries

CO4: Apply normalization techniques to improve database design

CO5: Develop Database Management System

Course Content:

Module1: Introduction: [3L]

Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.

Module2: Entity-Relationship and Relational Database Model: [11L]

Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.

Module3: SQL and Integrity Constraints [6L]

Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

Module4: Relational Database Design [8L]

Functional Dependency, Different anomalies in designing a Database, Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF, Case Study

Module5: Internals of RDBMS [9L]

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

Module6: File Organization &Index Structures [6L]

File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records,

Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

Text Books:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts",
2. Mc. Graw Hill. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.
3. Ramakrishnan: Database Management System, Mc Graw-Hill
4. Gray Jim and Reuter Address, "Transaction Processing: Concepts and Techniques", Moragan Kauffman Publishers
5. Ullman J D. ," Principles of Database Systems", Galgottia Publication.

Reference Books:

1. Jain: Advanced Database Management System Cyber Tech
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 Mc Graw Hill

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2							2		2		2	3	1	2
CO2			3					3		3		3	3	3	2
CO3				3	2			2		2			2	2	3
CO4				3				2		2			1	2	2
CO5			3									3	3	1	2

COURSE NAME: PROBABILITY AND STATISTICS

COURSE CODE: M(EC) 401

CONTACT: 3:0:0

TOTAL CONTACT HOURS: 36

CREDITS: 3

Prerequisites:

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

Course Objectives:

The objective of this course is to disseminate the prospective engineers with the knowledge of probabilistic approaches and applied statistics.

Course Outcome(s):

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

CO1: Recall the properties related probability distribution and applied statistics.

CO2: Explain the theoretical working of the concepts of probability distribution and applied statistics.

CO3: Apply the appropriate mathematical tools using the concepts of probability distribution and inferential statistics in Communication Science.

CO4: Analyze the real-world problems using the underlying principles of both probabilistic and statistical approaches.

CO-PO Mapping:

P O / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	2	2
CO2	3	2	1	-	-	-	-	-	-	-	-	1	3	1	2
CO3	3	3	2	1	-	-	-	-	-	-	-	2	2	2	3
CO4	3	3	3	2	-	-	-	-	-	-	-	2	1	2	2

Weightage Values: Strongly mapped: ‘3’, Moderately mapped: ‘2’, Weakly mapped: ‘1’, Not mapped: ’-‘.

Course Content:

Module-I: Probability and Random Variables **[10L]**

Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, Moments, Moment generating functions, Binomial, Poisson and Normal distributions

Module-II: Two Dimensional Random Variables **[9L]**

Joint distributions, Marginal and conditional distributions, Covariance, Correlation and linear regression, T Transformation of random variables, Central limit theorem (for independent and identically distributed random variables).

Module-III: Sampling Theory & Estimation of Parameters **[10L]**

Sampling Theory: Random sampling, Parameter & Statistic, Standard error of statistic, Distributions of the sample mean and the sample variance for a normal population, Chi-Square distributions, t distributions.

Estimation of Parameters: Unbiased and consistent estimators, Point estimation, Interval estimation, Maximum likelihood estimation of parameters (Binomial, Poisson and Normal), Confidence intervals and related problems.

Module-IV: Testing of Hypothesis **[7L]**

Simple and Composite hypothesis, Critical region, Level of significance, Type I and Type II errors, one sample and two sample tests for means and proportions, 32 - test for goodness of fit.

Text Books:

1. Das, N.G, *Probability and Statistics*, The McGraw Hill Companies.
2. Gupta S. C. and Kapoor V. K., *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons.
3. Goon A.M., Gupta M. K. and Dasgupta, B., *Fundamental of Statistics*, The World Press Pvt. Ltd.
4. Kreyszig, E., *Advanced Engineering Mathematics*, 9thEdition; John Wiley & Sons, 2006.

Reference Books:

2. Lipschutz, S.and Lipson, M., *Schaum's Outline in Probability* (2ndEd.); McGraw Hill Education.
3. Soong, T. T., *Fundamentals of Probability and Statistics for Engineers*; Wiley Publications.
4. Spiegel, M. R.,*Theory and Problems of Probability and Statistics (Schaum's Outline Series)*; McGraw Hill Book Co.
5. Montgomery, D.C. and Runger, G.C.,*Applied Statistics and Probability for Engineers*, Wiley Publications.

Course Name: EM theory and Antenna Lab
Course Code: EC491
Contact: 0:0:3
Credit: 1.5

Prerequisite:

The candidates should learn basic knowledge of vector calculus, electrostatic, magnetostatics.

Course Outcome:

After successful completion of this course, students should be able to:
CO1: To understand the theory of transmission lines in which EM wave propagate.
CO2: Define and identify different types of transmission line, its characteristics in various load conditions.
CO3: To realize the fundamentals of antenna theory.
CO4: Demonstrate different types of antennas with their radiation mechanism. and design any one type of antenna using EM software.

List of Experiments:

Module I:

1. Familiarization of basic elements of the Transmission Line.
2. Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited at the load end.
3. Unknown load Impedance of a terminated transmission line using shift in minima technique.
4. Study of parameters transmission line using Smith chart.
5. Study of electromagnetic phenomena of transmission lines in simulation software.

Module II:

6. Familiarization with antenna parameters measurement set-up and different antenna.
7. Radiation Pattern of dipole antenna and Mono-pole with ground plane.
8. Radiation Pattern of a folded-dipole antenna.
9. Radiation pattern of a Log-Periodic Antenna.
10. Beam width, gain and radiation pattern of a 3-element, 5-element and 7-element. Yagi-Uda antenna – Comparative study.
11. Radiation pattern, Gain, Directivity of a Pyramidal Horn Antenna.
12. Design of microstrip patch antenna using software.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	1	-	-	-	1	-	-	-	1	2	2	2
CO3	3	1	1	1	-	-	-	-	-	-	-	-	3	3	2
CO3	3	2	-	1	-	-	-	-	-	-	-	2	2	2	3
CO4	2	3	-	-	1	2	1	-	-	-	-	1	1	2	2

Course Name: Analog & Digital Communication Systems LabCourse Code: EC 493
Contact: 0:0:3
Credit: 1.5
Prerequisites: Knowledge of signals and systems

Course Outcomes:

Graduates of the ECE program will be able to:
CO1: Analyse the concept of Analog and Digital communication techniques and their applications.

CO2: Design Analog and Digital modulation/ demodulation method.
CO3: Calculate power requirements and bandwidth of AM and FM.
CO4: Conduct Analog and Digital Modulation using software simulation.CO5: Develop digital communication circuit for voice communication.

List of Experiments:

1. Measurement of output power with varying modulation index an AM signal (for DSB-FC &DSB-SC).
2. Measurement of the demodulated output with varying modulation index of an AM signal (DSB- FC).

3.Measurement of modulation index of a frequency modulated signal & and find outbandwidth.

4. Design a PLL using VCO & to measure the lock frequency.
5. Study of any Analog Modulation through software simulation.
6. Study of Pulse modulation (PAM, PWM) and demodulation.
7. Study of PCM and demodulation.
8. Study of Delta modulator and demodulator.
9. Study of Adaptive Delta modulator and demodulator.
10. Study of ASK modulator and demodulator
11. Study of BPSK modulator and demodulator
12. Study of BFSK modulator and demodulator.
13. Study of QPSK modulator and demodulator.
14. Study of any Digital Modulation through software simulation.

15.Innovative project: Breadboard realization of digital communication circuit for voicecommunication

Textbooks:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Principles of Communication Systems, H. Taub and D. Schilling, TMH Publishing Co.
3. Wireless Communication and Networks: 3G and Beyond, I. Asha Misra, TMH Education.
4. Communication Systems, A. Bruce Carlson, Paul B. Crilly TMH Education.

Reference books:

1. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
2.Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, OxfordUniversity Press.
3. Digital Communication, A. Bhattacharya, TMH Publishing Co.
4. Digital Communications by Dr. Sanjay Sharma S K Kataria and Sons
5. Digital Communications, J.G.Proakis, TMH Publishing Co.
6. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
7.Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, OxfordUniversity Press.
8. Digital Communication, A. Bhattacharya, TMH Publishing Co.
9. Digital Communications by Dr. Sanjay Sharma S K Kataria and Sons
10. Digital Communications, J.G.Proakis, TMH Publishing Co.

CO-PO Mapping:

Cos / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	2	3	2	2
CO2	2	1	3	3	1	-	-	-	-	-	-	2	2	3	2
CO3	2	3	2	3	2	-	-	-	-	-	-	2	2	2	3
CO4	2	1	3	3	1	-	-	-	-	-	-	2	1	2	2
CO5	3	1	3	3	1	-	-	-	-	-	-	2	3	1	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: DATABASE MANAGEMENT SYSTEM LAB
Course Code: IT(EC)491
Contact: 0:0:3
Credits: 1.5

Prerequisite:

Logic of programming language

Basic concepts of data structure and algorithms

Course Objective:

This lab enables the students to practice the concepts learnt in the subject DBMS by developing a database. The student is expected to practice the designing, developing, and querying a database.

Course Outcomes:

CO1: Apply the database concepts, technology and create the relations by specifying primary and foreign keys.

CO2: Construct a database by using data definition, data manipulation and control languages.

CO3: Design a Database application and retrieve the values with the help of queries using SQL.

CO4: Implement project developed for an application

Experiment Details:

1. Structured Query Language
2. Creating Database Creating a Database
3. Creating a Table Specifying Relational Data Types Specifying Constraints
4. Creating Indexes Table and Record Handling INSERT statement
5. Using SELECT and INSERT together DELETE, UPDATE, TRUNCATE

statements DROP, ALTER statements

6. Retrieving Data from a Database the SELECT statement Using the WHERE clause.

7. Using Logical Operators in the WHERE clause

8. Using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING Clause Using Aggregate Functions

9. Combining Tables Using JOINS Sub-queries Database Management Creating Views

10. Creating Column Aliases Creating Database Users Using GRANT and REVOKE PL/SQL

11. Database design using E-R model and Normalization

12. Design and implementation of some online system [Library Management System]

Textbook:

1. SQL, PL/SQL by Ivan Bayross, BPB Publications

2. Oracle PL/SQLProgramming,6th Edition-O'Reilly Media By Steven Feuerstein, Bill Pribyl

CO-PO-PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		3							2	3	2	2
CO2	3											3	3	3	2
CO3	3	3	2									2	3	2	3
CO4	3	2			3							3	1	2	2

R23 (All B. Tech.)

Curriculum & Syllabus for B.Tech under JIS Autonomy

Electronics and Communication Engineering

3rd Year 5th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	EC501	Digital Signal Processing	3	0	0	3	3
2	ENGG	Major	EC502	Microprocessor & Microcontroller	3	0	0	3	3
3	ENGG	Major	EC503	Computer Network	3	0	0	3	3
4	ENGG	Major	EC504A	Mobile Communication & Network	3	0	0	3	3
			EC504B	Embedded Systems					
			EC504C	RF & Microwave Engineering					
5	ENGG	Minor	CS(EC)501A	Object Oriented Programming using JAVA	3	0	0	3	3
			CS(EC)501B	Introduction to Quantum Computing					
			CS(EC)501C	Cloud Computing					
6	HUM	Ability Enhancement Course	HU(EC)501	Business Communication	1	0	0	1	1
B.PRACTICAL									
1	ENGG	Major	EC591	Digital Signal Processing Lab	0	0	3	3	1.5
2	ENGG	Major	EC592	Microprocessor & Microcontroller Lab	0	0	3	3	1.5
3	ENGG	Major	EC594A	Mobile Communication & Network Lab	0	0	3	3	1.5
			EC594B	Embedded Systems Lab					
			EC594C	RF & Microwave Engineering Lab					
4	ENGG	Minor	CS(EC)591A	Object Oriented Programming using JAVA Lab	0	0	3	3	1.5
			CS(EC)591B	Introduction to Quantum Computing Lab					
			CS(EC)591C	Cloud Computing Lab					
5	ENGG	Skill Enhancement Course	IT(EC)591	IT Workshop Lab (SciLab/MATLAB/C++)	0	0	2	2	1
Total of Theory, Practical								30	23

Subject Name: Digital Signal Processing

Subject Code: EC 501

Credits: 3

Total Contact: 36

COURSE OBJECTIVES:

1) Comprehend the fundamental concepts of digital signal processing including discrete-time signals, systems, convolution, and Fourier analysis.

2) Demonstrate proficiency in analyzing discrete signals using various transformation techniquessuch as the discrete Fourier transform (DFT) and the Z-transform.

3) Design, implement, and analyze digital filters (FIR and IIR) using different methodologies like windowing, frequency sampling, and bilinear transformation.

4) Apply DSP techniques to practical applications such as audio processing, image processing, communications, and biomedical signal analysis.

5) Gain hands-on experience in programming DSP algorithms using software tools like MATLAB, Python, or other relevant simulation platforms

COURSE OUTCOMES:

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

CO1: Interpret the impact and significance of fundamentals of digital signal processing in real- world applications like image, and communication systems.

CO2: Apply transformation techniques to analyse discrete signals using computational tools and implement digital filters for specific applications and analyse their performance.

CO3: Analyze and compare different methods of filter design (e.g., windowing, frequency sampling) and their implications on filter characteristics.

CO4: Critically evaluate the ethical implications associated with using DSP in diverse applications.

CO5: Develop innovative solutions by synthesizing various signal processing techniques to solve complex problems in audio, image, or biomedical signal analysis.

PREREQUISITE:

Prerequisites for Digital signal Processing are required a thorough understanding of various signals, systems, and the methods to process a digital signal and also the knowledge of arithmetic of complex numbers and a good grasp of elementary calculus. The questions reflect the kinds of calculations that routinely appear in Signals. The candidates are expected to have a basic understanding of discrete mathematical structures. The candidates required the concept of Z- transform, Relation between Fourier transform and Z transform, Properties of ROC and propertiesof Z transform, Initial value theorem and final value theorem, stability considerations for LTI systems using Z-transform, Inverse Z-transform by Residue method, power series & partial- fraction expansions.

MODULE – I: Discrete Fourier Transform and Fast Fourier Transform: [12]

Definition of DFT and IDFT, Twiddle factors and their properties, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, filtering of long data sequences using Overlap-Save and Overlap-Add methods. Parseval's Identity, Difference between DFT and FFT. Radix-2 algorithm, Decimation-In-Time, Decimation-In- Frequency algorithms, signal flow graphs Butterflies, Bit reversal.

MODULE – II: Filter Design: [17]

Basic concepts of IIR and FIR filters: Moving average system, Autoregressive system, Pole-zero system, Non-recursive and recursive structures, Low pass FIR digital filters, High pass FIR digitalfilters, Bandpass FIR digital filters, Notch FIR digital filters, difference equations, Realization of Filters using Direct form –I, II, transposed structure, Cascade & Parallel Form, Factors influencing the choice of structure, Design of IIR Filter using impulse invariant and bilinear transforms, approximation & Design of analogue Butterworth Filter, Design of Analog Low pass Chebyshev filters, Comparison between Butterworth Filter and Chebyshev filters, Design of linear phase FIR filters, Concept of Symmetric & anti- Symmetric FIR Filter, Various kinds of Window: Rectangular, Triangular, Raised Cosine, Hanning, Hamming, Blackman and Kaiser windows.

MODULE – III: Finite Word Length Effects in Digital Filters: [4]

Input Quantization error, Product Quantization error, Coefficient, Quantization error, Zero- input Limit cycle Oscillations, Dead band, limit cycle Oscillations.

MODULE – IV: Application of DSP: [3]

Introduction to DSP Hardware TMS320C 5416/6713 processor. Concept of Sub-band coding, Speech analysis.

TEXTBOOKS:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson Ed.

2. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.

3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).

4. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co.

REFERENCE BOOKS:

1. Digital Signal Processing; Spectral Computation and Filter Design Chi-Tsong Chen, Oxford University Press

2. Texas Instruments DSP Processor user manuals and application notes

Mapping of POs with COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	3	1	2	-	3	-	2	2	2	1	2	3	2	1
CO2	2	3	2	1	2	2	-	2	2	-	2	3	3	3	-
CO3	3	2	1	3	-	3	1	3	1	1	1	2	2	3	3
CO4	3	3	-	2	-	-	1	1	1	2	2	1	3	3	-
CO5	2	3	3	-	3	3	2	3	3	2	1	2	2	3	3

Course Name: Microprocessor and MicrocontrollerCourse
Code: EC 502
Contacts: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisite: Knowledge in Digital Electronics.

Course Outcomes:
Graduates of the ECE program will be able to:

CO1: To explain the architecture instructions, timing diagrams, addressing modes, memory interfacing, interrupts, data communication of 8085, 8086 microprocessors and 8051 microcontrollers.

CO2: Able to interpret the 8086 microprocessor-Architecture, Pin details, memory segmentation, addressing modes, basic instructions, interrupts.

CO3: Recognize 8051 micro controller hardware, input/output pins, ports, external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts and use 8085 simulator.

CO4: Apply instructions for assembly language programs of 8085, 8086 and 8051.

CO5: Design peripheral interfacing model using IC 8255, 8253, 8251 with IC 8085, 8086.

Course Content:

Module 1: **8085 Microprocessor:** **[7L]**
Introduction to Microcomputer based system, Evolution of Microprocessor and microcontrollers and their advantages and disadvantages, Architecture of 8085 Microprocessor, Address / Data Bus Memory interfacing, IO interfacing, ADC /DAC interfacing, Stack and Subroutine, Delay Calculation, Interrupts of 8085 processor, classification of interrupts.

Module 2: Assembly language programming with 8085: **[4L]** Addition, Subtraction, Multiplication, Block Transfer, ascending order, descending order, Finding largest & smallest number, Look-up table etc. Programming using interrupts (programming using INTR is not required). Instruction set, Addressing mode, Timing Diagram.

Module 3: 8086 Microprocessor: **[7L]**
8086 Architecture, Pin details, memory segmentation, addressing modes, Familiarization of basic Instructions, Interrupts & Direct Memory Access, Memory interfacing, ADC / DAC interfacing, PipelineArchitecture,

Minimum and Maximum mode of addressing, Que operation.

Module 4: Assembly language programming with 8086: [4L]
Addition, Subtraction, Multiplication, Block, Transfer, ascending order, descending order, Finding largest & smallest number etc.

Module 5: 8051 Microcontroller: [8L]
Difference between processor and controller, Features of 8051 microcontroller, 8051 architecture & Pin diagram, Memory organization, Direct and indirect Access of memory, SFR, PCON, SCON, TCON, TMOD, IE, IP, SBUFF serial data i/o, interrupts, Memory interfacing, ADC / DAC interfacing, Logical operations: Byte-level, bit-level, rotate and swap operations; Arithmetic operations: Flags, incrementing and decrementing, addition, subtraction, multiplication and division.

Module 6: Support IC chips: [6L]
8255, 8253 and 8251: Block Diagram, Pin Details, Modes of operation, control word(s) format. Interfacing of support IC chips with 8085, 8086.

Textbooks:
1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar, Penram International
2. The 8051 microcontroller - K. Ayala, Thomson
3. Microprocessors & interfacing – D. V. Hall, Tata McGraw-hill
4. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH
5. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley, Pearson
6. An Introduction to Microprocessor and Applications –Krishna Kant, Macmillan

ReferenceBooks:
1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan,Oxford university press
2. 8086 Microprocessor –K Ayala, Cengage learning
3. The 8051 microcontrollers – Uma Rao and Andhe Pallavi, Pearson

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1							1	3	3	1	2
CO2	2	3	2	1							1	3	3	2	3
CO3	3	2	2	3	2						2	3	3	1	3
CO4	2	3	3	3							1	3	2	2	3
CO5	3	3	3	3	2						2	3	1	1	3

Subject Name: Computer Network
Subject Code: EC 503
Credit:3
Total Contact Hours:36

Prerequisite: Digital Communication

Course Outcomes:

Graduates of the ECE program will be able to

CO1: Analyze various protocols in Data Communication
CO2: Analyze error control and flow control in Data Communication
CO3: Design Networking structure using networking devices in Data communication
CO4: Analyze various encryption techniques that are essential for network security

Course Content:

Module 1:

Overview of Data Communication: [**4L**]
Introduction; physical structure (type of connection, topology), categories of the network (LAN, MAN, WAN); Internet: brief history, Protocols, and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

Module 2:
Data Link Layers: **[9L]**

Physical Level: Transmission media (guided & unguided); Circuit switching time division &space-division switch, ADSL Modem
Data link Layer: Types of errors, framing (character and bit stuffing), error detection & and correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back-N ARQ, Selective repeat ARQ, Medium Access sublayer: Point to Point Protocol, Token Ring; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet (basic idea)

Module3:
Network Layers: **[11L]**

Network layer: Internetworking & devices: Hubs, Bridges (Basic Idea), Switches, Router, Gateway; Addressing: IP addressing, subnetting; Routing: techniques, static vs. dynamic routing, Source and Hop-by-routing (Dijkstra,), Unicast Routing Protocols: RIP, OSPF, Other Protocols: ARP, IPV6 (Basic idea), compare between IPv4 and IPv6, Router configuration (basic idea)
Transport layer: Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets (Concept); Leaky bucket algorithm, Token bucket algorithm,

Module 4:
Application Layers: **[10L]**

Application Layer: Introduction to DNS, HTTP & WWW, Bluetooth, and WLAN (Basic Idea)Need for Security, Security Attacks, Cyberattacks (Chosen plaintext, known plaintext , chosenciphertext) , Information Security, Methods of Protection. Symmetric Key Encryption: Data Encryption Standard (DES) Algorithm, Security of the DES, Advanced Encryption Standard (AES) Algorithm, DES and Comparison.

Public Key Encryption: Characteristics of Public Key System, RSA Technique, CryptographicHash Functions, Digital Signature Threats to E-Mail, Requirements and Solutions, Encryption for Secure E-Mail

Firewalls–Types, Firewall Configurations.

Text Books:

1. B.A. Forouzan –"Data Communications and Networking (3rd Ed.)"–T MH
2. A.S. Tanenbaum–"Computer Networks (4th Ed.)"–Pearson Education/PHI
3. W. Stallings–"Data and Computer Communications(5thEd.)"–PHI/Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI
6. Shay, Understanding Data Communication & Network, Vikas

Reference 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. WarwickFord, Michael S.Baum, "Secure Electronic Commerce: Building the Infrastructurefor Digital

	PO1	PO2	PO3	PO4	P05	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	-	-	1	3	3	3
CO2	2	3	3	3	3	-	-	-	-	-	1	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	-	-	1	3	3	2
CO4	3	3	3	2	2	-	-	1	-	-	-	1	2	3	3

Subject Name: Mobile Communication and Network

Subject Code: EC504A

Credits: 3

Total Contact hours: 36

Prerequisite: Knowledge of Analog & Digital Communication

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Analyze the evolution and History of Wireless Technology

CO2: Illustrate basics of cellular technology for mobile communication

CO3: Compare different cellular concepts in advancement of wireless mobile communicationwith

radio channels.

CO4: Facilitate wireless networks using mobile IP

CO5: Develop mobile networks in 5G key technologies with spectrum sharing and MIMO antennas.

Module I: INTRODUCTION [3L]

Evolution of mobile radio communications, mobile radio systems around the world, trends in cellular radio and personal communication, first generation (1G), second generation (2G), third generation (3G), Fourth Generation (4G) mobile cellular, 5G mobile cellular-Its use and underlying technologies to make up 5G, differences between the previous generations of mobile networks and 5G?How fast is 5G? Do I need a new phone if I want 5G? Introduction to 6G Key enablers.

Module II: CELLULAR CONCEPT [9L]

Limitations of conventional mobile system, Introduction to mobile cellular communication, concept of frequency reuse,cluster size, cellular system architecture, channel assignment strategies, call handoff strategies - hard handoff and soft handoff, prioritizing handoff; interference and system capacity, improving capacity in cellular systems – cell splitting, sectoring, microcell zone concept, Co-channel interference, Propagation effects - scattering,ground reflection, fading.

Module III: DIFFERENT MOBILE COMMUNICATION SYSTEMS [6L]

GSM services and features, system architecture, GSM radio subsystem, GSM channel types, location updating and call setup, WAP, SCSD, GPRS, EDGE, 3G W-CDMA; CDMA digital cellular standard

Module IV:WIRELESS NETWORKS AND IP [10L]

Network definition and topologies. Advantages and application of Wireless LAN,WLAN technology– RFandIRwirelessLAN, diffuse,quasi diffuse and point-to point IR wireless LAN,

IEEE802.11, IEEE802.11 architecture, Introduction to WI-FI, HIPERLAN2, Bluetooth – Bluetooth architecture. Introduction to Mobile IP, requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimization, Reverse tunneling; Mobile ad-hoc networks – Routing, Destination sequence distance vector, Dynamic source routing and Alternative metrics

Module V: MOBILE NETWORK IN 5G AND BEYOND [8L]

MOBILE NETWORK

Introduction to Mobile IP, requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimization, Reverse tunneling; Mobile ad-hoc networks – Routing, Destination sequence distance vector, Dynamic source routing and Alternative metrics, 5G Introduction and vision, Multi antenna Technologies: MIMO; software defined radio, adaptivemultiple antenna techniques, radio resource management, QOS requirements.

Small cells: Past, present, and future trends of cellular networks coverage and capacity of small cell networks Interference management, D2D architecture Towards IoT Spectrum Sharing. Massive MIMO: Point-to-point MIMO, Virtual MIMO (relaying), multiuse MIMO MassiveMIMO

CO-PO Mapping

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	3	2	-	-	1	3	2	2	2	3	2	1	3	2	2
CO2	2	-	2	-	3	2	2	2	3	2	3	2	3	2	1
CO3	2	-	3	3	3	2	1	2	3	1	3	1	2	3	2
CO4	2	2	1	-	2	3	2	2	3	2	3	-	2	2	2
CO5	2	-	3	3	3	2	2	2	3	1	3	1	2	2	3

Subject Name: Embedded System
Subject code: EC504B
Credit: 3
Total Contacts :36

Prerequisite:
(1) Concepts in 8085 ,8086 Microprocessor
(2) Concept of MCS51 series of Microcontroller.

Course Objectives:

- To familiarize the students with concepts related to the fundamental principles embedded systems design, explain the process and apply it.
- To understand knowledge of the advanced microcontroller technology both for hardwareand software.
- Students will be able to understand Hardware/Software design techniques for microcontroller-based embedded systems and apply techniques in design problems.
- Students will be able to develop microcontrollers programming in C and assembly language using Integrated Development Environments and using debugging techniques.

Course Outcomes (COs)

Graduates of the ECE program will be able to:

- CO1: To differentiate between general purpose system and embedded systems.
- CO2: To explain the hardware architecture , timing diagrams, interfacing, interrupts, data communication of PIC microcontrollers.
- CO3: To demonstrate the hardware architecture , RISC Instruction set, timing diagrams, interfacing, interrupts, data communication of ARM processors.
- CO4: To design customised embedded system.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	-	-	-	-	-	-	1	2	3	3

CO2	3	2	2	3	3	-	-	-	2	3	1	2	2	3	3
CO3	3	2	2	3	3	-	-	-	2	3	1	2	3	3	3
CO4	3	3	3	3	3	3	2	2	3	3	3	3	2	2	2

Module I: INTRODUCTION TO EMBEDDED SYSTEM: [5]

Basics of Embedded computer Systems, Microprocessor and Microcontroller difference, Hardware architecture and software components of embedded system Difference between embedded computer systems and general-purpose computer Systems. Characteristics of embedded systems, Classifications of embedded system.

Module II: INTRODUCTION TO PIC MICROCONTROLLER: [10]

PIC 18F4550 Microcontroller – Hardware Architecture & GPIOs ((Pin Diagram, Memory Organization, SFRs description, Program Counter, Accumulator (or Working Register), Reset, Clock Cycle, Machine Cycle, Instruction Cycle, Interrupts, SFRs & GPRs, Stack, Stack Pointer, Stack Operation, Timers and serial communication in PIC 16F877A). Microcontroller PIC Assembly Language, Programming in Embedded C, Introduction to programming software, Examples programs for PIC. I2C, SPI Protocol, Serial Memory, On chip Peripherals PWM.

Module III: ARM ARCHITECTURE AND PROGRAMMING: [10]

Introduction of ARM Processors, Evolution of ARM, 32 - bit Programming. ARM7 Architecture, Instruction Set Architecture, LPC21xx Description, Memories & Peripherals. ARM Processor Programming in C, Using ARM Programming Tools.

Module IV: HARDWARE SOFTWARE CO- DESIGN: [8]

Co-Design Types: Microprocessors/Microcontrollers/DSP based Design, FPGA / ASIC /pSOC based Design, Hybrid Design. Methodology: i) System specifications ii)) co-specifications of hardware and software) iii)) System Design Languages (capturing the specification in a single Description) iv) System modeling /simulation v) Partitioning (optimizing hardware/software partition) vi) Co-verification (simulation interaction between custom hardware and processor) f) Co-implementation vii) Embedded Systems Design development cycle. Programming concepts and embedded programming in C.

MODULE V: - REAL TIME OPERATING SYSTEM (RTOS): [3]

Introduction, Types, Process Management, Memory Management, Interrupt in RTOS, Task scheduling, Basic design using RTOS; Basic idea of Hardware and Software testing in EmbeddedSystems

Textbooks:

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley

2. Microchip's PIC microcontroller is rapidly becoming the microcontroller of choice throughout the world, Myke Predco

3. Embedded system Design: Peter Marwedel, Springer

4. Embedded Systems - Raj Kamal

5. PIC Microcontroller – Mazidi and Mazidi

Reference books:

1. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.

2. ARM Architecture Reference Manual

Subject Name: RF & Microwave Engineering
Subject Code: EC504C
Credit: 3
Total Contact: 36

Prerequisite: EM Theory &Antenna, Field theory, Analog Electronics

Course Outcomes:

Graduates of the ECE program will be able to:

CO 1: Analyze the Microwave components and their applications.

CO 2: Design the microwave matching networks and devices.

CO 3: Investigate the microwave devices and circuits to learn the formulations.

CO 4: Evaluate microwave parameters form microwave systems.**CO 5:**

Design and demonstrate a device in microwave frequency. **Course**

Content:

Module 1: Introduction[2L]

Introduction RF & Microwave Spectrum, Applications of Microwaves: Civil and Military, Medical, EMI/EMC, Safety considerations.

Module 2: Transmission line[3L]

Coaxial line, Planar Transmission line- Micro-strip lines, Coplanar waveguide, Slot line-design consideration, field patterns, propagation characteristics, Comparison for different characteristicsof the above-mentioned lines.

Module 3: Microwave Waveguides[7L]

Mathematical model of microwave transmission in parallel plate waveguide, Concept of mode,

Features of TEM, TE and TM Modes. Rectangular waveguide - TE10 mode analysis, cut-off frequency, propagation constant, intrinsic wave impedance, phase and group velocity, power transmission, attenuation, waveguide excitation, wall current. Concept of propagation constant, intrinsic wave impedance, phase and group velocity, power transmission, attenuation. Circular waveguide, Transmission line - Coaxial line, Planar Transmission line- Micro-strip lines,

Coplanar waveguide, Slot line-design consideration, field patterns, propagation characteristics, Comparison for different characteristics of the above-mentioned lines.

Module 4: Microwave Network Analysis of Passive Components [10L]

Realization of reactive elements as waveguide and planar circuit components. Equivalent voltages and currents, Network parameters for microwave circuits, Scattering Parameters, Waveguide Passive Components and their S-matrix Representation N-port networks-Properties of S matrix, Transmission matrix & their relationships; Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Magic tee
, hybrid ring, Circulators, Isolators; Microwave filter

Module 5: Microwave Active Devices [10L]

Microwave active components: Diodes, Transistors, Amplifiers, Oscillators, Mixers Microwave Semiconductor Devices: Gunn Diodes, Transit Time diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron up-to two cavities, Magnetron, TWT. Brief introduction to NBA, LNA

Module 6: Microwave Measurement [4L]

Typical Microwave Test Bench & measurement VSWR meter, Tunable detector, Slotted line andProbe detector, Frequency meter, Network analyzer, Measurement of VSWR – low, medium and high, Measurement of power: low, medium and high, Frequency measurement.

Textbooks:

1. Samuel Y Liao, “Microwave Devices & Circuits”, Prentice HallofIndia,2006.

2. Susrut Das,“MicrowaveEngineering”,OxfordUniversityPress,2014.

3. Annapurna Das and Sisir Kumar Das, “Microwave Engineering”, Tata McGraw Hill Inc.,3rd Edn.2015.

Reference Books:

1. D. M. Pozar, “Microwave Engineering.”, John Wiley & sons, Inc., 2006.

2. R. E. Collins, Microwave Circuits, McGraw Hill

3. M .L. Sisodia, G. S. Raghuvanshi, “ Microwave Circuits and Passive Devices”, 2010

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	-	1	-	-	1	1	2	2	3	2	2
CO2	3	3	3	2	1	1		-	-	-	2	2	3	2	1
CO3	3	2	2	2	-	1	-	-	2	-	1	2	3	1	1
CO4	3	2	1	1	-	1	-	-	-	1	1	1	3	3	2
CO5	3	3	3	2	1	1	1	-	2	-	1	2	2	2	2

Subject Name: OBJECT ORIENTED PROGRAMMING USING JAVA
Subject Code: CS(EC)501A
Credits: 3
Total Contact Hours: 36

Prerequisite: Basic knowledge of computers, basic knowledge of programming.

Course Outcomes:

CO1: Apply object-oriented design principles to solve complex programming problemsusing Java.

CO2: Demonstrate an understanding of advanced Java programming concepts, including lambda expressions, generics, and collections.

CO3: Design and implement solutions for complex engineering problems using inheritance, polymorphism, and other object-oriented features.

CO4: Gain proficiency in handling strings, string buffers, and command line argumentsin Java applications.

CO5: Implement advanced features in Java, including exception handling, multithreading, and file handling, and understand the basics GUI development.

Course Content:

MODULE I: Object-Oriented Design (2L)

1) Concepts of object-oriented programming language, Object, Class, relationships among objects, aggregation, links, relationships among classes-association, aggregation.

2) Introduction to Design Pattern: Brief overview of common design patterns and their application in object-oriented design.

MODULE II: Object-Oriented Concepts (2L)

1) Class, object, message passing, inheritance, encapsulation, polymorphism.
2) Advanced Inheritance Concepts: Deeper exploration of inheritance, interfaces, and their practical implementation.

MODULE III: Understanding Java Programming Language (2L)

1) History of Java Programming languages, Purpose of the invention of Java.
2) Structure of a basic Java Program, Components of Java Development Kit-API, JRE, Understanding the steps to run a complete Java Program.

MODULE IV: Basic Components of Java Program (2L)

1) Java Tokens-Literals, identifier, keywords, operator, separator, Data types, variables, constant, Type casting-defining type casting, requirement of type casting, implicit and explicit type casting.
2) Control structure. Access specifier.

MODULE V: Class & Object Properties (6L)

1) Defining class and object, Class Members-Local variable, instance variable, class variable, Primitive and Reference variable, Constructor, this keyword, finalize and garbage collection, Array-Declaring and defining array, accessing array elements, length properties, 2D array, anonymous array, array of Objects.
2) Understanding method- method returning object, passing objects, method passing and returning arrays, use of method overloading. Static-Static block and non-static block, static variable, static method. nested & inner classes.

MODULE VI: Reusability Properties (6L)

1) Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes & methods, interfaces.
2) Advanced Concepts in OOP: Advanced topics in OOP such as reflection, generics, and lambda expressions.

MODULE VII: String Handling (3L)

1) Basic string handling concepts- String (discuss char At() , compare To(), equals(), equals Ignore Case(), index Of(), length(), substring(), to Char Array(), to Lowercase(), to String(), to Upper Case(), trim(), value Of() methods) & String Buffer classes (discuss append(), capacity(), char At(), delete(), delete CharAt(), ensure Capacity(), get Chars(), index Of(), insert(), length(), set CharAt(), set Length(), substring(), to String() methods), concept of mutable and immutable string, command line arguments.
2) Regular Expressions in Java: Introduction to regular expressions and their application in Java.

MODULE VIII: Exception Handling & Multithreading (5L)

1) Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user-defined exception classes.
2) Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads.

MODULE IX: Basic IO Operation and File Handling (2L)

1) Understanding unformatted and formatted IO. Reading and writing files.MODULE X:

Swing Programming (3L)

1) Swing Origins, Components and containers, Difference between AWT and swing, small swing programs, swing apps, concept of delegation event model and listener.

MODULE XI: Applet Programming (using swing) (3L)

1) Basics of applet programming, applet life cycle, difference between application & applet programming, parameter passing in applets, concept of delegation event model and listener,I/O in applets.

TextBooks:

1. Rambaugh, James Michael, Blaha–"Object Oriented Modeling and Design"– PrenticeHall,India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH

Reference Books:

4. R.KDas–"Core Java For Beginners"–VIKASPUBLISHING
5. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
6. Ivor Horton's Beginning Java 2 SDK – Wrox 7. E. Balagurusamy – " Programming WithJava: A Primer" – 3rd Ed. – TMH

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	-	-	2	3	2	3
CO2	3	2	3	3	3	2	-	-	-	-	3	-	3	3	3
CO3	3	3	3	2	2	3	-	-	-	-	2	3	3	2	-
CO4	3	2	-	-	-	2	-	2	3	-	-	3	3	3	3
CO5	3	3	3	3	3	2	-	-	-	3	3	2	3	2	2

Subject: Introduction to Cloud ComputingCode:
CS(EC) 501B
Credit: 3
Contact: 36

Prerequisites:

Quantum Mechanics, Linear Algebra, Complex Numbers and Probability, Computer Science, Basic

Physics, Programming

Objectives:

This course covers foundational quantum computing concepts, delving into quantum circuits, information theory comparisons, and quantum algorithms like Shor's factorization and Grover's search. It explores quantum information processing theories, error correction methods, and their implications in classical computation, emphasizing both mathematical and physical underpinnings.

Course outcomes:

After completion of the course, students will be able to

CO1: Apply knowledge of foundational quantum mechanics principles to analyze and interpret quantum circuits and gate operations.

CO2: Demonstrate proficiency in constructing and optimizing quantum circuits for specific computational tasks.

CO-3: Evaluate and compare different quantum algorithms, including their computational advantages over classical counterparts.

CO-4: Design and implement strategies for quantum state manipulation and engineering, incorporating entanglement principles.

CO-5: Analyze real-world problems to determine their suitability for quantum computing solutions, considering challenges and limitations in implementation.

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	1	2	3	3
CO2	2	3	3	3	3	-	-	-	-	-	1	-	1	2	3
CO3	1	2	3	3	3	2		1	2	-	-	2	3	3	3
CO4	2	3	3	-	3	-	-	-	-	-	-	1	2	3	3
CO5	2	3	3	2	3	3	-	-	-	-	2	2	1	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1= Weakly matched,

(-) = Not matched

Course Content:

Module 1: Foundations of Quantum Mechanics (11 lectures)

Historical context and key experiments leading to quantum theory, Quantum postulates: superposition, measurement, and uncertainty principles, Introduction to Dirac notation and basic quantum state representation, Quantum gates: single-qubit gates (e.g., Pauli gates, Hadamard gate) and multi-qubit gates (e.g., CNOT gate), Quantum circuit model: construction and representation using gate operations, Universal gate sets and their significance in quantum computation, Qubit properties: understanding the physical systems used as qubits (e.g.,

spin, superconducting circuits, trapped ions), Qubit operations: manipulation of quantum states, state preparation, and measurement, Qubit coherence and quantum error sources, Building quantum circuits: examples and applications of constructing circuits for specific tasks (e.g., teleportation, superdense coding). Universal quantum gates and their role in quantum algorithms, Circuit optimization techniques and quantum circuit depth considerations.

Module 2: Qubits and Quantum States (9 lectures)

Qubit states: Bloch sphere representation and visualization of qubit states, Mathematical formalism: density matrices, pure and mixed states, Entropy and quantum information measures, Quantum state transformations: unitary evolution and quantum gates, Quantum state tomography and methods for state reconstruction, Quantum state engineering and control techniques, Entanglement basics: understanding entangled states and their properties, Entanglement measures and quantification, Applications of entanglement in quantum communication and computation, Overview of fundamental quantum algorithms (e.g., Deutsch's algorithm, Grover's search algorithm), Quantum parallelism: understanding how quantum algorithms achieve computational speedup, Comparison of quantum algorithms to classical counterparts.

Module 3: Quantum Algorithms and Applications (8 lectures)

Detailed walkthrough of Shor's algorithm for integer factorization, Quantum Fourier Transform: understanding its role in quantum algorithms, Prime factorization and its relevance in cryptography, Quantum simulation: applications in modeling quantum systems (e.g., chemistry, materials science), Quantum optimization algorithms (e.g., adiabatic quantum computing, variational algorithms), Comparative advantages of quantum optimization over classical methods, Practical applications of quantum computing in diverse fields (e.g., finance, healthcare, cryptography), Industry use-cases and ongoing research in utilizing quantum computation, Challenges and limitations in implementing quantum solutions for real- world problems.

Module 4: Quantum Error Correction and Quantum Cryptography (4 lectures)

Quantum error models and sources of quantum errors, Quantum error correction codes (e.g., Shor code, surface code) and their properties, Quantum error correction techniques and fault-tolerant quantum computation, Foundations of quantum key distribution (QKD) and its principles.

Module 5: Quantum Hardware and Future Directions (4 lectures)

Overview of current quantum computing architectures (superconducting qubits, trapped ions, photonic qubits, etc.), Hardware challenges and advancements in building quantum computers, Comparative analysis of different quantum computing platforms, Quantum error rates and decoherence: challenges in scaling up quantum systems, Quantum hardware improvements (e.g., error correction, qubit connectivity), Quantum software and hardware co-design principles.

Books:

1. "Quantum Computation and Quantum Information" by Michael Nielsen and Isaac Chuang

2. "Quantum Computing: A Gentle Introduction" by Eleanor G. Rieffel and Wolfgang H. Polak

3. "Quantum Computing for Computer Scientists" by Noson S. Yanofsky and Mirco A. Mannucci

4. "Programming Quantum Computers: Essential Algorithms and Code Samples" by Eric R. Johnston, Nic Harrigan, and Mercedes Gimeno-Segovia

5. "Quantum Computing: A Very Short Introduction" by John Preskill

6. "Introduction to Quantum Mechanics" by David J. Griffiths

Subject name: Cloud Computing
Subject code: CS(EC)501C Credit: 3
Total contact: 35

Prerequisite:

- Basic Computer Science Knowledge
- Networking Fundamentals
- Operating Systems Understanding
- Familiarity with Web Technologies

Course objective:

This course provides an in-depth understanding of cloud computing essentials, covering infrastructure, security, application development, resource optimisation, and emerging trends. Students gain hands-on skills through practical labs to effectively manage and deploy cloud systems.

Course outcomes:

CO1: Apply the fundamental cloud computing concepts, models, architectures, and their evolution inmodern computing systems.

CO2: Apply theoretical knowledge to design, deploy, and manage cloud-based systems, integrating security measures and best practices in diverse technological environments.

CO3: Analyze various cloud architectures, security frameworks, and application development strategies, identifying potential vulnerabilities and proposing effective solutions.

CO4: Develop problem-solving skills to address complex challenges in cloud computing, includingresource optimization, compliance issues, and emerging technology integration.

CO5: Foster a commitment to continuous learning, staying updated with emerging trends, ethical considerations, and future advancements in cloud technology.

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	1	2	3	3
CO2	2	3	3	3	3	-	-	-	-	-	1	-	1	2	3
CO3	1	2	3	3	3	2		1	2			2	3	3	3
CO4	2	3	3	-	3	-	-	-	-	-	-	1	3	3	3
CO5	2	3	3	2	3	3	-	-	-	-	2	2	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1= Weakly matched,(-) =

Not matched

Module 1: Fundamentals of Cloud Computing (Total Lectures: 7)

Introduction to Cloud Computing: Concepts and Definitions, Historical Evolution and Milestones in Cloud Technology, Cloud Service Models: IaaS, PaaS, SaaS, Cloud Deployment Models: Public, Private, Hybrid, Advantages and Challenges of Cloud Computing, Case Studies: Real-world Applications of Cloud Technology,

Future Trends and Innovations in Cloud Computing

Module 2: Cloud Architecture and Infrastructure (Total Lectures: 8)

Cloud Infrastructure Components and Components Overview, Network Design and Protocols in Cloud Environments, Storage Technologies: Databases, File Systems, Scalability and Elasticity in Cloud Systems, Virtualization Techniques in Cloud Computing, Hands-on Lab: Setting up Virtual Machines and Containers, High Availability and Disaster Recovery in Cloud Architectures, Case Studies on Cloud Architecture Implementations

Module 3: Security and Compliance in Cloud Computing (Total Lectures: 6)

Security Challenges in the Cloud: Threats and Vulnerabilities, Identity and Access Management (IAM) in Cloud Environments, Data Protection Strategies and Encryption in the Cloud, Compliance Frameworks and Governance in Cloud, Risk Management Strategies for Cloud Environments, Security Best Practices and Case Studies

Module 4: Cloud Services and Application Development (Total Lectures: 8)

Cloud-native Development: Principles and Practices, Containers and Orchestration: Docker, Kubernetes, Microservices Architecture and Implementation, DevOps Methodologies in Cloud-based Projects, Serverless Computing: Concepts and Use Cases, Hands-on Lab: Implementing Containerization andOrchestration, Hands-on Lab: Deploying Microservices in Cloud Environments, Case Studies on Cloud Application Development

Module 5: Cloud Management and Optimization (Total Lectures: 6)

Cloud Service Management and Service Level Agreements, Performance Monitoring and Optimization Techniques, Cost Management and Billing in Cloud Environments, Automation and Orchestration Tools, SLAs, Metrics, and Governance for Cloud Services, Emerging Trends in Cloud Management and Optimization, AWS – Basic working principle.

Books:

1. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, Prentice Hal
2. Cloud Computing: From Beginning to End" by Ray J. Rafaels - Publisher: Apress
3. Cloud Computing: Principles and Paradigms"* by Rajkumar Buyya, James Broberg, and Andrzej Goscinski - Publisher: Wiley-IEEE Press
4. Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, andIaaS)"* by Michael J. Kavis - Publisher: Wiley
5. Cloud Native Infrastructure" by Justin Garrison and Kris Nova - Publisher: O'Reilly Media
6. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" by Tim Mather,Subra Kumaraswamy, and Shahed Latif - Publisher: O'Reilly Media
7. Cloud Computing: A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti - Publisher:VPT

Subject Name: Business Communication
Subject Code: HU(EC)501
Credits: 1
Contact Hours: 12

Pre-requisites: A basic knowledge of English grammar, vocabulary and writing skills and the

workplace uses of English.

Course Objectives:

- To maximize exposure and train students in the professional use of English in the globalized workplace.
- To acquaint students with business vocabulary in context.
- To introduce students to the basics of business proposal writing.

Course outcome: By the end of the course the student should be able to

CO1.1	Identify, explain and reproduce Business English vocabulary in context and business writing conventions.
CO1.2	Apply, organize and plan business communication in e-mails, memos and reports based on situational variables.
CO1.3	Analyze, compare and evaluate business data, channels, templates and design considerations based on industry needs.
CO1.4	Construct, design and document a business start-up proposal, showcasing business and entrepreneurial skills in a globalized business scenario.

Syllabus: **12L**

Module 1: Business Communication Basics [3L]

1.1 Communicating in Business—the Workplace environment: basics of everyday organizational communication.
1.2 Reading and identifying business terms and vocabulary (vocabulary related to business products and processes, buying and selling, consumers, banking and finance)
1.3 Classifying and identifying business vocabulary in use from business newspapers, advertising, media and the internet.

Module 2: Writing Business E-mails and Memos [2L]

2.1 Business E-mails: Functions, Conventions and Modalities
2.2 Writing Memos: Types and Conventions

Module 3: Business Reports [3L]

3.1 Business Reports: Needs and Functions
3.2 Arranging and classifying information
3.3 Report Writing Styles and Rubrics

Module 4: Proposals for Business Start-ups [4L]

4.1 How to Write a Proposal for a Start-up
4.2 Business Proposal Templates
4.3 Proposal Writing Practice

Recommended Books/References:

1. Bill Mascull. *Business Vocabulary in Use*. 3rd Edition. Cambridge: Cambridge UniversityPress, 2010.
2. Ibbotson, Mark and Bryan Stephens. *Business Start-Up.* Cambridge: Cambridge UniversityPress, 2006.
3. Paul Emmerson. *E-mail English*. London: Macmillan, 2013.

CO-PO and PSO Mapping

	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HU(EC)501.1	-	-	2	-	-	1	1	-	2	3	-	2	-	-	-
HU(EC)501.2	-	-	2	2	-	3	3	-	2	3	-	3	2	1	1
HU(EC)501.3	-	-	2	2	-	3	3	2	2	3	-	3	2	-	-
HU(EC)501.4	-	-	-	-	-	3	3	2	2	3	-	3	-	-	-

Subject Name: Digital Signal Processing Lab.Paper
Code: EC591
Credits: 1.5
Total Contact: 35 Course

Objectives:

To develop and Implement DSP algorithms in software using a computer language such as MATLAB.
To analyze and Observe Magnitude and phase characteristics of different signals. To analyze and observe Magnitude and phase characteristics (Frequency response Characteristics) of digital FIR filters using window techniques.

Course Outcome:

CO1: Apply theoretical knowledge of signal processing algorithms and techniques to solve real- world problems.
CO2: Design, conduct, and analyze experiments that involve acquiring, processing, and interpreting signals, showcasing an understanding of experimental methodologies and their relevance to signal processing.
CO3: Implement and optimize digital signal processing algorithms using appropriate programming languages (such as MATLAB) and evaluate their performance.
CO4: Demonstrate proficiency in using various digital signal processing tools, software, and hardware equipment commonly employed in the field.
CO5: Communicate experimental findings, analysis, and results effectively through written reports, presentations, and demonstrations, demonstrating the ability to articulate technical concepts.

List of Experiments:
1. Generations of some basic signals.
2. Convolution of two sequences using graphical methods and using commands- verification of the properties of convolution.
3. Systems (Causal and Non_causal, Time-Invarient and Time-varient etc.) verification using MATLAB.
4. Z-transform of various sequences – verification of the properties of Z-transform.
5. DFT using twiddle factors.
6. DFTs / IDFTs using matrix multiplication and also using commands.
7. Circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.
8. Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.
9. Butterworth filter design with different set of parameters.
10. FIR filter design using rectangular, Hamming and Blackman windows.
11. Frequency responses of anti-imaging and anti-aliasing filters.
12. Analyze biomedical signals (like ECG, EEG) using digital signal processing techniques toextract

relevant information, perform filtering, and detect abnormalities.

Textbooks:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis&D.G.Manolakis, Pearson Ed.

2. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.
3.Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMHPublishing Co.

Reference books:

1. Digital Signal Processing; Spectral Computation and Filter Design Chi-TsongChen, Oxford University Press
2. Texas Instruments DSP Processor user manuals and application notes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	2	3	2	1	1	1	-	1	-	1	-	-	2	3	1
CO2	2	2	3	1	1	-	-	1	-	-	-	-	1	1	3
CO3	2	1	1	3	-	1	1	3	1	1	1	2	1	-	2
CO4	3	1	-	2	-	1	1	1	1	2	2	1	1	3	-
CO5	2	1	3	-	3	1	2	3	3	2	1	2			

Subject Name: Microprocessor and Microcontroller Lab
Subject Code: EC592
Contact: 0:0:3
Credits: 1.5

Prerequisites: Knowledge in Digital Electronics

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Able to understand small assignments using the 8085 basic instruction sets and memory mapping through trainer kit and simulator.

CO2: Able to write 8085 assembly language programs like Addition, Subtraction, Multiplication, Square, Complement, look up table, copying a block of memory, Shifting, Packing and unpacking of BCD numbers, Ascending order, Descending order etc. using trainer kit.

CO3: Able to analyze the interfacing technique using 8255 trainer kits through subroutine calls and IN/OUT instructions like glowing LEDs accordingly, stepper motor rotation etc.

CO4: Able to evaluate fundamental of 8051 programs using the trainer kit.

List of Experiments:

1. Familiarization with 8085 register level architecture, the basic instruction sets (data transfer, arithmetic, logical, branching) and the trainer kit components including the memory map.

2. Familiarization with the process of storing, executing, and viewing the contents of memory as well as registers in the trainer kit 8085 and simulator through small assignments.

3. Programming using 8085 kit and simulator for: Addition, Subtraction, Multiplication by repeated addition method, Square, Complement, look up table, Copying a block of memory, Shifting, Packing and unpackingof BCD numbers, Addition of BCD numbers, Binary to ASCII conversion, smallest and largest number from an array of numbers, Ascending order, Descending Order, String Matching, Multiplication using shift and add method.

4. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly, glowing of seven segment display.

5. Program for serial communication between two trainer kits.

6. Interfacing of 8255: Keyboard, Stepper motor rotation.

7. Study of 8051 Micro controller kit and writing programs.

Textbooks:

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar, Penram International
2. The 8051 microcontroller - K. Ayala, Thomson
3. Microprocessors & interfacing – D. V. Hall, Tata McGraw-hill
4. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH R21
5. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley, Pearson
6. An Introduction to Microprocessor and Applications –Krishna Kant,Macmillan

Reference Books:

1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford university press
2. 8086 Microprocessor –K Ayala, Cengage learning
3. The 8051 microcontrollers – Uma Rao and Andhe Pallavi, Pearson

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2			2	2	2	1	3	2	3	2
CO2	2	3	3	1	2			2	2	2	1	3	3	1	2
CO3	3	3	3	1	2			2	2	2	1	3	3	1	3
CO4	3	3	3	2	2		1	2	2	2	2	3	2	3	3

Subject Name: Mobile Communication and Network Lab
Subject Code: EC594A
Credits: 1.5

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Understand the path Loss and the factors behind it

CO2: Analyze the 3dB Bandwidth of a Base station Antenna.

CO3: Apply the concept of co-channel interference and evaluate Signal to Interference and NoiseRatio.

CO4: Analyze the impact of many different parameters influence the downlink C/I ratio like Cellradios, Tx power of B.S, Frequency reuse, Sectoring, Shadowing effect, B.S. height, Path loss exponent, Vertical beam tilt.

CO5: Understand and Analyze the effect of handover threshold and margin on SINR and call drop probability and handover probability and characterization of radio Attenuation

List of experiments:

1. Calculation of received signal strength as a function of distance of separation, antenna heightand carrier frequency.

2. To understand the impact of: -Transmitter Power, Path loss exponent, Carrier Frequency, Receiver antenna height, Transmitter antenna height.

3. To calculate path loss exponent and variance of shadow fading from measurements and hencefind the large- scale propagation's statistical characteristics.

4. To find the 3dB Bandwidth of a Base station Antenna.

5. To understand the concept of co-channel interference and hence Signal to Interference and NoiseRatio:

Downlink: To Calculate & plot SINR vs. distance at the MS for adaptation of the followingparameters: Shadowing effect, Vertical Beam Pattern, Tilt Angle variation.

6. To understand the concept of co-channel interference and hence Signal to Interference and NoiseRatio:

Uplink: To calculate & plot SINR vs. distance at the MS for adaptation of the following parameters:Shadowing effect, Vertical Beam Pattern, Tilt Angle variation.

7. To understand the cellular frequency reuse concept fulfilling the following objectives: Findingthe co-channel cells for a particular cell, finding the cell clusters within a certain geographic area.

8. To study the effect of handover threshold and margin on SINR and call drop probability andhand over probability.

9. Characterization of radio Attenuation by means of propagation Okumara Model.

10. Characterization of radio Attenuation by means of propagation Hata Model.

Textbooks:

1. Theodore S. Rappaport, Wireless communications: principles and practice, PHI/Pearson education.
2. J. Schiller, Mobile communications, Addison-Wesley.
3. William C.Y.Lee, Mobile cellular telecommunication–analog and digital systems,McGraw Hill,2nded.

Reference Books:

1. Wang, Wireless communication System, Pearson Education

2. Talukdar, Mobile computing, TMH3.J.W.Mark,W. Zhuang, Wireless Communication and Networking, PHI

3. Santamariaetal, Wireless LAN systems, Artech House.

5. Stallings, Wireless Communication & Networks, Pearson Education

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	1	3	2	2	2	3	2	1	2	2	3
CO2	2	-	2	-	3		2	2	3	2	3	2	1	2	3
CO3	2	-	3	3	3	2	1	2	3	1	3	1	2	2	3
CO4	2	2	1	-	2	3	2	2	3	2	3	-	3	2	3
CO5	2	-	3	3	3	2	2	2	3	1	3	1	3	2	3

Subject Name: Embedded System Lab
Subject Code: EC 594B
Credit: 1.5

It is suggested to perform at least one from Module-1, one from Module-2, 4from

Module-3 and 4 from Module-4

Module-1: Arduino-based experiments.

1. Connect an LCD to the Arduino to show real-time Sensors (temperature, humidity, current, LPG leakage, air quality) data locally.

2. Integrate a barometric pressure sensor (like BMP180 or BMP280) to measure atmospheric pressure.

Module-2: Raspberry Pi-based experiments.

1. Interface current and voltage sensors to the Raspberry Pi to measure power consumptionfrom different appliances or circuits within the home.

2. Implement a data logging system on the Raspberry Pi to continuously record energy consumption data. Store the data in a database for further analysis.

Module-3: PIC-based experiments.

1. write a program to interface PIC microcontroller with LED and glow LEDs on and off.
2. Write a program to Interface PIC microcontroller with Seven Segment display.

3. Write a program to Interface PIC microcontroller with Switch.

4. Write a program to Interface PIC microcontroller with LCD using 4 bit and 8-bit mode.
5. Write a program to Interface PIC microcontroller with Relay.

6. Write a program to Interface PIC microcontroller with Fingerprint Sensor

7. Write a program to Interface PIC microcontroller with GSM Modem

8. Write a program to Interface PIC microcontroller with Zigbee.

Module-4: ARM based experiments.

1. Familiarization with ARM evaluation system
2. Interface and control a LED.
3. Interfacing with a real time clock using a serial port to display time.
4. Interface a Keyboard and display the keystrokes on a LCD.
5. Familiarization of image processing using ARM
6. Interfacing Sensors (temperature and Humidity, gas sensor, air quality sensor etc)with ARM Microcontrollers for Data Acquisition
7. "Design and Optimization of Real-Time Image Processing Algorithms on ARM Cortex-M Microcontrollers"

Projects:

- Arduino Weather Station with Wireless Data Logging
- Create a web-based or mobile interface that displays real-time energy usage for different appliances or areas of the home. Users should be able to access this interface remotely.
- "ARM-Based Digital Signal Processing for Audio Applications"
- ARM Cortex-M-based Smart Home Automation System"
- Face id-based attendance system using ARM Cortex

Subject Name: RF & Microwave Engineering Lab

Subject Code: EC594C

Credits: 1.5

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Analyse, identify and list out special type transmission lines, its characteristics in microwave frequencies and concept of load.

CO2: Apply engineering mathematics to recognize, learn, categorize, arrange and implement suitably the various microwave passive devices.

CO3: Analyse and use the various sources of microwave energy and the characters of its operation.

CO4: Design, compute, solve and demonstrate microwave components properly using various hardware, software tools and measuring instruments in the field of Radio Frequencies, for the betterment of communication engineering, medical science and various domestic and commercialengineering.

List of Experiments:

1. Determination of phase and group velocities in a waveguide carrying TE_{10} Wave from Dispersion diagram [$\omega-\beta$Plot].

2. Measurement of unknown impedance using shift in minima technique using a waveguide test bench/Measurement of the susceptance of an inductive and or a capacitive window using shift in minima technique using a waveguide test bench

3. Study of the characteristics of a Reflex Klystron oscillator.

4. Study of Gunn-oscillator Characteristics using X-band waveguide test bench.

5. Measurement of coupling factor, Directivity, Insertion loss and Isolation of a Directional couplerusing X-band waveguide test bench setup.

6. Scattering matrix of a magic tee/E-plane tee/H-plane tee using waveguide test bench at X-band.

7. Experimental/Simulation Study of filter (LPF, HPF, BPF) response/ basic microsrtip antenna.

8. Measuring the dielectric constant of a material using a waveguide test bench at X-band.

9. Assignment on any particular topics or devices to design or formulation.

Reference Books:

1. ML Sisodia & GS Raghuvanshi, Basic Microwave Techniques and Laboratory Manual; Wiley Eastern Limited1987

2. EL Ginzton, Microwave Measurements, McGraw-Hill Book Co.

3. M Sucher, J Fox, Moe Wind, Handbook of Microwave Measurements, Vol I, Wiley-Interscience Inc.

CO- PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO 1	3	3	3	3	2	2	2	-	3	1	-	3	3	2	2
CO2	3	3	3	3	2	2	2	-	3	1	-	3	3	2	2
CO 3	3	3	3	3	2	2	2	-	3	-	-	3	3	2	2
CO 4	3	3	3	3	2	2	2	-	3	1	-	3	2	3	1

Course Name: Object Oriented Programming Lab
Course Code: CS(EC)591A
Credits: 1.5

Prerequisites:

1. Computer Fundamentals
2. Basic understanding of Computer Programming and related ProgrammingParadigms
3. Problem Solving Techniques with proper logic Implementation.

Course Outcomes:

CO1: Apply Java programming concepts to solve real-world problems.

CO2: Demonstrate proficiency in string handling, I/O operations, and regular expressionsin Java.

CO3: Implement and analyze inheritance, interfaces, and packages in Java.

CO4: Apply exception handling, multithreading, and applet programming conceptseffectively.

Course Content:

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.
5. Advanced array manipulation and stream processing in Java.

Module 2: Basic String handling & I/O:

1. Programming to show the use of String class methods - charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length(), substring(), toCharArray(), toLowerCase(),toString(), toUpperCase(), trim(), valueOf() methods.
2. Programming to show the use of StringBuffer class methods - append(), capacity(), charAt(), delete(), deleteCharAt(), ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods.
3. Programming on Command line arguments.
4. Programming using keyboard input by implementing BufferedReader & Scanner classes.
5. Introduction to regular expressions in Java.

Module 3: Inheritance, Interface and Java Packages: (ECE)

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 the same names for classes of different packages, adding multiple public classes to a package.
4. Java Module System and its usage in organizing code.

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 a simple applet to display some message, creating an applet toadd integers, creating an applet to do GUI-based programming.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	2	-	-	-	2	3	3	3
CO2	3	2	3	3	3	2	-	2	-	-	-	2	1	2	2
CO3	3	3	3	2	2	3	3	-	3	-	-	3	3	3	2
CO4	3	3	3	3	-	2	-	2	3	-	3	-	2	2	3

Subject: Introduction to Quantum Computing LabCode:
CS(EC) 591B
Credit: 1.5

Objectives:

The course aims to impart foundational knowledge in quantum mechanics for constructing and manipulating quantum circuits, implementing algorithms, and simulating error correction. Students will visualize qubit states, explore practical quantum applications, and critically analyze challenges in implementing quantum solutions for real-world problems.

Course outcomes:

CO-1. Analyze quantum principles and construct circuits applying single/multi-qubit gates.

CO-2. Design and implement fundamental quantum algorithms, assessing their computational superiority.CO-3.

Explain error correction, evaluate error models, and simulate error correction codes.

CO-4. Visualize qubit states through Bloch sphere representation and perform quantum state reconstruction.

CO-5. Assess real-world quantum computing applications, discussing implementation challenges and limitations.

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	1	3	2	3
CO2	2	3	3	3	3	-	-	-	-	-	-	-	2	3	3
CO3	1	2	3	3	3	2	-	-	-	-	-	2	3	3	-
CO4	2	3	3	-	3	-	-	-	-	-	-	1	3	3	2
CO5	2	3	3	2	3	3	-	-	-	-	-	2	3	3	3

To conduct the experiments software frameworks like Qiskit, Cirq or equivalent are suggested.

Experiment 1: Quantum Circuit Construction and Simulation

Construct and simulate basic quantum circuits using single-qubit and multi-qubit gates.
Experiment 2: Qubit State Visualization on Bloch Sphere

Visualize and explore qubit states using the Bloch sphere representation.

Experiment 3: Quantum Error Simulation and Correction

Simulate quantum errors and implement basic error correction codes (e.g., bit-flip code) to mitigate errors in a quantum circuit.

Experiment 4: Entanglement Generation and Measurement

Generate entangled states and perform measurements to confirm entanglement using Bell state analysis.

Experiment 5: Quantum State Tomography

Reconstruct unknown quantum states using quantum state tomography techniques.

Experiment 6: Implementing Quantum Algorithms

Implement fundamental quantum algorithms (e.g., Deutsch's algorithm, Grover's search) using a quantumprogramming framework (Qiskit, Cirq).

Experiment 7: Quantum Fourier Transform and Applications

Implement the Quantum Fourier Transform and apply it in simulating period finding for a simple function.

Experiment 8: Quantum Key Distribution Simulation

Simulate the BB84 quantum key distribution protocol and analyze the security properties of the exchangedkey.

Experiment 9: Quantum Circuit Optimization

Explore techniques for optimizing quantum circuits (e.g., reducing gate count, minimizing circuit depth) for specific quantum algorithms.

Experiment 10: Quantum Hardware Analysis

Analyze the characteristics and limitations of different quantum computing architectures (e.g.,superconducting qubits, trapped ions) through simulation or analysis of real experimental data.

Subject name: Cloud Computing Lab

Subject code: CS(EC)591C

Credit:1.5

Objective:

These lab experiments provide hands-on experience in different aspects of cloud computing, allowing students to apply theoretical knowledge to practical scenarios and gain proficiency in cloud-based technologies. Adjustments can be made based on available resources and specific learning objectives ofthe course.

Course Outcomes (COs):

CO1: Demonstrate a comprehensive understanding of cloud computing fundamentals, including service models, deployment models, and underlying infrastructure.

CO2: Apply theoretical knowledge to effectively utilize cloud platforms, implementing and managingcloud-based solutions in diverse contexts.

CO3: Evaluate and implement robust security measures, including access control, encryption, and compliance, to ensure data protection in cloud environments.

CO4: Design and implement scalable and optimized cloud architectures, employing resource managementand performance optimization techniques.

CO5: Analyze emerging trends and innovations in cloud computing, demonstrating an understanding oftheir impact on future technological landscapes.

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	1	3	3	1
CO2	2	3	3	3	3	-	-	-	-	-	-	-	1	2	3
CO3	1	2	3	3	3	2	-	-	-	-	-	2	2	3	3
CO4	2	3	3	-	3	-	-	-	-	-	-	1	2	3	3
CO5	2	3	3	2	3	3	-	-	-	-	-	2	2	3	3

Experiments:

1. Setting Up a Virtualized Environment: Students create and manage virtual machines using a hypervisorlike VirtualBox or VMware, understanding the basics of virtualization.

2. Networking in a Cloud Environment: Design and configure virtual networks, subnets, and securitygroups using cloud platforms like AWS or Azure.

3. Implementing Data Backup and Recovery: Set up and test backup solutions on cloud storage services, demonstrating data recovery processes in case of failure.

4. Security Measures Implementation: Configure access control lists (ACLs), encryption, and multifactor authentication in a cloud environment to enhance security.

5. Containerization with Docker: Build, deploy, and manage containers using Docker, understanding the principles of containerization.

6. Microservices Deployment: Develop and deploy a simple application using a microservices architectureon a cloud platform.

7. CI/CD Pipeline Setup: Create a continuous integration/continuous deployment (CI/CD) pipeline usingtools like Jenkins or GitLab CI.

8. Serverless Computing Experiment: Explore serverless architecture by deploying functions in a serverless environment (e.g., AWS Lambda or Azure Functions).

9. Performance Monitoring and Optimization: Utilize monitoring tools to analyze and optimize cloud resource usage for a given application.

10. Cost Management and Billing Simulation: Simulate a cloud environment with various services to understand cost estimation, billing models, and cost optimization techniques.

Subject Name: IT Workshop Lab
Subject Code: IT(EC)591 Credits: 2

Prerequisite

Computer Fundamentals and principles of computer programming

Course Outcomes (COs):

After attending the course students should be able to

CO-1: Demonstrate a thorough understanding of modular programming by designing programs that requires the use of programmer-defined functions.

CO-2: Demonstrate a thorough understanding of arrays by designing and implementing programs that search and sort arrays.

CO-3: Demonstrate a thorough understanding of the object-oriented programming concepts of encapsulation, data abstraction and composition by designing and implementing classes including the use of overloaded functions and constructors.

CO-4: Demonstrate a thorough understanding of the concept of pointers and dynamic memory allocation, the implementation of programmer-defined functions and classes by writing code, performing unit testing and debugging of multiple complex programs.

CO-5: Demonstrate a thorough understanding of the concept of pointers and dynamic memory allocation, the implementation of programmer-defined functions and classes by writing code, performing unit testing and debugging of multiple complex programs.

CO- PO Mapping:

COs/ POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	1	2	2	-	-	-	-	-	-	-	2	2	3	2
CO2	2	3	2	2	1	-	-	-	-	-	-	2	3	2	3
CO3	3	2	3	3	2	-	-	-	1	-	-	2	2	3	3
CO4	2	3	3	3	1	-	-	-	1	-	-	2	2	3	2
CO5	3	2	3	3	2	-	-	-	2	-	-	2	3	2	3

Course Content:

1. Introduction of UNIX/Linux Operating System which includes preliminary commands, start-up & shutdown methodology, file structure.

2. Handling as well as introduction to editors like Vi editor, introduction to GNU C & C++ compiler

3. Introduction to C++, basic loop control, executing programs.

4. Writing functions, selection statements, review of functions and parameters, command line arguments, recursion, I/O streams, arrays and string manipulation, pointers, structures & unions.

5. Object-Oriented Programming in C++, fundamentals of classes, constructors-destructors.

6. Dealing with member functions, operator overloading and polymorphism (both static & dynamic).

7. Dealing with inheritance, derived class handling.

8. Abstract class, virtual class, overriding, template class, name space & exception handling.

9. Dynamic memory allocation, implementation of Linked Lists, using C++.

10.MATLAB Environment, variable , constant, operators, loop, function.

11.MATLAB Toolbox, MATLAB Graphic function.

12. Reading and Writing to file, Numerical simulation.

13. Innovative experiments/Projects

Text Books

1. The C++ Programming Language by Bjarne Stroustrup Addison-Wesley publisher

2. Object-Oriented Programming in C++ b by Robert Lafore Publisher: Sams

Reference Books

1. Object Oriented Programming with C++ by Balagurusamy McGraw Hill Education; Sixth edition Addison-

Wesley publisher

2. Object-Oriented Programming in C++ b by Robert Lafore Publisher: Sams

3. MATLAB Getting Started Guidehttps://www.mathworks.com/help/pdf_doc/matlab/getstart.pdf

4.

R23 (All B. Tech.)

Curriculum & Syllabus for B.Tech under JIS Autonomy

Electronics and Communication Engineering

3rd Year 6th Semester									
Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	EC601	VLSI Design	3	0	0	3	3
2	ENGG	Major	EC602	Control System	3	0	0	3	3
3	ENGG	Major	EC603A	IoT for Communication	3	0	0	3	3
			EC603B	Digital Image Processing					
			EC603C	Soft Computing					
4	ENGG	Minor	CS(EC)601A	Artificial Intelligence	3	0	0	3	3
			CS(EC)601B	Web Technology					
			CS(EC)601C	Software Engineering					
B.PRACTICAL									
1	ENGG	Major	EC691	VLSI Design Lab	0	0	3	3	1.5
2	ENGG	Major	EC692	Control System Lab	0	0	3	3	1.5
3	ENGG	Major	EC693A	IoT for Communication Lab	0	0	3	3	1.5
			EC693B	Digital Image Processing Lab					
			EC693C	Soft Computing Lab					
4	ENGG	Minor	CS(EC)691A	Introduction to AI Lab	0	0	3	3	1.5
			CS(EC)691B	Web Technology Lab					
			CS(EC)691C	Software Engineering Lab					
5	ENGG	Internship	EC681	Industrial Training (Min. 2 Weeks)	0	0	0	0	1
Total of Theory, Practical								24	19

Subject Name: VLSI Design
Subject Code: EC601 Credit: 3
Total Contacts: 36

Prerequisites: Basic concept of Electronic Devices, Analog & Digital Electronic Circuits.

Course Objectives: Students will learn about integrated circuit design and VLSI technology.

Course Outcomes (COs)

Graduates of the ECE program will be able to:

CO1: Relate integrated design circuit schematic with fabrication technology with awarenessof scale of integration.

CO2: Analyse analog & digital integrated circuits determining figure of merits.

CO3: Design analog and digital integrated circuits for a set specification across technology.CO4:

Appraise integrated circuits for the effects of scaling in nanometer domain.

CO5: Apply CAD tools to simulate and create layout of integrated circuit and demonstrateresults.

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	2	2	2	-	-	-	-	3	2	2	1	3
CO2	-	3	3	2	2	2	-	-	-	-	3	2	3	2	3
CO3	3	3	3	2	2	2	-	-	-	-	3	2	2	2	3
CO4	-	-	-	3	-	-	-	-	-	-	3	2	2	2	3
CO5	3	-	-	-	3	-	-	-	2	-	3	2	2	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weaklymatched, (-) = Not matched.

Module I: Introduction to IC [5]

Integrated Circuits – Advantages, disadvantages, limitations; Scale of Integration – SSI, MSI,LSI, VLSI, ULSI; Moor's Law; Scaling of MOSFET-Constant field scaling and constant voltage scaling, Short Channel Effects; VLSI design flow, Y- Chart, IC Classification – Standard IC and ASIC, PAL, PLA, FPGA Architecture.

Module II: Digital VLSI Circuit Design [12]

Inverter Characteristics: Resistive load inverter – Voltage transfer characteristics (VTC, significance of parameters (only expression, no derivation) –VIL, VIH, VOL, VOH, Vth; CMOS inverter - VTC, Noise margin and aspect ratio of symmetric CMOS inverter.

[7]

Combinational Logic Circuit Design: Circuit design using Static CMOS style – basic gates, design of circuit for product of sum (POS) and sum of product (SOP) expression, Complex logic circuit,

full adder; Circuit design using pseudo NMOS logic, DCVSL Logic, TG Logic, Pass Transistor Logic, Complementary pass transistor logic, Dynamic logic, domino logic, NORA logic.

[5]

Sequential Circuit and Semiconductor Memory Design: Bistable Circuit -Design of CMOS S-R & J-K Latch, CMOS Clocked SR & JK Latch /Master –slave JK Flip- flop, CMOS D Flip- flop; 6T SRAM cell and 3T DRAM cell design.

Module III: Analog VLSI Circuit Design [9]

Analog sub-circuits -MOS Switch, Active resistors/MOS Diode , Current source and Sink ,Current Mirror ; Current and voltage references-voltage divider , MOS equivalent of P-N junction Voltage reference , Threshold voltage reference , Band gap reference (Basic Principle) ; Switch- Capacitor Circuit – resistance emulation of series , parallel and series-parallel circuit , Switch capacitor integrator and filter (1st order only) ;CMOS differential amplifier – design parameters ;Output amplifier (basic circuit) ; Block diagram of twostage CMOS OP-AMP (description only)

Module IV: Layout Design Rules and Fabrication Steps of ICs [6]

Micron and lambda design rules; Stick diagram and Layout - CMOS Inverter, NAND and NORgate; Fabrications steps of IC – Wafer preparation, Oxidation, photolithography, etching, diffusion, ion-implantation, metallization, and packaging. CMOS N-Well Process, overview of P-well and twin-tub process.

Module V: Power Consumption and Delay in VLSI Circuit Design [4]

Dynamic power, short circuit power and leakage power in CMOS Inverter; Gate delay and path delay, delay time expression of CMOS inverter (expression only).

Textbooks:

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 .

References:

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

6. Sunipa Roy, Chandan Kumar Sarkar, MEMS and Nanotechnology for Gas Sensors, CRC

Press, USA, 1st edition. 2017, ISBN: 9781315214351.

Subject Name: Control Systems
Subject Code: EC 602
Credits: 3
Total Contact: 36

Pre-requisite: Concepts in electrical circuits (Studied in Basic Electrical), Fundamental conceptson Laplace Transformation (studied in Mathematics).

Course Objectives:
To introduce concepts of mathematical modeling, open loop and feedback control systems.

To employ time domain analysis to predict and diagnose transient performance parametersof different types of systems for standard input signals.

To understand the various techniques of stability analysis in the time and frequency domain.

To identify the needs of different types of controllers and compensators to meet the required dynamic response from the system.

Course Outcome:
After completing the course, the student will be able to:

CO1: Understand mathematical models of physical systems and study their nature,configuration and relevant mapping into equivalent models.

CO2: Determine the time responses of different types of systems and time domain specifications.
CO3: Analyze and solve stability-related issues in time response, and stability analysis using root locus.

.
CO4: Evaluate the relative stability of control systems using frequency domain analysis.

CO5:Design controllers according to desired performance specifications.

Course Contents:
Module I: INTRODUCTION TO CONTROL SYSTEMS &MODELLING

[7L]

Basic Elements of Control System, Linear, Non-Liner and Discrete Time System (Introduction & Concept) Open loop and Closed loop systems – Differential equation on control system – About transfer function and its generation technique, Modelling of Electrical and mechanical systems - Block diagram reduction techniques - Signal flow graph, mason's gain formula.

Module II: TIME RESPONSE ANALYSIS

[5L]

Time response analysis –Different input deterministic test response – Order and Type of the incorporation of the systems with time response: First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors and error constants.

Module III: STABILITY ANALYSIS

[6L]

Routh -Hurwitz Criterion, Root Locus Algorithm, Construction of Root Locus, Effect of addition of pole and zero on the root locus, Application of Root Locus Diagram.

Module IV: FREQUENCY RESPONSE ANALYSIS [7L]

Concept of Frequency Response of a system, Bode Plot Computational Algorithm, Construction of Bode diagram, Polar Plot, Phase and gain margin, Nyquist Plot, Interpretation of Bode and Nyquist plot, Stability analysis using frequency domain specifications.

Module V: CLASSICAL CONTROL DESIGN TECHNIQUES

[3L]

Introduction to P, PI, PD and PID Controllers. Introduction to lead, lag and lead-lag compensators.

Module VI: STATE SPACE ANALYSIS OF CONTINUOUS TIME SYSTEMS [6L]

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and its Properties – Concepts of Controllability and Observability. Concept of statefeedback.

Module VII: ADVANCED CONTROL SYSTEM AND ITS APPLICATION [2L]

Concept of Robust Control and Adaptive Control. Application of advanced control systems

(Robotics, Traffic systems and radar tracking) in different fields.

Text Books:

1. Automatic Control Systems 8th edition– by B. C. Kuo 2003– John Wiley and son's,
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 2nd edition.
3. Control Systems –by Ramesh Babu

Reference Books:

1. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd.,3rdedition, 1998.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	1	1	1	1	3	2	2
CO2	3	2	2	2	1	-	-	-	2	1	1	1	2	2	3
CO3	3	2	2	2	1	-	-	-	2	1	1	1	2	2	3
CO4	3	2	2	2	1	-	-	-	2	1	1	1	2	2	3
CO5	2	2	3	2	1	1	1	-	2	1	1	1	2	2	3

Course Name: IoT for Communication

Course Code: EC603A

Credits: 3

Total Contact Hours: 36

Prerequisite: Sensors, Actuators, Microcontroller, Computer Networks

Course Objectives: The purpose of this course is to gather knowledge about IoT, its architecture different software and hardware components of IoT. Finally students will applysuch knowledge to design some hands-on models showcasing different IoT applications.

Course Outcomes:
Graduates of the ECE program will be able to
CO1: Able to understand Internet of Things and its hardware and software components.
CO2: Able to apply interface I/O devices, sensors & communication modules.
CO3: Able to analyze remotely monitor data and control devices.
CO4: Able to create real life IoT based projects.

Course Content

Module 1: *10L*
Introduction to IoT: Architectural Overview, IoT Enablers, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and Gateways, Data management, Idea of Cloud, Edge and Fog computing, Role of Cloud in IoT, Services offered by Cloud, Security aspects in IoT.

Module 2: 10L

Elements of IoT: Hardware Components- Arduino, Raspberry Pi development board, Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Embedded C/Python/Node.js) for Communication and Network Protocols - RFID, ZigBee, Bluetooth, BLE, MQTT, CoAP, TCP/IP, UDP

Module3: 10L
It Application Development: Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices. Use of AI and ML in IoT

Module 4: **6L**

IoT Case Studies and mini projects based on Industrial Automation, Transportation, Agriculture, Healthcare, Home Automation.

Textbooks and Reference Books:
1. Introduction to IoT by Sudip Misra, Anandarup Mukherjee,Arijit Roy ,1st Edition Cambridge University Press.
2. Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, "A Hands on Approach", University Press
3. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill
4. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
5. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
6. Adrian McEwen, "Designing the Internet of Things", Wiley

7. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media
8. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs

CO-PO Mapping:

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	1	2	2	-	-	-	-	-	-	-	2	2	2	3
CO2	2	3	1	2	1	-	-	-	1	-	-	2	3	2	2
CO3	3	2	2	3	2	-	-	-	-	-	-	2	2	2	3
CO4	2	3	3	3	1	-	-	-	2	-	-	2	2	2	3

Subject name: Digital Image Processing
Subject Code: EC603B
Credits: 3
Total contact hours: 36

Course Outcome:

Graduates of the ECE program will be able to:

CO1 – Implement different filtering techniques to enhance the quality of images and videosCO2

– Apply different image processing techniques to compress and segment images

CO3 – Illustrate image processing algorithms to secure images

CO4 – Analyze the performance of various algorithms in video processing

Course Content:

Module 1: [7L]

Digital Imaging Fundamentals: Basic idea of Digital image, Pixel, Mathematical operation of Digital Image, Sampling, Quantization, application of digital Image Processing Application of Artificial Intelligence/ Machine Learning in Image and Video Processing [3]

Transform of Digital Images: Importance of Digital Image Transform, Fourier Transform of Digital Image (DFT), Inverse Fourier Transform (IDFT), Fast Fourier Transform, Inverse Fast Fourier Transform, Application of Digital Image Transform in different area [4]

Module 2: [8L]

Digital Image Enhancement: Importance of Digital Image enhancement, enhancement in spatial and frequency domain, Bit plane slicing, Histogram, Histogram Equalization, Mean and Median filtering in Digital Images, Frequency domain filtering in Digital Images – LPF,HPF and BPF

Module 3: [5L]

Digital Image Compression: Importance of Digital Image Compression, Types of Image Compression, example of lossless and lossy compression, Image compression standards, Compression in spatial domain, Wavelet based Digital image compression

Module 4: [8L]

Segmentation of Digital Images: Importance and applications of Digital Image Segmentation, Detection of discontinuities, Segmentation basedon

Thresholding and Region Growing [4]

Edge detection in Digital Image Processing: Importance of Edge detection in Digital Image Processing, Types of Edge Detection-sobel, canny and prewitt edge detection techniques and mathematical Equation of each operator. [4]

Module 5: [4]

Security in Digital Image Processing: Introduction to Digital Image Security and its application, Image encryption in spatial and frequency Domain. Basic idea on CryptographySteganography and Watermarking for digital image.

Module 6: [4L]

Introduction of Video Processing: Basic Steps of Video Processing: Analog video, DigitalVideo, Time varying Image Formation models, Geometric Image formation, filtering operations [2].

2-D Motion Estimation: Optical flow, general methodologies, pixel-based motion estimation, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation [2].

Textbooks:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2010.

2. S. Annadurai,R. Shanmugalakshmi, “Fundamentals of Digital Image Processing”, Pearson Education, 2006

3. Yao wang, JoemOstarmann and Ya–quin Zhang,“Video processing and communication”,,PHI

References:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.

2. AnilJain K. “Fundamentals of DigitalImage Processing”, PHI Learning Pvt. Ltd., 2011.

3. Willliam K Pratt, “Digital Image Processing”, JohnWilley, 2002.

4.Pakhira,“DigitalImageProcessingandPatternRecognition”,FirstEdition,PHILearningPvt.Ltd. ,2011.

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

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	-	3	-	-	-	-	-	-	1	2	1	3
CO2	2	3	3	3	3	-	-	-	-	-	1	-	3	3	3

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

Subject name: Soft Computing
Subject code: EC603C

Credit: 3
Contact: 36

Prerequisite:

Solid grounding in math (calculus, linear algebra, probability), programming (Python/MATLAB), and machine learning basics are key. Understanding logic, set theory aids fuzzy logic grasp. Prior knowledge of optimization aids genetic algorithm understanding.

Course objectives:

This course aims to introduce soft computing principles—neural networks, fuzzy logic, genetic algorithms—alongside optimization techniques. Emphasis lies on practical applications spanning diverse domains, fostering problem-solving skills using these computational paradigms.

Course outcomes:

CO1: Demonstrate a solid understanding of the fundamental principles underlying neural networks, fuzzy logic, and genetic algorithms to solve computational problems.

CO2: Implement various soft computing techniques such as neural network models, fuzzy inference systems, and genetic algorithms using programming languages to solve real-world problems.

CO3: Analyze the performance and efficiency of different soft computing paradigms in solving complex problems across diverse domains, and evaluate their suitability based on results.

CO4: Design and develop computational models using soft computing techniques to address challenges in pattern recognition, classification, optimization, and decision-making systems.

CO5: Apply soft computing methodologies in engineering applications, demonstrating theability to optimize systems, analyze data, and make informed decisions, enhancing engineering solutions.

Module I: Introduction to Soft Computing [2]

- Overview of soft computing, including neural networks, genetic algorithms, and fuzzy logic

Module II: Neural Networks [14]

- Biological Neurons and Artificial Neural Networks

- Neuron models and activation functions

- Learning methods: supervised, unsupervised (Error Correction, Hebbian, Competitive)

- Network models: McCulloch-Pitts, Feedforward, Feedback, Perceptron, Adaline, Madaline

- Multi-layer networks, Back-propagation, Radial Basis function networks

- Handling logical operations and nonlinear separability (e.g., XOR)

- Applications in Pattern Recognition and Classification

Module III: Fuzzy Logic [10]

- Fuzzy membership functions and operations

- Fuzzy relations, propositions, and implications

- Fuzzy Rule-based Systems, Fuzzy Inference Systems

- Defuzzification Techniques, Neuro-Fuzzy Modelling

- Applications in Home Appliances and Fuzzy Logic Controllers

Module IV: Genetic Algorithms [7]

- Biological background and genetic algorithm fundamentals

- Encoding techniques: Binary, Simple GA

- Selection methods: Roulette wheel, Tournament, Elitism

- Crossover, Mutation, and their role in optimization

- Applications in Search, Clustering, Image Processing, and Pattern Recognition

Module: V: Optimization techniques [3]

Particle swarm optimization, Ant colony optimization

Books:

1) Simon Heykin : Neural Networks – A Comprehensive Foundation (2nd Edition),PHI
2) Genetic Algorithms in search, Optimization & Machine Learning by David E.Goldberg, Pearson/PHI
3) Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
4) S. Rajsekaran, G.A. Vijaylakshmi Pai: Neural Networks, Fuzzy Logic and Genetic Algorithm
5) Satish Kumar: Neural Networks – A Classroom Approach (Mc Graw Hill Ed.)
6) Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan, Prentice Hall
7) Principles of Soft Computing (2nd Edition) by SN Sivanandam, SN Deepa, Wiley

CO-PO mapping:

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	-	-	-	-	-	-	-	2	3	2	3
CO2	2	3	1	2	1	-	-	-	1	-	-	2	2	3	3
CO3	3	2	2	3	2	-	-	-	-	-	-	2	2	2	3
CO4	2	3	3	3	1	-	-	-	2	-	-	2	2	2	3
CO5	3	3	3	2	2	2	-	-	-	-	-	1	2	2	3

Subject Name: Low Power IC Design

Subject Code: EC 603 D

Credits:3

Total Contact Hours: 36

Prerequisites

- Basic knowledge of **Analog & Digital Circuits**
- Understanding of **CMOS Technology & VLSI Design**
- Fundamentals of **Semiconductor Devices**
- Basics of **Power Dissipation in ICs**

Course Objectives

The primary objectives of this course are:

1. To understand the **sources of power dissipation** in ICs.
2. To explore **low-power design techniques** for digital and analog circuits.
3. To study **power optimization at different design levels** (circuit, logic, and system).
4. To analyze **power management strategies** in modern ICs.
5. To apply **low-power techniques** in real-world applications, including IoT and embedded systems.

Course Outcomes (COs)

After completing the course, students will be able to:

1. Identify the **major sources of power dissipation** in digital and analog circuits.
2. Design **low-power CMOS circuits** using various optimization techniques.
3. Implement **architectural and system-level power reduction strategies**.
4. Evaluate **trade-offs between power, performance, and area** in IC design.
5. Apply power-efficient methodologies in **modern VLSI applications**.

CO-PO mapping:

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	-	-	-	-	-	-	-	2	3	2	3
CO2	2	3	1	2	1	-	-	-	1	-	-	2	2	3	3
CO3	3	2	2	3	2	-	-	-	-	-	-	2	2	2	3
CO4	2	3	3	3	1	-	-	-	2	-	-	2	2	2	3
CO5	3	3	3	2	2	2	-	-	-	-	-	1	2	2	3

Module 1: Introduction to Low Power Design

Need for low-power design in portable & high-performance applications, Sources of power dissipation in digital circuits Static & Dynamic power dissipation in CMOS, Power estimation techniques, Overview of technology scaling and power issues

Module 2: Circuit-Level Low-Power Techniques
Transistor sizing & threshold voltage scaling, Power gating and Multi-Vt design, Clock gating and supply voltage scaling Leakage power reduction techniques, Energy recovery circuits & Adiabatic Logic
Module 3: Logic & Architecture-Level Power Optimization

Signal activity reduction and operand isolation, Low-power combinational and sequential circuits, Power optimization in multipliers and adders, Parallelism, pipelining, and dynamic voltage scaling (DVS), Memory power optimization (low-power SRAM & DRAM)

Module 4: System-Level Power Management, Energy-efficient processor & system-on-chip (SoC) design

Power management techniques: DVFS, Power Gating, Clock Gating, Thermal-aware low-power design, Battery-aware system design, Role of power-aware EDA tools

Module 5: Low Power Design for Emerging Technologies, Low-power techniques in IoT & edge computing

Ultra-low power design for wearable & biomedical devices, AI & Machine Learning-based power management

Case studies on modern low-power processors & FPGAs, Future trends in low-power VLSI design

Books

Text Referenes

1. **"Low Power Design Methodologies"** – J. Rabaey & M. Pedram
2. **"CMOS VLSI Design: A Circuits and Systems Perspective"** – N. Weste & D. Harris
3. **"Low-Power CMOS Design"** – A. Chandrakasan, R. Brodersen

Subject Name: Artificial Intelligence

Subject Code: CS(EC)601A
Credits:3
Total Contact Hours: 36

Prerequisites:

Linear algebra and probability theory. Basic understanding of control systems and computing.

Course Objective:
The purpose of this course is to impart concepts of Artificial Intelligence and Expert System.

Course Outcome:
Graduates of the ECE program will be able to

CO1: Identify basic concepts and scope of Artificial Intelligence
CO2: Compare different AI search techniques and apply them on real world problems

CO3: Apply basic principles of AI in solutions that require problem solving, inference, Perception, knowledge representation, and reasoning
CO4: Design intelligent systems for Game Playing
CO5: Classify different learning paradigms and its application in Neural Network

Module-I [2]
Introduction: Foundations and History of Artificial Intelligence and robotics, Turing Test, Intelligent Agents, classification and usage of robots.

Module-II [12]
Searching and Problem-Solving: Problem-solving agents**,** Problem formulation with suitable examples, -8 puzzle problems, Data-driven and goal-driven search, Uninformed searchstrategies - Breadth-first search, Depth-first search, Bidirectional search, Travelling salesman problem, A* search, Heuristic function, Hill climbing, simulated annealing, Local search in continuous space,

Searching with partial observations

Module-III [10]

Knowledge Representation and Reasoning: Introduction to data, information and Knowledge, the concept of logic, Propositional logic, knowledge base, first-order predicate logic (FOPL), Rule of inference, Inference engine, knowledge representation technique, Forward and Backward chaining, Backtracking algorithm, Bayes' rule and Bayesian Networks.

Module-IV [12]

Learning: 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. Logical formulation of learning, Knowledge in learning, Learning with complete data, Learning with hidden variables: EM algorithm, Reinforcement learning: Passive & active reinforcement learning, Generalization in reinforcement learning

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	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	2	-	-	-	-	2	2	3	2
CO2	3	3	-	2	-	-	-	-	-	-	-	2	3	3	2
CO3	2	2	2	-	-	-	2	-	-	-	-	3	2	2	3
CO4	-	-	2	2	3	-	2	-	-	-	-	3	2	2	3
CO5	-	2	2	3	3	2	-	-	-	-	-	2	2	2	3

Subject name: Web Technology
Subject Code: CS(EC)601B Credit
Point: 3
No. of Lectures: 36

Course Objective(s):

To impart the design, development and implementation of Static and Dynamic Web s.To develop programs for Web using Scripting Languages and .net framework.
To give an overview of Server-Side Programming in Web.

Course Outcomes:

On completion of the course students will be able to
CS(EC)601B.1: To define the concepts of World Wide Web (www), Internet, HTTP Protocol,Web Browsers, Client-Server etc.
CS(EC)601B.2: To summarize interactive web s using HTML, DHTML and CSS. **CS(EC)601B**.3: To implement the knowledge of different information interchange formats likeXML.

CS(EC)601B.4: To explain web applications using scripting languages like JavaScript, CGI, PHP.
CS(EC)601B.5: To write different server-side programming like Servlet, JSP and .Net framework.

Course Contents:

Module 1: [4L] Introduction to Web [4L]:

Concept of World Wide Web (www), Internet and the relation with www [1L]; The Internet - Basic Internet Protocols, HTTP Protocol - Request and Response, Web browser [1L]; Web clients and Web servers, Dynamic IP [1L]; Clients, Servers, and Communication, Web site design principles, Planning the site and navigation [1L].

Module 2: [10L]

HTML, DHTML & CSS [7L]: Introduction, Elements, Attributes, Heading, Paragraph. Formatting [1L]; Link, Table, List, Block, Layout, Html Forms and input [1L];IFrame, Colors, Image Maps and attributes of image area [2L]; Introduction to CSS, basic syntax and structure of

CSS, different types- internal, external and inline CSS [1L]; Basic Introduction of DHTML, Difference between HTML and DHTML, Documentary Object Model (DOM) [2L].
Extended Markup Language (XML) [3L]: Introduction, Difference between HTML & XML, XMLTree [1L]; Syntax, Elements, Attributes, Validation and parsing, DTD [2L].

Module 3: [8L]

Java Scripts [4L]: Basic Introduction, Statements, comments, variable, operators, data types[1L]; condition, switch, loop, break [1L]; Java script functions, objects, and events[1L]. CGI Scripts [1L]: Introduction, Environment Variable, GET and POST Methods.
PHP Scripting [4L]: Introduction, Syntax, Variables, Output, Data types, String, Constants[1L]; Operator, Decision Control statements[1L]; switch-case, Loop, PHP function[1L]; array, Form Handling[1L].

Module-4: [14L]

Java Server (JSP) [8L]: JSP Architecture [1L]; JSP Servers, JSP Life Cycle [1L]; Understanding the layout of JSP, JSP Script-let Tag [1L]; JSP implicit object (request and response) [1L]; Variable declaration, methods in JSP [1L]; JSP directive (Tag-lib and include), JavaBean- inserting JavaBean in JSP [1L]; JSP Action tags (Forward & Include) [1L]; Creating ODBC data source name, Introduction to JDBC, prepared statement and callable statement [1L].
Java Servlet [3L]: Servlet environment and role, Servlet life cycle [1L]; Servlet methods- Request, Response, Get and post [1L]; Cookies and Session [1L].
.NET Framework [3L]: ASP.Net with MVC introduction, MVC Architecture, MVC routing, controller, Action method, Action Selector and Action verb, Model and View [1L]; .net framework, C#.net introduction, environment variable, basic syntax of conditional statement, loop and function[2L].

Textbooks:
1. "Web Technology: A Developer's Perspective", N.P. Gopalan and J. Akilandeswari, PHILearning, Delhi, 2013. (Topics covered: html, CSS, imagemap, xml)

2. “Learning PHP, MySQL & JavaScript”, Robin Nixon, O’Reilly Publication. (Topics covered: PHP, Java Script)
3. “Head First Servlet’s & JSP”, Bryan Basham, Kathy Sterra, Bert Bates, O’Reilly Publication. (Topics covered: Servlet, JSP)
4. ASP.NET Core 2.0 MVC And Razor s for Beginners:” Jonas Frajerberg, O’ReillyPublication. (Topics covered: MVC, ASP.Net, C#)

Recommended books:

1. "Programming the World Wide Web", Robert. W. Sebesta, Fourth Edition, Pearson Education, 2007.
2. ”Core Web Programming”- Second Edition-Volume I and II, Marty Hall and Larry Brown, Pearson Education, 2001.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS(EC)601B .1	3	1	3	3	2	-	-	-	-	-	3	3	2	3	2
CS(EC)601B .2	3	2	3	3	2	-	-	-	-	-	2	3	3	1	3
CS(EC)601B .3	2	3	2	2	2	-	-	-	-	-	1	3	2	2	3
CS(EC)601B .4	2	2	3	2	3	-	-	-	-	-	2	2	2	2	3
CS(EC)601B .5	2	3	1	3	1	-	-	-	-	-	1	3	2	2	3

Subject Name: Software Engineering

Subject Code: CS(EC)601C

Credits: 3

Total Contact: 36

Prerequisites:

Programming for Problem Solving

Course Outcomes (COs):

After attending the course students should be able to

CO1	Understand the basic concept of Software Engineering and mathematical knowledge and apply them in designing solution to engineering problem including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements
CO2	Analyze, elicit and specify software requirements through a productive working relationship with various stakeholders of the project
CO3	Design applicable solutions in one or more application domains using software engineering approaches that integrates ethical, social, legal and economic concerns.
CO4	Develop the code from the design and effectively apply relevant standards and perform testing, and quality management and practice team work.
CO5	Identify and Use modern engineering tools necessary for software project management time management and software reuse, and an ability to engage in life-long learning.

Course Content:

Module-1: **6L**

Introduction: Software Engineering, Characteristics, Components, Application, Definitions. Software Project Planning-Feasibility Analysis, Technical Feasibility, Cost-Benefit Analysis, Basics of estimation: COCOMO (Basic, intermediate, Complete) model.

Module- 2: **6L**

Evolution and impact of Software engineering, software life cycle models: Waterfall, prototyping, Evolutionary, and Spiral models. Feasibility study, Functional and Non-functional requirements, Requirements gathering, Requirement's analysis and specification.

Module -3: **8L**

Basic issues in software design, modularity, cohesion, coupling and layering, function-oriented software design: DFD and Structure chart, object modeling using UML, Object-oriented software development, user interface design. Coding standards and Code review techniques, Use case diagram, class diagram, activity diagram, sequence diagram, Deployment diagram, and state machine diagram.

Module -4: **7L**

Fundamentals of testing, White-box, and black-box testing, Test coverage analysis and test case design techniques, mutation testing, Static and dynamic analysis, Software reliability metrics, reliability growth modeling.

Module -5: **9L**

Software project management, Project planning and control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations: Rayleigh-Norden results, quality management, ISO and SEI CMMI, PSP and Six Sigma. Computer aided software engineering, software maintenance, software reuse, Component-based software development, project documentation using UML.

Text Books:

1. Fundamentals of Software Engineering by Rajib Mall, –PHI-3rd Edition, 2009.
2.SoftwareEngineering-PankajJalote(Wiley-India)

Reference Books:

1.Software Engineering–Agarwal and Agarwal(PHI)
2.Software Engineering, by Ian Sommerville, Pearson Education Inc., New Delhi, (2009).
3. Software Engineering: A Practitioner's Approach", by Roger S. Pressman, McGraw-Hill.(2005)

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	2	2	3
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	3	2
CO3	3	3	3	3	-	-	-	3	-	-	-	3	3	1	3

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

Course Name: VLSI Design Lab
Course Code: EC 691
Contact: 0:0:3
Credit: 1.5 Course

Outcome:

Graduates of the ECE program will be able to:

CO1: Apply experimental methods to determine critical parameters of analog and digital integrated circuits.

CO2: Design analog and digital integrated circuits across technologies in CAD tools.

CO3: Analyse and verify circuit designs for optimal conditions.

CO4: Create innovative solutions of problems with stat-of-art technology.

CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	2	3
CO2	-	-	3	3	3	-	-	-	-	-	-	3	2	2	-
CO3	-	3	-	-	-	-	-	-	2	-	-	-	2	2	3
CO4	-	-	-	3	3	-	-	-	-	-	-	-	2	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weaklymatched, (-) = Not matched.

List of Experiments:

1. Simulation of CMOS inverter to plot voltage transfer characteristics (VTC) for different values of kn/kp ratio for VDD=1 V and nano dimensional channel length using SPICE.

a. Measurement of critical voltages VIL, VIH, VOL, VOH from VTC.

b. Calculation of noise margin from critical voltages.

2. Functional verification, measurement of gate delay and average power consumption of CMOS inverter circuit for VDD range 0.5 V to 1.2 V and with the nano dimensional channellength of MOS transistor using SPICE tools.

3. Design and testing of functionality of the following gate and combinational circuit with thehelp of SPICE tools at schematic level. a. CMOS AND/NAND, OR/NOR, XOR/XNOR gate
b. CMOS full adder circuit.

4. Layout design and functional verification of CMOS inverter, CMOS NAND, CMOS NORgate

using layout design tools of SPICE based on design rules.

5. Design and examination of functionality of the sequential circuits - CMOS SR latch, clocked SR latch & D flip-flop at schematic level using SPICE tools.

6. Design and simulation of a) Logic gates b) Full adder using half adder c) 4:1 MUX using 2:1 MUX with the help of VHDL following suitable modelling style (structural, behavioral, dataflow, mixed).

7. Design of the following Sequential circuits using VHDL

a. S-R Flip-Flop

b. 8bit synchronous counter

c. 8 Bit bi-directional register with tri-stated input output.

8. Familiarity with FPGA based system design. Design and realization of 4:1 Mux using FPGA.

9. Design of CMOS differential amplifier at schematic level with active load and current mirror bias circuit for given specifications using SPICE tools.

10. Innovative experiment.

Course Name: Control Systems Lab
Course Code: EC 692
Contacts: 0:0:3
Credit: 1.5

Course Objectives:

To introduce concepts of mathematical modeling, open loop and feedback control systems.

To employ time domain analysis to predict and diagnose transient performance parametersof different types of systems for standard input signals.

To understand the various techniques of stability analysis in the time and frequency domain.

To identify the needs of different types of controllers and compensators to meet the required dynamic response from the system.

Course Outcomes: After completing the following experiments, students will be able toCO1:

Understand mathematical models of physical systems and study their nature, configuration and

relevant mapping into equivalent models.

CO2: Determine transient and steady-state behaviour of different systems using standard test signals.

CO3: Analyze and solve the importance of gain, location of poles and zeros to design a system.CO4:

Evaluate the relative stability of control systems using frequency domain analysis.

CO5: Design controllers according to desired performance specifications.

CO-PO mapping:

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	1	1	1	1	2	1	3
CO2	3	2	2	2	1	-	-	-	2	1	1	1	3	2	3
CO3	3	2	2	2	1	-	-	-	2	1	1	1	2	2	3
CO4	3	2	2	2	1	-	-	-	2	1	1	1	2	2	3
CO5	2	2	3	2	1	1	1	-	2	1	1	1	2	2	3

List of Experiments:

1. Familiarization with MATLAB Control System Toolbox and SIMULINK.

2. Study of the effect of feedback on systems.

3. Study of first-order systems having different time constants.

4. Study of second order systems having different damping ratios.

5. Study of time response of different electrical and mechanical system.

6. Verification and validation of time domain specifications of second order systems.

7. Study of steady-state errors for different ‘types’ of systems.

8. Study of system stability using Root locus technique.

9. Determination of Bode-plot and computation of gain crossover frequency, phase cross over frequency, gain margin and phase margin using MATLAB.

10. Study of closed loop stability using Nyquist plot.

11. Study of system representation using State Model.

12. Determination of PI, PD and PID controller action on first-order simulated process.

13. Evaluation of steady-state error, setting time, percentage peak overshoots, gain margin and phase margin with addition of lead compensator/lag compensator in forward path transferfunction using MATLAB.

14. Tuning of PID Controller.

Course Name: IoT for Communication Lab
Course Code: EC693A
Contact: 0:0:3
Credit: 1.5
Prerequisites: Sensors, Actuators, Microcontroller, Computer Networks

Course Objectives: The purpose of this course is to gather knowledge about IoT, its architecture

different software and hardware components of IoT. Finally students will apply such knowledge to design some hands-on models showcasing different IoT applications.

Course Outcomes: After this course students will be able to
CO1: Able to understand Arduino and Raspberry pi with its hardware and softwarecomponents.
CO2: Able to apply interface I/O devices, sensors, actuators and communication modules in ESP32 or ESP8266 Board through Arduino IOT Cloud.
CO3: Able to analyze remotely monitor data and control devices through Wireshark captureand Blynk IOT Console.
CO4: Able to create real life IoT based innovative projects.

Lab Experiments:

1. Familiarize with Arduino and Raspberry pi with necessary installations
2. Interface LED with ESP32 or ESP8266 Board through Arduino IOT Cloud.
3. Design of Traffic Management system with Arduino and Raspberry pi
4. Interface DHT11/22 (Temperature and humidity) Sensor with ESP32 or ESP8266 Board through Arduino IOT Cloud.
5. Interface and control DC Motor with ESP32 or ESP8266 Board through Arduino IOT Cloud.
6. Interface MQ-05 (LPG) Sensor with ESP32 or ESP8266 Board through Arduino IOT
7. Find machine IP address and packets sent using Wireshark capture
8. Implement MQTT protocol installing Node.js and Node-RED
9. Install Blynk App in mobile and control LED on /off remotely by mobile button
10. Interface Ultrasonic Sensor with ESP32 or ESP8266 Board through Blynk IOT Console.
11. Set up an experiment for Think Speak based DHT Sensor Monitoring
12. Any other innovative experiments

Books
1. 21 IoT Experements,Yashavant Kanetakr,Shrirang Korde, BPB
2. IoT based Projects: Realization with Raspberry Pi, NodeMCU, Rajesh Singh Anita Gehlot,BPB

CO-PO Mapping:

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	2	3	2	3
CO2	2	1	3	3	1	-	-	-	2	-	-	2	3	2	3
CO3	2	3	2	3	2	-	-	-	1	-	-	2	2	2	3
CO4	2	1	3	3	1	-	-	-	2	-	-	2	2	2	3

Subject Name: Digital Image & Video Processing Lab CourseSubject Code: PEC 693 B
Contact hour: 0:0:3

Credits: 1.5

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Build knowledge on Digital Imaging fundamentals and Digital Image Transform.

CO2: Understanding Digital Image enhancement techniques in spatial and frequency domain.

CO3: Explain in the requirements and types of Image Compression and its standards.

CO4: Demonstrate the Segmentation and Edge detection techniques of Digital Images

CO5: Build ideas on Digital Image security and Basic Steps of Video Processing

List of Experiments:

1. Convert RGB Digital Images into Grayscale Images and show result.

2. Transform a grayscale image into frequency domain and show its magnitude and phase angle.

3. Display histogram of a digital image and equalized the image.

4. Apply LPF and HPF in a Grayscale Digital Image and display result.

5. Apply Mean and Median filtering in a Grayscale Digital Image and display result.

6. Compress and reconstruct a Grayscale Digital Images in spatial domain.

7. Compress and reconstruct a Grayscale Digital Image in frequency domain.

8. Apply segmentation technique (anyone) in a Digital Image and display result.

9. Apply Edge detection technique in a Digital Image and display result.

10. Apply any cryptography or watermarking technique for image encryption and display result.

11. Experiment of division of a video into frames

12. Experiment on Frequency domain motion estimation

13. Experiment on Kernel based tracking

14. Experiment on video short boundary detection

15. Innovative experiment

Textbooks:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2010.

2. S. Annadurai,R. Shanmugalakshmi, “Fundamentals of Digital Image Processing”, Pearson Education, 2006

3. Yao wang, JoemOstarmann and Ya–quin Zhang,“Video processing and communication”,,PHI

References:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third

Edition Tata Mc Graw Hill Pvt. Ltd., 2011.

2. AnilJain K. “Fundamentals of DigitalImage Processing”, PHI Learning Pvt. Ltd., 2011.

3. Willliam K Pratt, “Digital Image Processing”, JohnWilley, 2002.

4. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd.,

2011.

5. M. Tekalp , “Digital video Processing”, Prentice Hall Internationa

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	2	-	2	-	-	-	3	3	2	3
CO2	-	3	-	2	-	1	-	-	2	-	-	3	3	2	3
CO3	2	-	1	-	1	-	3	-	-	2	-	3	2	2	3
CO4	3	-	1	-	-	-	2	1	-	-	-	3	2	2	3
CO5	2	-	2	-	-	3	1	-	-	2	-	3	2	2	3

Subject name: Soft Computing Lab
Subject code: EC693C
Credit: 1.5

Objectives:

Foster hands-on implementation of neural networks, fuzzy logic controllers, and genetic algorithms. Develop problem-solving skills, optimize models, and apply soft computing techniques to real-world scenarios in a lab setting for practical engineering applications.

Course outcomes:

CO1: Understand the foundational theories and principles underlying neural networks, fuzzy logic, and genetic algorithms.

CO2: Apply neural network models, fuzzy inference systems, and genetic algorithms to solve engineering problems.

CO3: Analyze engineering challenges and design solutions using appropriate soft computing

methodologies.

CO4: Conduct experiments, evaluate performance, and optimize soft computing techniques for diverse engineering applications.

CO5: Demonstrate professional skills in implementing and integrating soft computing techniques into engineering projects, considering ethical and societal implications.

1. Implement McCulloch-Pitts neuron models in Python or MATLAB to solve the XOR problem, experimenting with different activation functions.

2. Create a feedforward neural network in MATLAB to classify handwritten digits from the MNIST dataset, applying backpropagation for training.

3. Develop a fuzzy logic controller in MATLAB for a simulated control problem (e.g., temperature control), considering various membership functions and rule sets.

4. Design a fuzzy inference system using MATLAB's Fuzzy Logic Toolbox to control a household appliance, evaluating defuzzification techniques.

5. Implement a genetic algorithm in Python to optimize parameters for a mathematical function, comparing selection methods (roulette wheel vs. tournament) and mutation rates.

6. Develop a genetic algorithm-based clustering algorithm in Python and apply it to a dataset, analyzing its clustering performance.

7. Create an RBF network in MATLAB to approximate a complex function or solve a regression problem, exploring its applications in pattern recognition.

8. Construct a neuro-fuzzy system in a programming environment (Python or MATLAB) combining neural networks and fuzzy logic, applying it to a pattern recognition task.

9. Implement PSO in Python for image processing tasks such as optimizing parameters for edge detection filters or noise reduction algorithms.

10. Determine the optimum value of a function using Ant Colony optimization.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	2	-	2	-	-	-	3	3	2	3
CO2	-	3	-	2	-	1	-	-	2	-	-	3	3	2	3
CO3	3	-	1	-	-	2	-	2	-	-	-	3	2	2	3
CO4	-	3	-	2	-	1	-	-	2	-	-	3	2	2	-
CO5	2	-	1	-	1	-	3	-	-	2	-	3	2	2	3

Subject name: Low Power IC Design Lab

Subject code: EC693D
Credit: 1.5

Course Objectives:

- To understand techniques for low-power design in Integrated Circuits (ICs).
- To analyze power consumption in digital and analog circuits.

- To implement and simulate low-power circuits using CAD tools.
- To explore advanced power reduction techniques at different levels of abstraction.

Course Outcomes (COs):

1. **CO1:** Understand different sources of power dissipation in CMOS circuits.
2. **CO2:** Analyze and implement voltage scaling and clock gating techniques.
3. **CO3:** Design and optimize low-power sequential circuits.
4. **CO4:** Evaluate power reduction techniques such as power gating and multi-Vt design.
5. **CO5:** Implement low-power arithmetic circuits and assess their efficiency.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	2	-	2	-	-	-	3	3	2	3
CO2	-	3	-	2	-	1	-	-	2	-	-	3	3	2	3
CO3	3	-	1	-	-	2	-	2	-	-	-	3	2	2	3
CO4	-	3	-	2	-	1	-	-	2	-	-	3	2	2	-
CO5	2	-	1	-	1	-	3	-	-	2	-	3	2	2	3

List of Experiments

Experiment 1: Introduction to Power Dissipation in CMOS Circuits

- Understanding dynamic, static, and leakage power dissipation.
- Power estimation using SPICE simulations.
  Outcome: Students will analyze different types of power dissipation in CMOS circuits.

Experiment 2: Design and Analysis of Low-Power CMOS Inverter

- Simulating power consumption at different supply voltages.
- Investigating the impact of scaling on power and performance.
  Outcome: Students will understand the effect of voltage scaling on power reduction.

Experiment 3: Implementation of Power Gating Techniques

- Applying sleep transistors to reduce leakage power.
- Comparing power consumption with and without power gating.
  Outcome: Students will implement and evaluate power gating in circuits.

Experiment 4: Design and Simulation of Clock Gating for Power Reduction

- Implementing clock gating in sequential circuits.
- Measuring power savings using simulation tools.
  Outcome: Students will learn clock gating techniques for dynamic power reduction.

Experiment 5: Design of Low-Power Flip-Flops and Latches

- Comparing power consumption of different flip-flop architectures.
- Optimizing circuit design for minimal power usage.
  Outcome: Students will evaluate and design energy-efficient storage elements.

Experiment 6: Voltage Scaling and Multi-Vt Techniques in Digital Circuits

- Implementing Multi-Vt transistors to reduce leakage power.
- Analyzing trade-offs between speed and power consumption.
  Outcome: Students will understand how threshold voltage scaling affects power efficiency.

Experiment 7: Design of Low-Power Arithmetic Circuits (Adder & Multiplier)

- Implementing and comparing different low-power adder architectures.
- Power-performance trade-off analysis.
  Outcome: Students will optimize arithmetic circuits for power-efficient designs.

Experiment 8: Case Study and Project on Low-Power IC Design

- Students will design and implement a power-optimized circuit of their choice.
- Verification of power reduction techniques using CAD tools.
  Outcome: Students will apply low-power design techniques in a real-world IC project.

Course Name: Artificial Intelligence
Course Code: CS(EC)691A
Contacts: 0:0:3
Credit:1.5

Prerequisites:

- Strong knowledge of mathematics
- Good command over programming languages
- Good Analytical Skills
- Ability to understand complex algorithms

Course Outcome:

CO1: Apply various pre-processing techniques on different datasets.

CO2: Construct Machine learning programs for Supervised, Unsupervised and Semi supervised learning models.

CO3: Develop Deep learning programs for Supervised & Unsupervised learning models.

CO4: Apply Artificial Intelligence concepts to solve real world problems.

Experiments:

A. Using Prolog

1. Familiarization of Prolog
2. Study of facts, objects, predicates and variables in PROLOG.
3. Study of Rules and Unification in PROLOG.
4. Study of “cut” and “fail” predicate in PROLOG.
5. Write a Prolog program to maintain family tree.
6. Write predicates One converts centigrade temperatures to Fahrenheit, the other checksif a temperature is below freezing.

B. Using any programming language

7. Write a program to solve the Tower of Hanoi problem.
8. Write a program to solve 4-Queen problem.
9. Write a program to solve 8-puzzle problem.
10. Write a program to solve traveling salesman problem.
11. Write a program to solve water jug problem
12. Write a program to implement hill climbing algorithm
13. Write a program to implement simulated annealing algorithm
14. Write a program to simulate breadth first search and depth first search
15. Write a program to solve the Monkey Banana problem.
16. Write a program to simulate hill climbing and simulated annealing
17. Write a program to implement Perceptron.
18. Write a program to implement AND, OR gates using Perceptron.
19. Write a program to implement Iris data classification using Back Propagation.
20. Write a program to implement a Chatbot
21. One experiment on NLP

Text Books:

1.Artificial Intelligence: A Modern Approach, Russell & Norvig, Prentice Hall.2.Artificial

Intelligence, Elain Richand Kevin Knight, TMH.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	-	-	-	-	2	-	2	3	2	3
CO2	3	3	2	-	2	-	-	-	-	2	-	2	3	3	1
CO3	3	3	2	-	3	-	-	-	-	2	-	2	2	2	3
CO4	2	2	3	-	3	-	2	-	-	2	-	3	2	2	-

Name of the Paper: Web Technology LabLab
Paper Code: CS(EC)691B
Contact (Periods/Week): 3P/Week
Credit Point: 2
No. of Lectures: 30

Prerequisite: Fundamentals of Programming

Course Objective(s):

- To impart the design, development and implementation of Static and Dynamic Webs
- To develop programs for Web using Scripting Languages and .net framework
- To give an overview of Server-Side Programming in Web Course Outcomes

Course Outcomes:

- **CS(EC)691B.1**: To define interactive web s using HTML, DHTML, CSS and imagemap.
- **CS(EC)691B.2**: To summarize the knowledge of information interchange formats like XML.
- **CS(EC)691B.3**: To implement JavaScript – a client side scripting languages in web

programming. CS792C.4: To explain PHP and ASP.net related web applications.

- **CS(EC)691B.4**:To explain PHP and ASP.net related web applications.
- **CS(EC)691B.5**: To write the server side programming concepts using Servlet, JSP.

List of Experiments:

1. Write a single html program through which you can explain a) anchor tag, b)'imp' tag with 'src' attribute, c) paragraph d) heading.

2. Write a single html program through which you can draw a table which consists of 3 row and 4 columns where 1st row contains 4 different column fields of a student's information with red text color and Calibri font style with font 12. Rest cells of whole table contain values with blue text colors and Times new roman font style with font 10.

3. Write a single html program where 1st paragraph can collect its specified style from internal stylesheet describes inside that html program and 2nd paragraph can collect its specified style from another file (external stylesheet).

4. Write a single html program which implements image map concept using 'usemap' and .

5. Write a html program to find out Celsius temperature of a given Fahrenheit temperature using JavaScript.

6. Write a html program to find out m to the power n (m, n valid integer no) using a function using JavaScript.

7. Write a xml parsing technique through which parse a text string into an XML DOM object,and extracts the info from it with JavaScript.

8. Write a simple PHP program through which you can find out maximum and minimum among three nos specified by the user.

9. Write a simple PHP program through which you can implement the concept of GET & POST method w.r.t PHP Form handling.

10. Write a simple program in ASP.net through which you can create a login of your ownwebsite.

11. Write a simple JSP program through which you can print even and odd no separately withina given range.

12. Create an Online Registration form for individual user of a website using Servlet.

Textbooks:

1. "Web Technology: A Developer's Perspective", N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Topics covered: html, CSS, imagemap, xml)

2. "Learning PHP, MySQL & JavaScript", Robin Nixon, O'Reilly Publication.(Topics covered: PHP, Java Script)

3. "Head First Servlet's & JSP", Bryan Basham, Kathy Sterra, Bert Bates, O'Reilly Publication. (Topics covered: Servlet, JSP)

4. ASP.NET Core 2.0 MVC And Razor s For Beginners:" Jonas Frajerberg, O'Reilly Publication. (Topics covered: MVC, ASP.Net, C#)

Recommended books:

1. "Programming the World Wide Web", Robert. W. Sebesta, Fourth Edition, Pearson Education, 2007.

2. ”Core Web Programming”- Second Edition-Volume I and II, Marty Hall and Larry Brown, Pearson Education, 2001.

3. “Web Technologies”, Black Book, Dreamtech Pre

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS(EC)691B.1	3	3	2	3	2	-	-	-	-	-	2	3	2	1	2
CS(EC)691B.2	2	2	3	2	3	-	-	-	-	-	3	2	2	3	2
CS(EC)691B.3	1	2	1	2	2	-	-	-	-	-	1	2	2	2	3
CS(EC)691B.4	3	2	3	2	3	-	-	-	-	-	3	2	2	2	-
CS(EC)691B.5	1	3	2	3	2	-	-	-	-	-	2	3	2	3	2

Subject Name: Software Engineering Lab
Subject Code: CS(EC)691C
Credits: 1.5

Prerequisites:
Programming for Problem Solving

Course Outcomes (COs):
After attending the course students should be able to

CO1	Understand the basic knowledge of how to apply Software Engineering and mathematical knowledge and designing solution to software engineering problem including the specification
CO2	Analyze the cost-benefit trade-off
CO3	Design solutions to the one or more application domains using software engineering approaches that integrates ethical
CO4	Develop the code from the design and effectively apply relevant standards and perform testing

CO5	Identify and use of modern software engineering tools necessary for software project management

Course Content:

Module-1: **6L**

Preparation of requirement document for standard application problems in standard format. (e.g., Library Management System, Railway Reservation system, Hospital management System, University Admission system). DFD of standard application problems.

Module-2: **6L**

Software Requirement Analysis: Describe the individual Phases/ modules of the project, Identify deliverables. Compute Process and Product Metrics (e.g Defect Density, Defect Age,Productivity, Cost etc.) Estimation of project size using Function Point (FP) for calculation. Cost Estimation models.

Module-3: **6L**

Use Case diagram, Class Diagram, Sequence Diagram, Activity Diagram and prepare Software Design Document using tools like Rational Rose. (For standard application problems)

Module-4: **9L**

Software Development, Coding Practice and Debugging, Design Test Script/Test Plan (both Black box and White Box approach)

Module-5: **9L**

Software project management, Project planning and control, configuration control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations using standard tools.

Text Books:

1. Fundamentals of Software Engineering by Rajib Mall, –PHI-3rd Edition, 2009.
2.SoftwareEngineering-PankajJalote (Wiley-India)

Reference Books:

1.SoftwareEngineering–AgarwalandAgarwal(PHI)
2.Software Engineering, by Ian Sommerville, Pearson Education Inc., New Delhi, (2009).
3. Software Engineering: A Practitioner‟s Approach", by Roger S. Pressman, McGraw-Hill.(2005)

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	-	3	-	-	-	3	2	2	3
CO4	3	3	3	3	-	-	-	-	3	-	-	-	2	2	3
CO5	3	2	3	2	3	-	-	-	3	2	3	3	2	2	3

R23 (All B. Tech.)

Curriculum & Syllabus for B.Tech under JIS Autonomy

Electronics and Communication Engineering

4th Year 7th Semester									
Sl. No.	**Broad Category**	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	EC701	Satellite Communication	3	0	0	3	3
2	ENGG	Major	EC702A	Information Theory & Coding	3	0	0	3	3
			EC702B	Fiber Optic Communication					
			EC702C	Remote Sensing & GIS					
3	ENGG	Major	EC703A	Computer Architecture	3	0	0	3	3
			EC703B	Machine Learning					
			EC703C	IC Technology					
4	ENGG	Minor	CS(EC)701 A	Data Analytics	3	0	0	3	3
			CS(EC)701 B	Deep Learning					
			CS(EC)701 C	Cyber Security & Cryptography					
5	HUM	Skill Enhancement Course	HU(EC) 701	Economics for Engineers	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Major	EC791	Satellite Communication Lab	0	0	2	2	1
2	ENGG	Internship	EC781	Internship (Min. 1 Month)	0	0	0	0	1
3	PRJ	Project	EC782	Project-I	0	0	0	6	6
Total of Theory, Practical								22	22

Paper Name: Satellite Communication

Paper Code: EC701

Total Contact Hours: 38

Credit: 3

Prerequisite: Basic idea of Communication System, Electromagnetic Theory and Antenna

Course Objectives:

1.To describe the electronic hardware systems associated with the satellite subsystem and earth station.

2.To describe the various applications of satellite with the focus on national satellite system.

3.To compute the satellite link parameters under various propagation conditions with the illustration of multiple access techniques.

Course Outcomes:

On completion of the course students will be:

CO1 :Able to learn the orbital aspects of the satellite and the design of satellite links.

CO2 :Able to understand the Satellite transponder and Earth Station Design

CO3: Able to understand Multiple Access Techniques used in satellite communication

CO4 :Able to realize the various Propagation impairments on satellite communication

CO5 :Able to comprehend satellite Navigation and the GPS, GIS and remote sensing

Module-I: Satellite Orbital Mechanics Launcher and Subsystems (10L)

Origin of Satellite communication, Current state of satellite communication. Orbital aspect of satellite communication: Orbital mechanism, equation of orbit, locating satellite in orbit, orbital elements, orbital perturbation, look angle, orbital period and velocity, azimuth and orbital inclination, coverage angle slant range, placement of satellite in geostationary orbit. Space craft subsystem: Attitude and orbit control system, Telemetry tracking and command system, power system, communication subsystem, antenna subsystems.

Module-II: Satellite Link Design(5L)

Basic link analysis, interference analysis, attenuation due to rain, link with and without frequency reuse. System noise temperature and G/ T ratio, uplink design, down link design, , design of satellite link for specified C / N.

Module-III: Satellite Transponder and Earth Station Design(6L)

Transponder model, transponder channelization, frequency plans, processing transponders. Earth Station Technology: Earth Station design; Earth station antenna, gain, pointing loss, G/T variation and it's measurement, antenna tracking, LNA, HPA, RF multiplexing, up converter, down converter, transponder hopping, polarization hopping, redundancy configuration, factors affecting orbit utilization, tracking, equipment for earth station.

Module-IV: Multiple Access Techniques (6L)

Frequency Division Multiple Accesses: SPADE, FDM-FM-FDMA, Commanded FDM-FM-FDMA and SSB-AM-FDMA, inter modulation products in FDMA, optimized carrier-to-inter modulation plus noise ratio. Time division Multiple Access: Principle, TDMA frame structure, TDMA Burst structure, TDMA Super frame structure, Frame acquisition and synchronization. TDMA timing. Demand

Assignment Multiple Access and Digital Speech interpolation. Type of demand assignment, DAMA characteristics, Real time frame reconfiguration, DAMA interfaces, SCPC-DAMA, CDMA, SDMA.

Module-V Propagation Effects on Satellite (7L)

Earth's path – propagation effects, atmospheric absorption, Scintillation effects, Land and Sea multipath, Rain and ice effects, Rain drop distribution, calculation of attenuation. Rain effects on Antenna noise temperature. Encoding and forward error correction: Error detection and correction, channel capacity, error detecting codes- linear block codes, cyclic codes. Introduction to VSAT systems: Low earth orbit and non-geostationary satellite systems. Network error control poling VSAT network. Mobile satellite network: Operating environment. MSAT network concept, CDMA MSAT relink. Worldwide timing by satellite relay. Direct broadcast Television DTH and Radio, SatellitePhone

Module-VI Satellite Navigation and Remote Sensing(4L)

Global Positioning System (GPS), Global Navigation Satellite Systems (GNSS), Indian Regional Navigation Satellite System (IRNSS), Navigation with Indian Constellation (NavIC) Basic concept of Geographic Information Systems (GIS), Idea of Remote Sensing.

Text books:

1) Timothy Pratt, Charles Bostian, Teremy Allnutt, Satellite Communication, John Wiley & Sons.

2) Satellite Communication, D. C. Agrawal, Khanna Publishers

3) Satellite Communication, Dennis Roddy, 4th Edition, McGraw- Hill International edition, 2006

4) Monojit Mitra: Satellite communications, Prentice Hall of India

Reference Books:

1) "Satellite Communication", T. T. Hai., Mc.Graw Hill Publications

2) Satellite Communication Systems Engineering, W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson, 2nd Ed., Pearson Education, 2007.

3) Satellite Communication, Mark R Chartrand, Cenage Learning

4) J. J. Spilker, Jr., Digital Communication by Satellite, Prentice Hall.

5) 4. Bruce R. Elbert, Satellite Communication Applications Hand Book, Artech House.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	-	-	-	-	-	-	-	2	3	2	2
CO2	2	3	1	2	1	-	-	-	-	-	-	2	3	2	2
CO3	3	2	2	3	2	-	-	-	-	-	-	2	2	2	3
CO4	1	3	3	3	1	-	-	-	-	-	-	2	3	3	3
CO5	3	2	2	2	2	-	-	-	-	-	-	2	2	3	1

Weightage Values: 3=Strongly matched, 2=Moderately matched,1=Weakly matched, (-)=Not matched.

Course Name: Information Theory & Coding

Course Code: EC 702A
Contact: 3:0:0
Total Contact Hours: 36 Credits:3

Prerequisite: Digital Electronics, probability

Course Outcomes:

Graduates of the ECE program will be able to
CO1 – Understand the concepts of information theory and various source coding techniques.

CO2 – Calculate channel capacity and rate of information in the digital communication system.

CO3 – Apply source coding techniques to compress and encrypt data.

CO4 – Implement various error detection and correction coding techniques in the communication system to solve problems.
CO5 – Design circuits for different error control coding techniques.
Course Content

Module 1: Source Coding [6L]
Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes. Shannon - Fano Coding.
Module 2: Channel Capacity and Coding [6L] Channel models, channel capacity, information capacity theorem, The Shannon limit.
Module 3: Linear and Block Codes for Error Correction [8L] Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block, Standard array and syndrome detection code, Hamming codes (error detection and correction).
Module 4: Cyclic Codes [8L]
Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, decoding cyclic codes, Encoding and Decoding of message using circuit

Module 5: Other Codes: [8L]
Convolutional Codes: Encoding, state diagram, Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, decoding of convolutional codes, Viterbi decoding, examples of convolutional codes, Application of Information Theory and Coding in Cyber Security, and Coding inMachine Learning (Basic idea).

Basic idea of BCH coding (Galois Field, Minimal Polynomial)

Text Books:

1. Information theory, coding and cryptography-Ranjan Bose; TMH.

2. Introduction to Error Control Codes –Salvatore Gravano, Oxford

3. Information theory, coding and cryptography–A Saha, S Mondal; Pearson

Reference Books:

1. Information and Coding- N Abramson; McGraw Hill.

2. Introduction to Information Theory- M Mansurpur; McGraw Hill.

3. Information Theory - R B Ash; Prentice Hall.

4. Error Control Coding- Shu Lin and D J Costello Jr; Prentice Hall.

4. Todd K Moon,- Error Correction Coding: Mathematical Methods and Algorithms, John Wiley & Sons

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		1	-	-	-		-	-	-	3	3	1
CO2	2	3	3	-	3	-	-	-	-	-	-	1	2	3	3
CO3	2	3	3	3	3	-	-	-	-	-	1	-	2	3	3
CO4	3	3	3	2	2	2	-	-	-	-	-	1	3	3	3
CO5	3	3	3	2	2	2	-	-	-	-	1	1	2	3	1

Fiber Optic Communication

Code:EC702B

Contacts:3-0-0

TotalContacthours:36

Credits: 3

Prerequisite: Concept of Ray theory, electromagnetic wave theory and communication engineering.

Course Outcome:

After the successful completion of the course the students will be able to:

CO1: Analyze basic concept of Optical fiber communication and ray theory concept.

CO2: Illustrate Types of fibers and Wave guides fundamentals.

CO3: Demonstrate the principle and operation of the optical sources and detectors such as LASER &amplifiers; APD and optical connectors.

CO4: Generalise SONET/SDH and architecture of Optical Transport Network.

CO5: Discuss the elements of WDM networks and its potential applications.

Course Content:

Module I: Introduction to Fiber Optics communication system and properties of Ray theory transmission: 4L

Concepts of Analog and Digital Optical Fiber link , Advantages of Optical Fiber Communication, Cladding and Core concept of Optical Fiber waveguides, Total Internal reflection, Snell's Law, Acceptance angle, Numerical Aperature, Meridional ray, Skew ray

Module II: Optical Fiber: 8L

Materials, Types of fibers, Wave guides fundamentals:

Analog and Digital Optical Transmitters and Receivers concepts: Modes in Planar Guide, Phase and Group Velocity, Mode Coupling, Steps and Graded Index Fiber : Basic concept with mathematical expression(no derivation needed), Transmission characteristics: Attenuation and Dispersion mechanism and their effects. Special type Fibers, Loss- limited and dispersion- limited light wave systems, Long-haul systems with In-Line Amplifiers, Dispersion compensation techniques in optical communication systems Power budget and rise-time.

Module III: Optical Sources and Detectors: 7L

General Principles of LASER action: Absorption and emission of radiation, Population inversion , Optical feedback and LASER Oscillation, Threshold condition for LASER oscillation, Introduction to lasers, Simple rate equation modeling of: saturation, gain, amplifiers, Examples of types of lasers: HeNe, Nd:YAG, diode, Ti:Sapphire. LEDs and ILDs : Characteristics, Drive circuits; Optical detection principle, P-N, P-I-N and APD, Photo transistor, Receiver Structure, SNR, Sensitivity.

Module IV: Inter-Connecting Devices: 5L

Couplers, Isolators, Polarizers, Circulators, Filters, Add/Drop Mux/Demux, Fiber Optic Repeaters, Optical Amplifiers.

Module V: Communication System and Optical Network : 12L

System design issues, Link analysis, Intensity modulation/direct detection system. Digital systems: coding and multiplexing mechanism, Coherent light wave systems: Modulation and Demodulation scheme for coherent communication, System performance issues. Multichannel Light wave systems: WDM components and devices, Multiplexing techniques and system performance issues. Optical Networks: Network topologies, SONET/SDH, Broadcast-and-Select WDM Networks-single-hop networks, multi hop Networks, Wavelength routed networks

Text books: 1. Optical Networks –Rajiv Ramaswami, K. N. Sivarajan, Galen H. Sasaki (Morgan-Kaufman)
2. Optical Fibre Communication : John M. Senior (Pearson)

3. Optical Communications: N. Bala Saraswathi, I. Ravi Kumar (LaxmiPublications)

Reference Books 1.Optical Communication Systems: John Gawar (PHI)

2. Optical Fibre Communication: Gerd Kaiser (TMH)

3. Fiber optics communication by G.P Agrawal.

4. Raman Amplifiers for communications by M.N. Islam(Ed).

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	1	-	-	2	3	1	2	2	2	3	2	3
CO2	3	3	1	2	2	-	-	3	3	2	-	2	3	3	3
CO3	3	3	3	2	2	-	-	-	-	-	-	2	2	3	3
CO4	2	2	3	2	3	-	3	2	3	-	-	2	3	3	3
CO5	3	2	3	3	3	-	3	3	3	-	-	2	2	3	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Subject Name: Remote Sensing & GIS

Subject Code: EC702C

Credits: 3

Contact: 3:0:0

Total Contact Hours: 36

Pre-Requisite: Analog & Digital Communication, EM Theory & Antenna

Course Objectives: To develop applications of environmental remote sensing and GIS which can directly enhance service delivery on land use management, ground water management/prospects, agriculture, forestry, food and water security, disaster management, etc.

Course Outcomes:
At the end of this course, students will be able to
CO1: Interpret the basic concept of remote sensing and GIS.
CO2: Recognize the principles of aerial and satellite remote sensing.
CO3: Categorize different types of sensors in remote sensing as per applications and data representation in GIS.
CO4: Analyze the different kinds of radar for atmospheric remote sensing.
CO5: Apply knowledge of GIS software in various application fields and digital image processing for RS image enhancement analysis.

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			2						3		3		2	3	2
CO2				2		2		3	3	1	3	3	3	3	1
CO3	3		2						2		3	3	2	2	2
CO4						2			3	1	3		2	2	2
CO5		2		2				2	3		3		1	2	1
AVG	3	2	2	2		2		2.5	2.8	1	3	3	1.8	2.2	1.6

Module I: Introduction [2L]

Concept of Remote Sensing: Remote Sensing, Data, Sources of Energy, Interaction with Atmosphere and Target, Recording of Energy, Concept of GIS, types of GIS data: Civilian & Military, commercial GIS software.

Module II: Radio Wave Propagation [10L]

Basic Radio propagation mechanism: Short distance & long distance propagation cases. Free space Propagation models. Diffraction, Reflection and Scattering. Variation of the earth's reflectivity with angle of incidence, wavelength and geographical location; Seasonal variation of reflectivity; Effects of Solar radiation, Earth's thermal radiation, atmospheric radiation, cosmic background noise & atmospheric variation. Measurement techniques for propagation characteristics, Role of antennas in wave propagation, Radio wave propagation in 5G and mmWave communication, Future trends in radio wave propagation studies.

Module III: Remote Sensing [12L] Sensors and Cameras:

optical and infrared detectors and filters, optical and infrared cameras; microwave and millimeter wave radiometers; scanning systems, mechanical and electronic systems; scatter meter; altimeter. Radar Imaging GPS: Calibration, Requirement of Ground Truth Data, Parameters of Ground Truthing Atmospheric Condition, Surface Water, Factors of Special Measurement—Sun Angle, Aerosol, Haze, Water Vapor. Remote Sensing of Atmosphere and Sea State: Passive and active remote sensing; Side Looking Airborne Radar (SLAR); Synthetic Aperture Radar (SAR); Along Track Scanning Radiometer (ATSR), Laboratory measurements of remote sensing parameters.

Module IV: Geographic Interpretation System [12L]

Interpretation of Sensing Data: Photo-interpretation, image and pattern recognition; Spectral interpretation of remote sensing imagery; Interpretation of thermal maps; Color coding and enhancement; Computer interpretation of images. Tropical rainfall measurements; Microwave sensing of sea surface. Geocoding and network analysis, Spatial interpolation techniques, Terrain analysis (DEM, Contours, Slope, Aspect)

Text books:

1. "Remote Sensing and GIS" by Basudeb Bhatta – Oxford University Press, 3rd Edition (2021)
2. "Introduction to Remote Sensing" by James B. Campbell & Randolph H. Wynne – The Guilford Press, 5th Edition (2011)
3. "Fundamentals of Remote Sensing" by George Joseph – Universities Press, 2nd Edition (2005)
4. "Concepts and Techniques of Geographic Information Systems" by C.P. Lo & Albert K.W. Yeung – Pearson Education, 2nd Edition (2007)
5. "Geographic Information Systems: An Introduction" by Tor Bernhardsen – Wiley, 3rd Edition (2002)

Reference Books:

1. "Remote Sensing and Image Interpretation" by Thomas M. Lillesand, Ralph W. Kiefer & Jonathan W. Chipman – Wiley, 7th Edition (2015)
2. "Principles of Geographical Information Systems" by Peter A. Burrough & Rachael McDonnell – Oxford University Press, 2nd Edition (1998)
3. "GIS, Spatial Analysis, and Modeling" by David J. Maguire, Michael Batty & Michael F. Goodchild – Esri Press, 1st Edition (2005)
4. "Introduction to Modern Photogrammetry" by Edward M. Mikhail, James S. Bethel & J. Chris McGlone – Wiley, 1st Edition (2001)
5. "Geographic Information Science and Systems" by Paul Longley, Michael Goodchild, David Maguire & David Rhind – Wiley, 4th Edition (2015)

Subject name: Computer Architecture
Subject code: EC703A
Credit: 3
Total Contact Hours: 36
Prerequisites: Digital Electronics, Analog Electronics, Microprocessor and Microcontroller, Sensors

Course Objectives:

The course objectives are commonly associated with computer architecture:

Describe Instruction Set Architecture (ISA), Examine Memory Hierarchy, and Understand Basic Computer Components Examine computer arithmetic, analyze performance metrics, apply concepts of parallel processing, learn about emerging technologies, build problem-solving skills, Study processor organization and critically evaluate architectural choices. By completing these goals, students shouldbe able to analyze, design, and optimize computer systems in addition to having a thorough understanding of computer architecture, ranging from fundamental ideas to more complex ideas. For students to meet the required learning outcomes, instructors must create assessments and activities that are in line with these goals.

Course Outcomes (COs):

After completing the course, the student will be able to:

CO1: Recall the fundamental components of a computer system, including the CPU, memory, andinput/output devices. List the various types of memory found in a computer system.

CO2: Describe the instruction set architecture (ISA) concept and its role in computer organization.Summarize the pipelining principles and their impact on instruction execution.

CO3: Apply the knowledge of binary and hexadecimal number systems to represent data in acomputer. Create a simple instruction set for a fictitious computer architecture.

CO4: Assess the benefits and drawbacks of parallel processing in computer architecture. Examine the effect of memory hierarchy on overall system performance.

CO5:Design a basic computer system, considering the organization of the CPU, memory, and input/output systems. Propose improvements to a given computer architecture to enhance performance.

CO-PO mapping:

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO 1	3	2	1	2	-	2	-	-	-	-	-	3	3	2	2
CO 2	-	2	-	3	-	1	-	-	-	-	-	3	2	2	3
CO3	2	-	3	-	2	-	3	-	-	-	-	3	3	3	3
CO4	3	-	1	-	-	-	2	-	-	-	-	3	3	3	3
CO5	3	-	2	-	-	2	1	-	-	-	-	3	2	3	1

Modules:

Module 1: Basic Structure of a Computer System [6L]

Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats,. MIPS Addressing

Module 2: Arithmetic for Computers [6L]

Processor organization, Information representation, number formats. Addition and Subtraction, Multiplication & division, Fixed point multiplication -Booth's algorithm, Fixed point division - Restoring and non-restoring algorithms, – Subword Parallelism

Module 3: Processor and Control Unit [9L]

ALU design, Floating Point arithmetic, IEEE 754 floating point formats, Subword Parallelism,Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, Microprogrammed

computers – CPU control unit.

Module 4: Memory & I/O Systems [6L]
Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory, System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces, TLB's, Bus structure — Bus operation — Arbitration — Interface circuits — USB.

Module 5: Parallelism [9L]
A Basic MIPS implementation, Building a Datapath, Control Implementation Scheme, Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network, Handling Data Hazards and control Hazards — Exceptions. Parallel processing challenges — Flynn?s classification — SISD, MIMD, SIMD, SPMD, and Vector Architectures. Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

References:

1. V.Carl Hammacher, "Computer Organisation", Fifth Edition.
2. A.S.Tanenbum, "StructuredComputer Organisation", PHI, Third edition
3.Y.Chu, "Computer Organization andMicroprogramming", II,EnglewoodChiffs,N.J., PrenticeHallEdition
4. M.M.Mano, "Computer System Architecture",Edition
5. C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition
6. HayesJ.P, "Computer Architecture and Organization", PHI, Second edition

Course name: Machine Learning
Course Code: EC703B
Contacts: 3:0:0 Total contacts: 36

Credits:3

Prerequisite:

Knowledge of basic computer science principles and skills familiarity with the basic probability theory And basic linear algebra

Course objectives:

- To acquire theoretical knowledge on setting hypothesis for pattern recognition.
- To apply suitable machine learning techniques for data handling and knowledge extraction.
- To evaluate the performance of algorithms
- To provide solutions for various real-world applications.

Course outcomes:

CO1: Able to identify characteristics of machine learning strategies.
CO2: Able to classify the importance of feature selection and extraction techniques.
CO3: Able to analyze various clustering and classification techniques.
CO4: Able to Create a suitable unsupervised learning model for handling unknown patterns.
CO5: Able to select algorithms to a real-world problem.

Course Content:

Module-I (Introduction) [2L]
Overview of machine learning, PAC Learning-Consistent and inconsistent hypothesis, concept of

supervised, unsupervised learning,

Module-II (Regression) [6L]
Linear regression in one variable, multiple variables, least square method, SSE, gradient descent, overfitting, underfitting and just fit in terms of bias and variance.

Module-III (Dimension ality reduction) [6L]
Feature selection: Concept of regularization, filter method, wrapper method. Feature extraction: PCA, LDA

Module-IV(Classifier) [8L]
Logistic regression (binary classification), Decision trees, Naïve Bayes Classifier, KNN, SVM.

Module-V(Clustering) [6L]
K-Means, Hierarchical clustering, Gaussian mixture density estimation, Cluster validation index(silhouette).

Module-VI(ANN) [8L]
Comparison of Biological Neurons and Artificial neurons, model of neuron-activation function,McCulloch-Pitts model, Feedforward& Feedback network, Single layer perception, implementation of logical AND & OR, Single-Layer vs. Multi-Layer Perceptron (MLP), Forward and Backward Propagation Mechanism, Loss Functions: Mean Squared Error (MSE), Cross-Entropy

Text books:

1. Understanding Machine Learning by Shai Shalev-Shwartz and Shai Ben- David, Cambridge University Press
2. Patternrecognitionand machinelearningby ChristopherM.Bishop,Springer
3. Pattern Classification by Richard O Duda, Peter E. Hart & David G. Stock, John Wiley.
4. PatternRecognitionbyKonstantinosKoutroumbas,SergiosTheodoridis,Elsevier

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3						2		1			3	2	3	1
CO2				3									3	3	
CO3		3				1				2			1		2
CO4			3								11			2	3
CO5				3	2			1						3	3

Course Name: IC Technology
Course Code: EC703C
Contacts:3-0-0
Total Contacts:36
Credits: 3

Course Pre-Requisites:
1. Electronic Devices
2. Digital Circuits and Design
3. Discrete electronics circuits
4.Design with Linear Integrated circuits

5. Basic VLSI design

Course Objectives:

1. To teach fundamental principles of fabrication of VLSI devices and circuits
2. To disseminate knowledge about novel VLSI devices

Course Outcome:

After successful completion of the course student will be able to

CO1: Understand Semiconductor Materials and Crystal Growth Techniques.

CO2: Apply Semiconductor Fabrication Processes in IC Manufacturing.

CO3: Analyze Dopant Diffusion, Ion Implantation, and Metallization Techniques.

CO4: Assess Semiconductor Testing, Packaging, and Reliability.

CO5: Explore Advanced Semiconductor Technologies and Emerging Trends.

CO-PO mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	3	-	-	3	3	3
CO2	3	3	3	3	3	-	2	-	-	3	-	3	3	1	3
CO3	3	1	3	1	-	-	-	-	-	2	-	-	3	1	-
CO4	3	1	-	3	3	-	-	-	3	-	-	-		2	3

Module 01: Environment and Crystal Growth for VLSI Technology [6]

Environment: Semiconductor technology trend, Clean rooms, Wafer cleaning, Semiconductor Substrate: Phase diagram and solid solubility, Crystal structure, Crystal defects, Czochralski growth, Bridgman growth of GaAs, Float Zone growth, Wafer Preparation and specifications, Mono crystalline vs. Polycrystalline Silicon, Defect Engineering in Crystal Growth, Impact of 2D Materials (Graphene, MoS_2) on IC Technology

Module 02: Fabrication Processes Part 1 [10]

Epitaxy: Molecular Beam Epitaxy, Vapor Phase Epitaxy, Liquid Phase Epitaxy, Evaluation of epitaxial layers, **Silicon Oxidation:** Thermal oxidation process, Kinetics of growth, Properties of Silicon Dioxide, Oxide Quality, high κ and low κ dielectrics, **Deposition:** Evaporation, Sputtering and Chemical Vapor Deposition, **Lithography:** Photo reactive materials, Pattern generation and mask making, pattern transfer, Electron beam, Ion beam and X-ray lithography, **Etching:** Wet chemical etching, dry physical etching, Atomic Layer Deposition (ALD), Extreme Ultraviolet (EUV) Lithography, Nano imprint Lithography, Plasma-Assisted Etching Techniques

Module 03: Fabrication Processes Part 2 [7]

Diffusion: Nature of diffusion, Diffusion in a concentration gradient, diffusion equation, impurity behavior, diffusion systems, problems in diffusion, evaluation of diffused layers, **Ion Implantation:** Penetration range, ion implantation systems, process considerations, **Device Isolation, Contacts and Metallization:** Junction and oxide isolation, LOCOS, trench isolation, Selective Doping Techniques, High-K Metal Gate Technology, Advanced Copper and Graphene-Based Interconnects

Module 04: Measurements, Packaging, and Testing [6]

Semiconductor Measurements: Conductivity type, Resistivity, Hall Effect Measurements, Packaging: Wafer-Level Chip-Scale Packaging (WLCSP), System-in-Package (SiP), 3D IC Stacking, Machine Learning in IC Testing: Technology trends affecting testing, VLSI testing process and test equipment, test economics and product quality

Module 05: SOI, GaAs, and Bipolar Technologies [7]

SOI Technology: SOI fabrication using SIMOX, Bonded SOI and Smart Cut, PD SOI and FD SOI Device structure and their features, **GaAs Technologies:** MESFET Technology, Digital Technologies, Hetero junction Bipolar Transistors (HBT), Silicon-Germanium (SiGe) Technology, Carbon Nanotube FETs (CNTFETs), Neuro morphic Computing with Emerging Materials

TEXTBOOKS:

1. S.M.Sze(2nd Edition)"VLSI Technology", McGraw Hill Companies Inc.
2. C.Y. Chang and S.M.Sze (Ed), "ULSI Technology", McGraw Hill Companies Inc.
3. VLSI Design Techniques for Analog and Digital Circuits R. L. Geiger, P.E. Allen, and N. R. Strader
4. S.Franssila Introduction to Microfabrication Wiley 2010 (2nd ed.) ISBN 978-0-470-74983-8
5. Sunipa Roy, Chandan Kumar Ghosh, Sayan Dey, Abhijit Kumar Pal, Solid State & Microelectronics Technology, ISBN: 978-981-5079-88-3 (Print), Bentham science publishers, 1stedition. June 2023.

REFERENCES:

1. Stephena, Campbell, "The Science and Engineering of Microelectronic Fabrication", Second Edition, Oxford University Press.
2. James D.Plummer, Michael D.Deal, "Silicon VLSI Technology" Pearson Education
3. Richard C. Jaeger, Introduction to Microelectronic Fabrication, Prentice Hall, 2002. (2nd ed.) ISBN0-201-44494-1.
4. Gary S. May, Simon M. Sze, Fundamentals of Semiconductor Fabrication, Wiley, 2004.
5. Sunipa Roy, Chandan Kumar Sarkar, MEMS and Nanotechnology for Gas Sensors, CRC Press,USA, 1st edition. 2017, ISBN: 9781315214351

Module 1: Introduction to VLSI Testing

Importance of testing in VLSI design cycle, Basics of testing, test process and challenges
Defects, errors, and fault modeling, Fault models: Stuck-at faults, transition faults, bridging faults
Fault Equivalence & Fault Collapsing, Introduction to Test Metrics: Fault Coverage, Test Compaction

Module 2: Fault Simulation & Test Generation

Need for fault simulation, Serial, Parallel, Deductive, and Concurrent fault simulation
Combinational ATPG (Automatic Test Pattern Generation): D-algorithm, PODEM, FAN
Sequential ATPG: Time-frame expansion, 9-valued logic, ATPG optimization techniques

Module 3: Design for Testability (DFT) Techniques

DFT Basics: Testability measures, controllability, and observability, Scan-based Design: Scan Flip-Flops, Scan Chain, Scan Insertion, Boundary Scan (JTAG - IEEE 1149.1 standard), Partial scan and full scan methods, ATPG for scan-based designs

Module 4: Built-In Self-Test (BIST) & Memory Testing

Need for BIST, BIST architecture: Test Pattern Generator (TPG), Response Compaction
LFSR-based test pattern generation, Signature analysis using MISR (Multiple Input Signature Register), Memory Testing: Fault models (stuck-at, transition, coupling, neighborhood pattern sensitive faults), March Test algorithms

Module 5: Advanced Topics & Industrial Trends

System-on-Chip (SoC) Testing Challenges, Power-aware testing, Delay test techniques
Iddq Testing & Advanced DFT Techniques, Case studies on industry-standard test methodologies
Introduction to testing tools like Tetramax, FastScan, and Synopsys Test Solutions

Textbooks & Reference Books:

Textbooks:

1. **M.L. Bushnell & Vishwani D. Agrawal**, *Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits*, Springer.
2. **Michael L. Bushnell, Vishwani Agrawal**, *VLSI Testing and DFT Techniques*, Springer.
3. **Abramovici, Breuer, and Friedman**, *Digital Systems Testing and Testable Design*, IEEE Press.

Reference Books:

1. **Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen**, *VLSI Test Principles and Architectures: Design for Testability*, Morgan Kaufmann.
2. **P.K. Lala**, *Digital Circuit Testing and Testability*, Academic Press.
3. **Miron Abramovici**, *Computer-Aided Testing and Fault Simulation*, IEEE Press.

Course Name: Data AnalyticsCourse Code: CS(EC)701A Contacts: 3L
Total Contact Hours: 36Credit: 3

Prerequisite: Numerical Knowledge of probability theory, statistics, and programming is desirable.

Course Outcome:

Undergraduate students of ECE program will be able to:

CO1: Implement statistical analysis techniques for solving practical problems.

CO2: Perform statistical analysis on a variety of data.

CO3: Explore the fundamental concepts of big data analytics

CO4: Understand the various search methods and visualization

techniques.CO5: Learn to use various techniques for mining data stream

Module I: Introduction to Data Analytics: [2L]

Data Analytics Overview, Importance of Data Analytics, Types of Data Analytics, Descriptive Analytics, Diagnostic Analytics, Predictive Analytics, Prescriptive Analytics, Benefits of Data Analytics, Business Intelligence.

Module I: Data and Representation: [4L]

Introduction to Statistics, Sources and nature of data, classification of data (structured, semi-structured, unstructured), Collection of data, classification and tabulation of data, Data cleaning, Types of data: Primary data, Secondary data, Presentation of data Diagrammatic and Graphical Representation: Histogram, frequency curve, frequency polygon, Ogive curves, stem and leaf chart.

Module III: Statistical Methods: **[8L]**

Descriptive Statistics: Introduction, Probability Distributions.

Sampling theory and tests of significance: Methods of sampling (Description only): Simple randomsampling with and without replacement (SRSWR and SRWOR) stratified random sampling.

Inferential Statistics: Introduction, Inferential Statistics through hypothesis tests Permutation & Randomization Test. Regression & ANOVA (Analysis of Variance). Elements,Variables, and Data categorization.

Measures of Central Tendency and Dispersion (Basics)

Module IV: **[12L]**

Machine Learning: Introduction and Concepts Differentiating algorithmic and model-based frameworks Regression: Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification.

Supervised Learning with Regression and Classification techniques -1: Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression and Classification Trees, Support Vector Machines

SupervisedLearningwithRegressionandClassificationtechniques-2: Ensemble Methods, Random Forest, Classification using Decision Trees, Neural Networks Deep learning.

Unsupervised Learning and Challenges for Big Data Analytics: Clustering, Associative RuleMining, Challenges for big data analytics

Prescriptive analytics: Creating data for analytics through designed experiments, Creating data for analytics through Active learning, Creating data for analytics through Reinforcement learning.

Module V **[3L]**

Data Visualisation: Visual Analytics and Business Performance Management Business Reporting Definitions and Concepts. Data and Information Visualization. Different Types of Charts and Graphs.The Emergence of Data Visualization and Visual Analytics

Module VI **[7L]**

Data analysis using Python: Introduction to Python, Programming in Python, Python for Data Science, Data Visualization in Python, Exploratory Data Analysis. Modeling Process – Training model – Validating model

Case Study: Healthcare diagnostics and Treatment
personalization,Data Science Case Studies in Retail
Case Studies for Data Analytics in Social Media
Data Science Case Study Examples in Entertainment Industry

Text Book:

[1] Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Introducing Data Science, Manning Publications Co., 1st edition, 2016.

[2] Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to

StatisticalLearning: with Applications in R, Springer, 1st edition, 2013.

[3] Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and itsApplications, Wiley.

[4] D J Patil, Hilary Mason, Mike Loukides, Ethics and Data Science, O' Reilly, 1st edition, 2018.

[5] N.G. Das, Statistical Methods, 1st edition, McGraw Hill Education. ISBN: 978-0070083271

Reference Books:

[1] Dr Anil Maheshwari, Data Analytics Made Accessible, Publisher: Amazon.com Services LLC.

[2] Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly, 1st edition, 2015.

[3] Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from the Frontline, O' Reilly, 1stedition, 2013.

[4] Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2nd edition, 2014.

[5] Eric Siegel, Predictive Analytics The Power to Predict Who Will Click, Buy, Lie, or Die, 2 ndEd.,Wiley.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	P O5	P O6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	3	3	3	2	3
CO2	3	2	-	-	-	-	-	1	-	-	3	3	3	1	1
CO3	3	2	2	-	-	-	1	-	-	-	3	3	3	1	2
CO4	3	1	-	-	-	-	-	2	-	-	3	3	3	2	2
CO5	3	2	2	-	-	-	1	-	-	-	3	3	3	2	2

Course Name: Deep Learning

Course Code: CS(EC)701B

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite:

Solid background in Statistics, Calculus, Linear Algebra and Probability.

Good Exposure of Python packages like, Numpy, Pandas, Matplotlib, Scikit-learn, basic concepts ofimage processing.

Course Outcomes (COs):

On completion of the course Graduates of the ECE program will be able to:

CO1. Define and Apply the basic concepts of Neural Networks in Deep Learning **CO2.**

Analyse and implement the different Convolutional Neural Network architectures**CO3.**

Analyse and implement the different the Recurrent Neural Networks

CO4. Design and implement CNN and RNN and Deep generative model

CO5. Solve and evaluate real world applications using Natural language processing in Deep Learning

Course Objectives:

- To introduce basic Neural network concepts

To impart the knowledge about the methods and terminologies involved in CNN and RNN

- To impart knowledge on Sequence Models
- To introduce Generative Models and Unsupervised Learning
- To solve real world applications using Natural language processing through project based learning

Course Content:

Module 1: Introduction to Neural Networks [7]

Perceptrons, activation functions, Multilayer Perceptrons (MLPs), Feed forward neural networks: architecture, and training, Gradient Descent Optimization: Stochastic Gradient Descent (SGD), learning rates, Back propagation Algorithm: Chain rule, computing gradients,

Classical regularization: L1 and L2 regularization, regularization as a constrained optimization

Module 2: Convolutional Neural Networks (CNNs) [7]

Convolutional Layers: Convolution operation, filters, and feature

mapsPooling Layers: Max pooling, average pooling, down sampling

CNN Architectures: LeNet, AlexNet, VGG, ResNet, and their architectures

Module 3: Recurrent Neural Networks (RNNs) and Sequence Models [7]

Recurrent Neural Networks: Structure, back propagation through time (BPTT)

Long Short-Term Memory (LSTM) Networks: Architecture, handling sequential

dataApplications of RNNs:

Sequence-to-Sequence Models: Encoder-decoder architectures, attention mechanisms

Module 4: Generative Models and Unsupervised Learning [8]

Auto encoder Architecture: Variational auto encoders (VAEs), denoising auto

encodersRepresentation Learning: Dimensionality reduction, feature learning

Generative Adversarial Networks (GANs):

GAN Framework: Generator, discriminator, adversarial training

GAN Applications: Image generation, style transfer, and data augmentation

Module 5: Applications [7]

Overview of Natural Language Processing (NLP): Definition and applications, Role of deep learning in solving NLP tasks. Word Embedding: Word2Vec and GloVe algorithms, Applications of word embedding in NLP. Sequence-to-Sequence Models and Attention Mechanism: Introduction to encoder-decoder architectures, how attention mechanisms improve model performance. Transfer

Learning in NLP: Introduction to pre-trained language models (e.g., BERT, GPT), Fine-tuning and adapting pre-trained models for specific tasks. Ethical considerations and challenges in NLP.

CO-PO MAPPING

CO	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	3	3	-	-	-	-	-	-	-	1	3	2	3
CO2	2	2	2	2	1	-	-	-	-	-	-	-	3	2	2
CO3	3	2	2	2	2	1	-	-	-	-	-	1	3	1	3
CO4	3	3	2	1	2	1	-	-	-	-	-	3	3	2	-
CO5	2	2	-	-	2	2	1	1	-	2	2	3	3	2	2

Weightage Value: (3) = Strongly matched; (2) = Moderately matched; (1) = Weakly matched; (-) =Notmatched.

CO-BT-MODULE MAPPING

CO	BT	Module
CO1	BT1 , BT2	M1
CO2	BT3, BT4	M2
CO3	BT3, BT4	M3
CO4	BT3 , BT6	M2,3,4
CO5	BT3 , BT5	M5

Course Name: Cyber Security & CryptographyCourse Code: CS(EC)701 C
Contact: 3:0:0
Total Contact Hours:
36Credits: 3
Prerequisites :
1. Knowledge of Computer Networks and Operating Systems fundamentals
2. Understanding of Discrete Mathematics concepts

Course Outcome(s):
Graduates of the ECE program will be able to
CO1 Apply fundamental knowledge to solve various cryptographic

problemsCO2 Design various block cipher and stream cipher models
CO3 Implementation of the technology of public key cryptosystems, hash functions, and digitalSignatures in real-life applications.
CO4 Analyze varied network security tools and authentication applicationsCO5 Develop email security, IP security, and web security services.

Course Contents

Module -1 **[7L]**

Introduction - Services, Mechanisms, and attacks, OSI security architecture, Network security mode, Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography), Finite Fields and Number Theory: Groups, Rings, Fields, Modular arithmetic, Euclid's algorithm, Polynomial Arithmetic, Prime numbers,

Module-2 **[9L]**

Data Encryption Standard- Block cipher principles, block cipher modes of operation, Advanced Encryption Standard (AES), Triple DES, Blowfish, RC5 algorithm, public key cryptography: Principles of public key cryptosystems, The RSA algorithm, Key management -Diffie-Hellman Key exchange,

Module-3 **[5L + 7L]**

Authentication requirement, Authentication function, MAC, Hash function, Security of hash function and MAC, Digital signature and authentication protocols, DSS

Authentication applications, Kerberos, X.509, Internet Firewalls for Trusted System: Roles of Firewalls, Firewall related terminology- Types of Firewalls, Firewall designs principles, SET for E-Commerce Transactions, Intruder, Intrusion detection system, Virus and related threats, Countermeasures, Trusted systems.

Module-4 **[8L]**

E-mail Security: Security Services for E-mail-attacks possible through E-mail, Establishing key privacy, authentication of the source, IP Security: Overview of IPSec, IPv4 Authentication Header, Encapsulation Security Payload (ESP), Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding), Web Security: SSL/TLS Basic Protocol, computing the keys, client authentication, PKI as deployed by SSL Attacks fixed inv3, Exportability, Encoding, Secure Electronic Transaction, Different types of cyber attack – chosen plaintext, known plaintext andchosen ciphertext

Textbooks

[1] Kahate, A.(2013).Cryptographyandnetworksecurity.TataMcGraw-HillEducation.
[2] Forouzan, B.A., & Mukhopadhyay, D.(2015). Cryptography and network security. NewYork,NY: McGraw-Hill Education (India) Private Limited.

Reference Books

[1] Stallings, W. (2006).Cryptography and network security, 4/E. Pearson Education India.
[2] Daras, N.J.,& Rassias, M.T.(Eds.). (2015). Computation, cryptography, and networksecurity (pp.253-287).Springer.
[3] Kumar, A., & Bose, S. (2017). Cryptography and network security. Pearson EducationIndia.

CO-Po Mapping:

	PO1	PO2	PO3	PO4	P05	PO6	PO7	PO8	P[O9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	1	3	2	-
CO2	2	3	3	3	3	-	-	-	-	-	1	-	3	3	-
CO3	1	2	3	3	3	2	-	1	2	-	-	2	2	3	1
CO4	2	3	3	-	3	-	-	-	-	-	-	1	3	1	2
CO5	2	3	3	2	3	3	-	-	-	-	2	2	-	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1= Weakly matched,(-) =Not matched

Paper Name: Satellite Communication

LaboratoryPaper Code: EC791

Contacts:

3LCredit:

1.5

Course Objectives:

1. To Describe the electronic hardware systems associated with the satellite subsystem and earth station.
2. To Describe the various applications of satellite with the focus on national satellite system.
3. To Compute the satellite link parameters under various propagation conditions with the illustration of multiple access techniques.

Course Outcomes:

On completion of the course students will be:

CO1: Able to learn the orbital aspects of the satellite and the design of satellite

links.CO: Able to understand the Satellite transponder and Earth Station Design.

CO3: Able to understand Multiple Access Techniques used in satellite

communication.CO4:Able to realize the various Propagation impairments on satellite

communication. CO5:Able to comprehend satellite Navigation and the GPS, GIS and

remote sensing.

List of Experiments:

1. To study satellite trainer kit.

2. To set up an active satellite link and demonstrate link fail operation.

3. To communicate voice signal through satellite link.

4. To establish analog /digital communication link and transmit and receive three signals (audio, video,tone) simultaneously using satellite communication trainer.

5. To transmit and receive PC data through satellite link.

6. To find the link C/N ratio.

7. Evaluation of SNR/BER in satellite links.

8. To observe effect of fading margin of received signal in satellite link

9. To study the analysis of link power budget equation.

10.To study any software simulation tool for satellite navigation and remote sensing.

Text Books:

1) Timothy Pratt, Charles Bostian, Teremy Allnutt, Satellite Communication, John Wiley & Sons.

2) Satellite Communication", D. C. Agrawal, Khanna Publishers

3) "Satellite Communication", Dennis Roddy , 4th Edition, McGraw- Hill International edition, 2006

4) Monojit Mitra : Satellite communications , Prentice Hall of

IndiaReference Books:

1) "Satellite Communication", T. T. Hai., Mc.Graw Hill Publications

2) Satellite Communication Systems Engineering, W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson,2nd Ed., Pearson Education, 2007.

3) Satellite Communication, Mark R Chartrand, Cenage Learning

4) J. J. Spilker, Jr., Digital Communication by Satellite, Prentice Hall.

5) Bruce R. Elbert, Satellite Communication Applications Hand Book, Artech House.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	-	-	-	-	-	-	-	2	3	2	-
CO2	2	2	3	2	1	-	-	-	-	-	-	2	3	2	2
CO3	3	2	2	3	2	-	-	-	-	-	-	2	3	1	-
CO4	1	3	2	2	1	-	-	-	-	-	-	2	3	2	-
CO5	3	2	2	2	2	-	-	-	-	-	-	2	3	2	2

Weightage Values: 3=Strongly matched, 2=Moderately matched,1=Weakly matched, (-)=Notmatched.

R23 (All B. Tech.)

Curriculum & Syllabus for B.Tech under JIS Autonomy

Electronics and Communication Engineering

4th Year 8th Semester

Sl. No.	Broad Category	Category	Paper Code	Subject	Contact Hours/Week				Credit Points
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	EC801 A	Ad-Hoc and Wireless Sensor Networks	3	0	0	3	3
			EC801B	Introduction to EDA					
			EC801C	Speech and Audio Signal Processing					
2	ENGG	Major	EC802A	Adaptive Signal Processing	3	0	0	3	3
			EC802B	Electronic System Design					
			EC802C	Industrial Automation & Robotics					
3	ENGG	Minor	CS(EC)801A	Data Mining and Data Warehouse	3	0	0	3	3
			BM(EC)801B	Biomedical Electronics					
			CS(EC)801C	Block Chain					
4	HUM	Ability Enhancement Course	HU(EC)801	Principles of Management	2	0	0	2	2
B.PRACTICAL									
1	ENGG	Internship	EC881	Grand Viva	0	0	0	0	1
2	PRJ	Project	EC882	Project-II	0	0	0	12	6
Total of Theory, Practical								23	18

Subject name: Ad-Hoc and Wireless Sensor Networks
Subject code: EC 801A
Credit: 3
Total Contact Hours: 36
Prerequisites: Basic knowledge of Data Communication Networks

Course Objectives:

. To learn about the issues and challenges in the design of wireless ad hoc networks.
• To understand the working of MAC and Routing Protocols for ad hoc and sensor networks
• To learn about the Transport Layer protocols and their QoS for ad hoc and sensor networks.
• Design wireless sensor network system for different applications under consideration.

Course Outcome:

Sem. No.	Course Title (Code)	CO Codes	Course Outcomes
			On completion of the course students will be able to
8th	Ad-Hoc and Wireless Sensor Networks EC 801A	CO.EC801A.1	Recall fundamental concepts and terminology related to Ad Hoc and Wireless Sensor Network and its challenges
		CO.EC801A.2	Explain the principles of wireless communication and sensor networks and its architecture
		CO.EC801A.3	Design simple ad hoc network topologies and sensor deployments
		CO.EC801A.4	Evaluate the performance of various routing protocols in dynamic ad hoc environments
		CO.EC801A.5	Critically evaluate the strengths and weakness of existing protocols

CO-PO mapping:

Sem. No.	Course Title (Code)	CO Codes	Program Outcomes (POs)														
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
8th	Ad-Hoc and Wireless Sensor Networks EC 801A	CO.EC801A.1	3	3	3	1	1	1	1		2			2	3	3	1
		CO.EC801A.2	3	3	3	3	3	1	2			1	1	2	3	3	2
		CO.EC801A.3	3	3	3	3	3	2	1		2			2	3	1	1
		CO.EC801A.4	3	3	3	3	1	1	2			2	1	2	3	2	-
		CO.EC801A.5	3	3	3	3	3	2	1					2	3	2	2

Module I **8**

MAC and ROUTING IN AD HOC NETWORKS: AD HOC Wireless Networks: Introduction,Issues in Ad Hoc Wireless Networks, AD Hoc Wireless Internet. MAC Protocols for Ad Hoc

Wireless Networks, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention -Based Protocols, Contention -Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

Module II **7**

Transport & QoS in Ad Hoc Networks: TCP challenges and Design Issues in Ad Hoc Networks – Transport protocols for ad hoc networks – Issues and Challenges in providing QoS – MAC Layer QoS solutions – Network Layer QoS solutions – QoS Model

Module III **7**

Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Applications, Challenges, Sensor network architecture, MAC Protocols for wireless sensor networks, Low duty cycle protocols and wakeup concepts, Contention, Based protocols, Schedule-Based protocols.

Module IV **7**

Transport & QoS In Wireless Sensor Network: Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control in network processing

Operating systems for wireless sensor networks – Examples

Module V

Security In Ad Hoc And Sensor Networks: Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Anti-tamper techniques – Water marking techniques – Defense against routing attacks - Secure Ad hoc routing protocols.

References:

1. C.Siva Ram Murthy and B.S.Manoj, ―Ad Hoc Wireless Networks – Architectures and 2 Protocols‖, Pearson Education, 2006.

2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006

3. Holger Karl, Andreas Willing, ―Protocols and Architectures for Wireless Sensor Networks‖, John Wiley & Sons, Inc., 2005

4. Waltenegus Dargie, Christian Poellabauer, ―Fundamentals of Wireless Sensor Networks Theory and Practice‖, John Wiley and Sons, 2010

□

Course Name: Introduction to EDA Tools

Course Code: EC801B

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisites: Basic Concepts of Digital and Analog Electronics

Course Outcomes:

CO1: Relate integrated design circuit with EDA flow and understand the need for EDA (BL 1,2)

CO2: Apply VLSI Circuits in physical design phase with the help of partitioning, flooring, placement and routing **(BL 3)**

CO3: Estimate and analyze the delay of IC in design phase with the help of logical effort,electrical effort, elmore delay and Timing Analysis.(BL4)

CO4: Predict fault in digital IC with the help of different fault model and D-algorithm and develop test pattern with the help of ATPG algorithm for BIST.(BL5)

CO5: Create design of system with the help of Verilog HDL for the application in combinational and sequential domain.(BL6)

Course Content:

Module I: Introduction to EDA

[5L]

The need for EDA, Hardware description languages, The design process

Semi-custom design tools, Design entry, Design verification, Design layout, Full custom design tools, Design entry, Design layout, Design verification, Low and high level tools

Module II: Introduction to Synthesis [6L]

Introduction –High level synthesis – Control and Data flow graph, scheduling, allocation & binding, Logic synthesis -gate level optimization , technology mapping ,BDD,ROBDD

Module III: Physical Design Automation

[8L]

Partitioning -level of partioning, partitioning algorithm ; Floorplanning – input ,output & objectives with example, cost estimation of floorplan, dead space, slicing & non-slicing floorplan, hierarchical floorplan, polar graph, Floorplanning algorithm, pin assignment; Placement – objectives , placementproblem at different levels (system , board & chip),estimation of wirelength (multi terminal)

Module IV: Timing Analysis

[5L]

A brief history of SPICE, Types of analysis using SPICE 1.12.1 DC analysis1.12.2 AC analysis1.12.3 Transient analysis, Obtaining results1,DC convergence problems, Transient analysisproblems Slew balancing , transistor equivalency , design of basic gates for equal rise and fall time ,intrinsic delay, parasitic delay, logical effort, electrical effort, D algorithm

ModuleV: Testing of VLSI Circuit

[6L]

The Need for Testing, Role of the Fault Simulator, Fault Simulator Operation: FaultSimulation-Serial, Parallel, Deductive & Concurrent Fault Simulation

Fault Simulation in the Design Process , Basic Testing Concepts

The SA0 and SA1 Fault Model , Controllability and Observability

Test pattern Generation- BoundaryScan, Built-In-Self-Test(BIST),AutomaticTestPatternGeneration(ATPG),Design for Testability (DFT).

ModuleVI: Design using Verilog **[6L]**

Operators, datatypes, numbers, logic, Modeling using Verilog, statements (assignment,wait,control), testbench, FSM, design example –combinational and sequential.

Textbooks:

1. Algorithmfor VLSI Physical Design Automation, NaveedA.Sherwani
2. **Electronic Design Automation: Synthesis, Verification, and Test (**by Laung-Terng Wang (Editor), Yao-Wen Chang (Editor), Kwang-Ting (Tim) Cheng (Editor)
3. CMOS: Circuit Design, Layout, and Simulation, J. Baker,Harry W. Li,David E. Boyce , Wiley–Blackwell
4. VLSI Design and EDATools, AngsumanSarkar, SwapnadipDe, C.K.Sarkar, Scitech
5. VLSI Design, Debaprasad Das, Oxford
6. Verilog HDL: A Guide to Digital Design and Synthesis Second Edition by Samir Palnitkar

ReferenceBooks:

1. G.DeMicheli. Synthesis and optimization of digital circuits,
2. Digital Integrated Circuit, J.M.Rabaey, Chandrakasan, Nicolic, PearsonEducation

CO-PO-PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3										3	3	3	1
CO2	3											3	3	3	2
CO3			3		3							3	3	1	1
CO4				3	3							3	3	2	-
CO5			3		3		3	3	3		3	2	3	2	2

WeightageValues:3=Stronglymatched,2=Moderatelymatched,1=Weaklymatched, (-)=Notmatched

Subject Name: Biomedical Electronics
Subject Code: BM(EC)801B
Credit: 3

Total Contact Hours: 36

Prerequisite:

Concepts in Analog Electronics (Studied in Basic Electronics Engineering). Fundamental Concepts of mathematics. Concepts in Digital Signal Processing.

Course Outcomes:

Graduates of the ECE program will be able to

CO1: Correlate Bioelectric signals, human physiologically stem, and different types transducers

CO2: Determine Different Types of Medical Measurement Systems.

CO3: Illustrate various types of biomedical signal acquisition electrodes, different types of signal amplification techniques and able to design the amplifiers.

CO4: Examine the data handling, filtering techniques of biomedical signals and able to analyze timeand frequency domain.

CO5: Implement medical imaging techniques and their different algorithms to feature extract the signals.

Course Content:

ModuleI: Introduction of Medical Electronics: [6L]

Origin of Bioelectric signals, Electrocardiogram (ECG), Electromyogram (EMG), Recording Electrodes- Silver Silver Electrodes, Electrodes for ECG, EEG and EMG, Physiological Transducers- Pressure Transducers, Temperature sensors, Pulse sensors; Sources of bioelectric potential, resting potential, action potential, propagation of action potentials in nerves, Artificial heart (Basic Idea)

ModuleII:Medical Measurement systems:[8L]

Specifications of Instruments, static dynamic characteristics, classification errors, statistical analysis. Introduction to reliability, accuracy, fidelity, speed of response, Impedance, and current distribution, bipolar and tetrapolar circuits, skin impedance, galvanic skin response measurement, total body impedance, cardiac output, neural activity, respiratory activity, impedance plethysmography-resistance and capacitance type. Brain-computer interface, Neural Implants, Retinal Implants

ModuleIII:Bio-amplifier and Bio-potential electrodes: [8L]

Need for bio-amplifier-single ended bio-amplifier, differential bio-amplifier–right leg driven ECG amplifier. Band passes filtering, isolation amplifiers –transformer and optical isolation –isolated DC amplifier and AC carrier amplifier. Types of electrodes -surface, needle and micro electrodes and their equivalent circuits. Recording problems-measurement with two electrodes. Patchclamp amplifier –the electronics o flow noise current detection.

ModuleIV: Medical Signal Processing: [8L]

Biomedical signal origin & dynamics (ECG), Biomedical signal origin & dynamics (EEG, EM Getc.), Filtering for Removal of artefacts Illustrations of problem with case studies Morphological Analysis of

ECG Correlation Coefficient the Minimum phase correspondent and Signal Length. EMG Signal and its Processing: EMG Signal Filtering & Noise Removal, Detection of Flexion and extension.

Module V: Medical Imaging Techniques: [6L]

CTscan, Ultrasound, NMR and PET, Implementation of algorithms covered in the course to characterize these signals. Radiological Effects and safety limits for each imaging modality. Computer Aided Diagnosis (CAD) and advanced diagnostic image processing. Utility of PACS and DICOM inthe field of Medical Imaging Techniques.

Reference Books:

1. Wavelets and Time frequency methods for Biomedical Signal Processing-M. Akay, IEEE Press,
2. Digital Processing of speech signals-L. Rabinar, Pearson Education
3. Biomedical Instrumentation and Measurements- Cromwell, Weibell and Pfeiffer, PHI

CO-PO-PSO MAPPING

CO	P O1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	2	3	2	-	2	1	1	1	1	1	1	2	3	2	2
CO2	3	2	2	-	-	-	-	-	2	2	-	1	3	3	2
CO3	3	2	1	2	1	1	2	-	2	1	2	-	3	2	2
CO4	3	1	-	-	1	2	-	2	1	2	-	1	3	2	2
CO5	1	1	3	2	1	1	-	-	2	1	-	2	2	2	2

Course Name: Data Mining and Data Warehousing
Course Code: CS(EC)801A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Pre-requisites: Data Structure, Design and Analysis of Algorithms, Database Management Systems, Statistics, Artificial Intelligence

Course Objective: After completion of the course students will be able to providea comprehensive and well-rounded education in data mining and warehousing, covering theoretical foundations, ethical considerations, technical skills, communication, project management, financial aspects, and practical applications.

Course Outcome(s):

CO1: Understand and explain the essential concepts of Data Mining and Data Warehousing technologies, recognizing their practical relevance in the current tech landscape, fostering exploration for lifelong learning.

CO2: Identify and formulate an engineering problem within the scope of Data Mining and Data Warehousing paradigm.

CO3: Explore relevant literature and apply the concepts of Data Mining and Data Warehousing to solve problems of making automated decisions dealing with huge amounts of data.

CO4: Develop ideas for proposing solutions to the challenging problems of Data Mining and Data Warehousing.

CO5: Develop comprehensive competencies in data mining and warehousing, encompassing ethical analysis, individual and team-based data analysis proficiency, effective communication of data insights, project management skills, and the integration of financial considerations for successful planning and execution of data projects.

CO6: Implement ideas of Data Mining and Data Warehousing through developing feasible algorithms or frameworks and investigate their effectiveness by analyzing the performances in solving the relevant problems.

Course Content:

Module-1: Introduction to Data Mining [5L]

Basic Concepts 1L

Data Exploration: Data Types, Data Attributes, Statistical Description of Data, DataVisualization, Data Similarity Measure 2L

Data Preprocessing: Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization 2L

Module-2: Introduction to Data Warehousing [6L]

Basic Concepts 1L

Data Warehouse Modeling: Data Cube and OLAP (On Line Analytical Processing) 2L

Data Warehouse Design, Usage, Implementation 2L

Data Generalization by Attribute-Oriented Induction 1L

Module-3: Mining FrequentPatterns, Associations and Correlation Analysis [5L]

Basic Concepts, Frequent Item set Mining Methods: The Apriori Algorithm, Mining Frequent Item Sets without Candidate Generation, Mining Frequent Item Sets Using Vertical Data Format, Correlation Analysis 4L

Pattern Mining in Multilevel and Multidimensional Space 1L

Module-4: Classification and Regression [6L]

Basic Concepts, k-Nearest-Neighbor Classifier, Decision Tree Classifier, Naïve Bayes Classifier 3L

ANN-Back propagation Based Classifier, Support Vector Machine Based Classifier, Linear and Nonlinear Regression Methods 3L

Module-5: Clustering and Outlier Analysis [5L]

Basic Concepts, Partitioning Methods: k-Means and k-Medoids, Hierarchical Methods: Agglomerative and Divisive Hierarchical Clustering, Density-Based Methods: DBSCAN: Density-Based Clustering Based on Connected Regions with High Density, Frequent Pattern– Based Clustering Method 4L

Outlier Analysis 1L

Module-6: Mining Data Stream, Time-Series, and Sequence Data [3L]

Basic Concepts of Data Stream Mining 1L Mining Time Series Data 1L

Mining Sequence Patterns in Biological Data 1L

Module-7: Introduction to Graph Mining, Social Network Analysis, Multi-relational Data Mining, Text Mining and World Wide Web (WWW) Mining 6L

Graph Mining: Methods for Mining Frequent Subgraphs (Apriori-based Approach& Pattern Growth Approach) 2L

Basic Concepts of Social Network Analysis and Multi-relational Data Mining 2L

Basic Concepts of Text Mining 1L

Basic Concepts of World Wide Web (WWW) Mining 1L

Textbook:

1. Han J & Kamber M, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Third Edition.
2. Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques", Cambridge University Press.

Reference Books:

1. Pang-Ning Tan, Vipin Kumar, Michael Steinbach, "Introduction to Data Mining", Pearson Education
2. Robert Layton, "Learning Data Mining with Python",Packet Publishing

CO–PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	3	3	2	2
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	3	2
CO3	2	2	3	2	-	-	-	-	-	-	-	-	3	2	2
CO4	2	2	2	3	-	-	-	-	-	-	-	2	3	2	2
CO5	2	2	2	-	-	2	-	3	3	2	3	2	2	3	2
CO6	2	2	3	3	2	2	2	-	-	-	-	2	2	2	3

Subject: Block chain
Code: CS(EC)801C
Credit: 3
Contact: 36

Prerequisite:
The students must have concept of Distributed Systems, Computer Networks, Cryptography, Python Programming Language.

Course Objective:
The objective of the course is to learn and understand Blockchain technology in detail and identifies the application potentials of this technology.

Course Outcome:
After completion of this course students will be able to
CO-1: Understand the basic concepts of blockchain and it's architectures.
CO-2: Analyze different issues in the domain of blockchain and understand the practical applications of blockchain.
CO-3: Evaluate and analyze different solutions for the real life problems related to the blockchain.
CO-4: Design different solution applying and analyzing concept of Block chain.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	--	--	--	--	--	--	--	--	3	2	2
CO2	2	--	3	2	--	--	--	--	--	--	--	--	3	3	2
CO3	3	3	2	3	--	--	--	--	--	--	--	--	3	2	2
CO4	3	--	3	--	--	--	--	--	--	--	3	3	3	2	2

Course Contents:
MODULE I: Centralized - Distributed Systems: [6L]
Client-Server Model, Distributed System, P2P Network Model, Distributed Database, Two General Problem in distributed database, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete.

MODULE II: Security, Trust and Privacy: [6L]
Confidentiality; Integrity; Availability; Authentication; Authorization; Access Control; Accounting; Non-Repudiation, Symmetric Key and Asymmetric Key Cryptography, Hash function, Merkle tree hash, Digital Signatures – RSA, Schnorr, and ECDSA, Memory Hard Algorithm, Zero Knowledge Proof, User privacy.

MODULE III: Fundamentals of Blockchain:[6L]
Introduction, Benefits over traditional distributed database, Blockchain Network, Data structure of block, Block construction and addition, Block mining mechanisms, Merkle Pa-tricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain policy, Real-time application of Blockchain, Soft & Hard Fork, Private, Public, and Consortium blockchain.

MODULE IV: Consensus algorithms in Blockchain:[9L]

Distributed Consensus, Nakamoto consensus, Proof of Work (PoW), Proof of Stake (PoS), Proof of Burn (PoB), Delegated Proof of Stake (DPoS), Byzantine Fault Tolerance (BFT), Practical Byzantine Fault Tolerance (PBFT), Ripple Protocol Consensus Algorithm (RPCA), Difficulty Level, Sybil Attack, Energy utilization and alternate.

MODULE V: Cryptocurrency and Blockchain Applications: [9L]
History, Distributed Ledger Technology (DLT),Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contracts and Distributed Applications (Apps), GHOST, Vulnerability, Attacks, Sidechain, Namecoin, Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy, Application of Blockchain in Finance and Banking, Energy trading, Internet of Things (IoV, IoD, IIoT, Smart city, Smart Home, and so on), Medical Record Management System, Real estate business, Entertainment, Future scope of Blockchain.

Textbooks:
1. Roger Wattenhofer, Distributed Ledger Technology: The Science of the Blockchain, SecondEdition, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Gold feder,Bitcoin and Cryp-tocurrencyTechnologies: A Comprehensive Introduction, Princeton University Press, 2016.
3. Andreas M. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, O'Reilly Publication House, 2014.

Reference books:
1. Melanie Swan Blockchain: Blueprint for a new Economy, O'Reilly Publication House, 2015.
2. Andreas M. Antonopoulos and Dr. Gavin Wood, Mastering Ethereum Building Smart Contracts and DApps, O'Reilly Publication House, First Edition, 2018.

Paper Name: Adaptive Signal Processing

Paper Code: EC802A

Total Contact Hours: 34

Credit: 3

Prerequisite: Digital Signal Processing

Course Objectives: The aim of the Adaptive Signal Processing course is to present its algorithms and architectures and explain their use in real world applications. As prerequisites it is assumed that students have studied discrete and continuous signals and systems, and introductory linear algebra.

Course Outcomes:

On completion of the course students will be:

CO1 Able to learn the concept of adaptive signal processing and its applications

CO2 Able to understand the idea of Weiner filter

CO3 Able to understand LMS and RLS algorithm CO4

Able to realize Lattice Filters and its realization

CO5 Able to comprehend Kalman Filtering and its applications

Course Content:

Module 1Adaptive Filter and Applications(8L)

Adaptive systems - Definition and characteristics – Properties, Correlation Matrix, Applications and examples of an adaptive system- Adaptive Modeling and System Identification, Inverse Adaptive Modelling, Adaptive Interference Cancelling, Telecommunications Adaptive Equalization, Adaptive Arrays and Adaptive Beam-Forming.

Module 2Wiener Filter (6L)

Wiener filters - Linear optimum filtering - Minimum mean-square error - Wiener- Hopf equations - Multiple linear regression model - Steepest-descent algorithm - Linear prediction - Forward linear prediction, Levinson-Durbin algorithm.

Module 3LMS and RLS algorithm (8L)

Least-Mean-Square (LMS) adaptive filters - LMS algorithm, LMS adaptation algorithm, method of steepest descent and its convergence criteria, LMS versions: normalized LMS, leaky, sign, variable step size, transform domain LMS algorithm using DFT and DCT. Block LMS (BLMS) algorithm: frequency domain BLMS (FBLMS),Method of Least Squares - Normal equations and linear least square filters, Recursive least squares (RLS) algorithm.

Module 4 Lattice Filters (6L)

Machine Learning-Based Lattice Filters – Incorporating deep learning and reinforcement learning techniques to enhance adaptability in non-stationary environments. Real-Time Adaptive Lattice Filters – Optimizing algorithms for ultra-fast processing in applications like telecommunications and radar systems. Energy-Efficient Implementations – Using FPGA/ASIC-based architectures for power-efficient lattice filter designs. Hybrid Lattice Structures – Combining LMS, RLS, and nonlinear filtering for superior performance. Biomedical & IoT Applications – Enhancing noise suppression and predictive filtering in medical devices and sensor networks

Textbooks:

1. Simon Haykin, “Adaptive Filter Theory”, Pearson Education, Fifth Edition, 2013.
2. Bernard Widrow and Samuel. D. Stearns, “Adaptive Signal Processing”, Pearson Education, 2001

Reference Books:

1. Farhang-BoroujenyB.,”Adaptive Filters Theory and Applications”, John Wiley & Sons, 1st Ed.,1998.
2. John. R. Triechler, C. Richard Johnson (Jr), Michael. G. Larimore, “Theory and Design of Adaptive Filters”, Prentice Hall India Private Limited, 2004
3. Ali H. Sayed,”Fundamentals of Adaptive Filtering”, Wiley, 1st Ed., 2003.
4. Todd K. Moon, Wynn C. Stirling, “Mathematical Methods and Algorithms for Signal Processing” Prentice Hall, First edition, 1999.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	-	-	-	-	-	-	-	2	3	2	2
CO2	2	3	1	2	1	-	-	-	-	-	-	2	3	3	2
CO3	3	2	2	3	2	-	-	-	-	-	-	2	3	2	2

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

Weightage Values: 3=Strongly matched, 2=Moderately matched,1=Weakly matched,(-)=Not matched.

Regulation 2023 (R-23)

Course Name: Electronic System Design

Course Code: EC 802B

Contacts: L:T:P = 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite: Knowledge of Analog Electronic Circuit, Digital Electronic Circuit, Microprocessor & Microcontroller.

Course objectives:

Graduates will have to gather the conceptual and practical understanding of Electronic Systems and their design perspective.

Course Outcome:

CO-1: Distinguish Analog Electronic Systems.
CO-2: Illustrate Digital Electronic Systems.
CO-3: Design PCB for various Electronic Circuits.
CO-4: Determine fault and test Electronic Systems.
CO-5: Apply the principles and guidelines of physical architecture design as individual and also in team to solve complex electronic systems from Printed Circuit Boards (PCBs) levels to higher levels considering societal and sustainable environmental values.

Course Content:

1. **Introduction: [5L]**

   Different Stages in product design- Market Survey, Product Specifications, R&D and Prototypes, Batch processing, Environmental testing, Manufacturing. Electronic Products Classification: Consumer, Industrial and Military, Comparative study in terms of reliability. Bathtub curve, Measures taken (at Component and Product level) to improve reliability. Various soldering techniques including Surface Mount Technology.

2. **Analog & Digital Design: [10L]**

   Analog signal conditioning: Op-Amps for signal conditioning and applications, Instrumentation Amplifier design using discrete components and special purpose IC. Amplification of Low-level

signals, Grounding, Shielding and Guarding techniques. Design of Data Acquisition Systems- Interpretation of A/D and D/A specifications from design viewpoint, Dual slope, Quad slope and high-speed A/D converters, Microprocessors Compatible A/D converters, Sample and Hold Circuit, considerations in selecting references for data converter. Interfacing of LED, LCD, Keyboard, Relays, Counters, Frequency meter (Electromagnetic and Solid State) with Microcontrollers. Microcontroller specifications and performance determining factors, Comparative study of different Microcontroller architectures, Comparison of buses and protocols used in electronic products- I2C, SPI, CAN, LIN, Flex ray.

3. Software Design and Testing: [11L]

Different approaches for development of application software for Electronic Product. Assemblers, Assembly language and High-level language, debugging tools and techniques for software, Features of Simulators, ICE, IDE. PCB Design: PCB Design practices for Analog and Mixed signal circuits: Ground Loops, Precision circuits, shielding and guarding. PCB Design Practices for High-speed digital circuits, Signal integrity and EMI/EMC for PCB design

4. Fault Finding and Testing: [10L]

Analyses-DC/Operating Point Analysis, AC (Frequency Response), Transient, Sensitivity, Monte Carlo. Debugging /Faultfinding-Features and limitations of Analog CRO, DSO, Spectrum analyzer, Logic Analyzer and Mixed Signal Oscilloscopes in finding hardware/software faults. Fault Simulator and Automatic Test Pattern Generation Tools for IC (Stuck at fault). Environmental Testing: Need for Environmental Testing, Temperature, Humidity Tests, EMI/EMC testing standards and compliance. Introduction to Design Thinking for Electronic System Design, Empathize & Define – Understanding User Needs in ESD, Ideate & Prototype – Conceptualizing & Building Electronic Systems, Testing & Iteration – Refining the Electronic System.

Textbooks:

1. Bernhard E. Bürdek,"History, Theory and Practice of Product Design", Springer Science, 2005
2. Paul Horowitz, "Art of Electronics", Cambridge University Press
3. Howard Johnson, Martin Graham, "High-speed Digital design- A Handbook of Black Magic", Prentice Hall Publication
4. G. Pahl and W. Beitz J. Feldhusen and K.-H. Grote, "Engineering Design- A Systematic Approach", Springer,2007
5. Tim Williams, "EMC for Product Designers", Elsevier, Fourth edition 2007

References:

1. Jerry C Whitaker, "The Electronics Handbook", CRC Press, IEEE Press, ISBN 0- 8493-8345-5
2. David Bailey, "Practical Radio Engineering and Telemetry for Industry", Elsevier, ISBN 0750658037
3. Pressman, "Software Engineering - A Practitioner's Approach"
4. Domine Leenaerts, Johan van der Tang, Cicero S. Vaucher, "Circuit Design for RF Transceivers", Kluwer Academic Publishers, 2003.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1					1	2	2	3	2	2
CO2	3	3	2	2	1					1	2	2	3	3	2
CO3	3	3	2	2	1					1	2	2	3	2	2
CO4	3	3	2	2	1					1	2	2	3	2	2
CO5	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

Course Name: Industrial Automation & Robotics
Course Code: EC802C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Electrical Networks & Control System
Linear algebra and probability theory. Basic understanding of control systems and computing.

Course Outcomes:
The Graduates of the ECE program will be able to:
CO1: Identify different components of an automation system.
CO2: Interface the given I/O device with appropriate PLC
CO3: Prepare a PLC ladder program for the given application.
CO4: Gain knowledge of Elements of robots.
CO5: Calculate the forward kinematics and inverse kinematics of serial and parallel robots.
CO6: Able to do the motion planning & control for a robotic system.

Course Content:

Module 1: [5L]
Introduction:
Architecture of Industrial Automation Systems, Measurement Systems Characteristics, Data Acquisition Systems, Types of Sensors and Transducers.

Module 2: [7L]
Introduction to Programmable Logic Controllers: advantages& disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC.PLC programming methodologies: ladder diagram, PLC functions: bit logic instructions, ladder diagram examples, interlocking, latching, inter dependency and logical functions, PLC Timer & Counter functions on-delay timer, off- delay timers, retentive on-delay timers, pulse timers, timer examples, up-counter, down-counter and up-down counter, counter examples, register basics.

Module 3: [4L]
PLC Data Handling: data move instructions, table and register moves, PLC FIFO & LIFO functions. PLC arithmetic and logical functions: addition, subtraction, multiplication, division instructions, increment decrement, trigonometric and log functions, AND, OR XOR, NOT functions, PLC compare and convert functions.
PLC program control and interrupts: jumps, subroutine, sequence control relay, watchdog. PID Control of Continuous process.

Module 4: Supervisory Control And Data Acquisition (SCADA) [4L]
Introduction to SCADA, SCADA System Architecture, SCADA Hardware Components, SCADA Communication Protocols, SCADA Software and HMI Development, Data Acquisition and Processing, SCADA

Security and Cybersecurity.

Module 5: Elements of robots: [5L]
Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using-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-torque sensors, proximity sensors and vision.

Module 6: Kinematics of robots: [7L]

Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Degrees of- freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators.

Module 7: 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.

Textbooks:

T. A. HUGHES: Programmable Controllers.
C. D. JOHNSON: Process Control Instrumentation.
Robotics: Fundamental Concepts and Analysis, Ashitava Ghosal, OXFORD University Press.

Reference Books:
JOHN WEBB: Programmable Logic Controllers Principles & applications, PHI
Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Senand A. K. Deb, Jaico Publishing House, 2013.
S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PS O2	PS O3
CO1	3	3	3	1	3	1	1	1	1	1	1	3	3	2	2
CO2	3	3	3	1	3	1	1	1	1	1	1	3	3	3	2
CO3	3	3	3	3	3	2	2	1	1	1	2	3	3	2	2
CO4	3	3	3	3	3	2	2	1	1	2	1	3	3	2	2
CO5	3	3	3	3	3	1	2	1	2	2	2	3	2	3	2
CO6	3	3	3	3	3	2	2	1	1	2	1	3	3	1	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched,(-) = Not matched.