LBS INSTITUTE OF TECHNOLOGY FOR WOMEN, POOJAPPURA, THIRUVANANTHAPURAM

B TECH-CURRICULUM & SYLLABUS (2024 SCHEME)
ELECTRONICS AND COMMUNICATION ENGINEERING

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

(A State Government University)

B. Tech Curriculum-2024

Semester I to VIII

Electronics & Communication Engineering

Branch Code: EC

(Group B)

Ambady Nagar, Sreekaryam

Thiruvananthapuram- 695016

FIRST SEMESTER (July-December): Group B														
10 Days Compulsory Induction Program and UHV														
Sl. No:	**Slot**	**Course Code**	**Course Type**	**Course Category**	**Course Title (Course Name)**	**Credit Structure**				**SS**	**Total Marks**		**Credits**	**Hrs./Week**
						L	**T**	**P**	**R**		**CIA**	**ESE**		
1	A	GYMAT101	BSC	GC	Mathematics for Electrical Science-1	3	0	0	0	4.5	40	60	3	3
2	B S1/ S2	GBPHT121	BSC	GC	Physics for Electrical Science	3	0	2	0	5.5	40	60	4	5
		GXCYT122			Chemistry for Electrical Science									
3	C	GMEST103	ESC	GC	Engineering Graphics and Computer Aided Drawing.	2	0	2	0	4	40	60	3	4
4	D	GXEST104	ESC	GC	Introduction to Electrical & Electronics Engineering (Part 1: Electrical Engineering)	2	0	0	0	3	20	30	2+2=4	4
					(Part 2: Electronics Engineering)	2	0	0	0	3	20	30		
5	F	UCEST105	ESC	UC	Algorithmic Thinking with Python	3	0	2	0	5.5	40	60	4	5
6	L	GXESL106	ESC	GC	Basic Electrical and Electronics Engineering Workshop	0	0	2	0	1	50	50*	1	2
7	I* S1/S2	UCHWT127	HWP	UC	Health and Wellness	1	0	1	0	0	50	0	1	2/3
		UCHUT128	HMC		Life Skills and Professional Communication	2	0	1	0	3.5	100	0		
8	S_1/ S_2	UCSEM129	SEC	UC	Skill Enhancement Course: Digital 101(NASSCOM)	MOOC***				2			-	
Total										**30/ 32**			**20**	**25/ 26**
Bridge Course (Mathematics or Introduction to Computer Science) *: Total 15 Hrs.														

**No Grade Points will be awarded for the MOOC course and I slot course.*

SECOND SEMESTER (January-June): Group B														
Sl. No:	**Slot**	**Course Code**	**Course Type**	**Course Category**	**Course Title (Course Name)**	**Credit Structure**				**SS**	**Total Marks**		**Credits**	**Hrs./Week**
						L	**T**	**P**	**R**		**CIA**	**ESE**		
1	A	GYMAT201	BSC	GC	Mathematics for Electrical Science-2	3	0	0	0	4.5	40	60	3	3
2	B S1/S2	GBPHT121	BSC	GC	Physics for Electrical Science	3	0	2	0	5.5	40	60	4	5
		GXCYT122			Chemistry for Electrical Science									
3	C	GXEST203	ESC	GC	Foundations of Computing: From Hardware Essentials to Web Design	3	0	0	0	4.5	40	60	3	3
		GBEST213			Engineering Mechanics (EEE, CP, RA & RU)									
4	D	GXEST204	ESC	GC	Programming in C	3	0	2	0	5.5	40	60	4	5
5	E	PCECT205	PC	PC	Network Theory	3	1	0	0	5	40	60	4	4
6	F	UCEST206	ESC	UC	Engineering Entrepreneurship & IPR	3	0	0	0	4.5	60	40	3	3
7	I* S1/S2	UCHWT127	HWP	UC	Health and Wellness	1	0	1	0	0	50	0	1	2/3
		UCHUT128	HMC		Life Skills and Professional Communication	2	0	1	0	3.5	100	0		
8	L	GXESL208	ESC	GC	IT Workshop	0	0	2	0	1	50	50*	1	2
	S_1/ S_2	UCSEM129	SEC	UC	Skill Enhancement Course: Digital 101(NASSCOM)	MOOC***							1	
Total										**34**			**24**	**27/ 28**

**No Grade Points will be awarded for the MOOC course and I slot course.*

- L-T-P-R: Lecture-Tutorial-Practical-Project
- SS (Self Study) Hours= 1.5L+0.5 T+0.5P+R

  CIA: Continuous Internal Assessment, ESE: End Semester Examination

Note: *Physics, Chemistry, Health and Wellness & Life Skill and Professional Communication can be offered in both Semester 1 (S1) and Semester 2 (S2). Institutions are encouraged to guide approximately 50% of their branches to choose between Physics* ***or*** *Chemistry (Slot B) and Health and Wellness* ***or*** *Life Skill and Professional Communication (Slot I) in Semester 1.*

Digital 101 (NASSCOM)		
Sl. No:	**Technologies Covered**	**Hours**
1	Artificial intelligence and Big Data Analytics (AI/BDA)	11
2	Internet of Things (IoT)	2.5
3	Cyber Security	2.5
4	Block Chain	2.5
5	Robotic Process Automation	1.5
6	Augmented Reality and Virtual Reality (AR and VR)	2.5
7	Cloud Computing	2.5
8	3 D Printing and Modelling	2
9	Web, Mobile Dev and Marketing	2
10	Responsible AI	1
	Total Hours	**30**

Skill Enhancement Course: *Digital 101 is an introductory Massive Open Online Course (MOOC) offered by NASSCOM. It is designed to provide students with foundational knowledge and skills in digital technologies, preparing them for further studies and careers in the digital domain. By incorporating the Digital 101 course into the curriculum, KTU ensures that all students gain valuable digital skills early in their academic journey, enhancing their readiness for advanced courses and future careers in technology.*

Course Registration and Completion*:*

- *Students have the flexibility to register and complete the Digital 101 course either in their first semester (S1) or second semester (S2).*
- *The credit for this course (1 credit) will be officially recorded in the second semester grade card.*

THIRD SEMESTER (July-December)														
Sl. No:	**Slot**	**Course Code**	**Course Type**	**Course Category**	**Course Title (Course Name)**	**Credit Structure**				**SS**	**Total Marks**		**Credits**	**Hrs./ Week**
						L	**T**	**P**	**R**		**CIA**	**ESE**		
1	A	GYMAT301	BSC	GC	Mathematics for Electrical Science-3	3	0	0	0	4.5	40	60	3	3
2	B	PCECT302	PC	PC	Solid State Devices	3	1	0	0	5	40	60	4	4
3	C	PCECT303	PC	PC	Analog Circuits	3	1	0	0	5	40	60	4	4
4	D	PBECT304	PC-PBL	PB	Logic Circuit Design	3	0	0	1	5.5	60	40	4	4
5	F	GNEST305	ESC	GC	Introduction to Artificial Intelligence and Data Science	3	1	0		5	40	60	4	4
6	G S3/S4	UCHUT346	HMC	UC	Economics for Engineers	2	0	0	0	3	50	50	2	2
		UCHUT347			Engineering Ethics and Sustainable Development									
7	L	PCECL307	PCL	PC	Analog Circuits Lab	0	0	3	0	1.5	50	50	2	3
8	Q	PCECL308	PCL	PC	Logic Circuit Design Lab	0	0	3	0	1.5	50	50	2	3
9	R/M		VAC		Remedial/Minor Course	3	1	0	0	5			4*	4*
Total										**31/ 36**			**25/29***	**27/31***
Bridge Course for Lateral Entry Students: Total 15 Hrs.														

FOURTH SEMESTER (January-June)														
Sl. No:	**Slot**	**Course Code**	**Course Type**	**Course Category**	**Course Title (Course Name)**	**Credit Structure**				**SS**	**Total Marks**		**Credits**	**Hrs./ Week**
						L	**T**	**P**	**R**		**CIA**	**ESE**		
1	A	GBMAT401	BSC	GC	Mathematics for Electrical Science-4	3	0	0	0	4.5	40	60	3	3
2	B	PCECT402	PC	PC	Signals and Systems	3	1	0	0	5	40	60	4	4
3	C	PCECT403	PC	PC	Linear Integrated Circuits	3	1	0	0	5	40	60	4	4
4	D	PBECT404	PC-PBL	PB	Microcontrollers	3	0	0	1	5.5	60	40	4	4
5	E	PEECT41N	PE	PE	PE-1	3	0	0	0	4.5	40	60	3	3
6	G S3/S4	UCHUT346	HMC	UC	Economics for Engineers	2	0	0	0	3	50	50	2	2
		UCHUT347			Engineering Ethics and Sustainable Development									
7	L	PCECL407	PCL	PC	Linear Integrated Circuits Lab	0	0	3	0	1.5	50	50	2	3
8	Q	PCECL408	PCL	PC	Microcontroller Lab	0	0	3	0	1.5	50	50	2	3
9	R/M/ H		VAC		Remedial/Minor/Honours Course	3	1	0	0	5			4*	4*
Total										**31/ 36**			**24/ 28***	**26/ 30***

Note: *Economics for Engineers and Engineering Ethics and Sustainable Development shall be offered in both S3 and S4. Institutions can advise students belonging to about 50% of the number of branches in the Institution to opt for Economics for Engineers in S3 and Engineering Ethics &Sustainable Development in S4 and vice versa.*

PROGRAM ELECTIVE I: PEECT41N					
SLOT	**COURSE CODE**	**COURSES**	**L-T-P-R**	**HOURS**	**CREDIT**
E	PEECT 411	Instrumentation	3-0-0-0	**3**	3
	PEECT 412	Power Electronics	3-0-0-0		3
	PEECT 413	Machine Learning	3-0-0-0		3
	PEECT 414	Object Oriented Programming	3-0-0-0		3
	PEECT 416	Digital System Design	3-0-0-0		3
	PEECT 415	**Digital Systems and VLSI Design**	3-0-0-0		**5/3**

Note : *Level 5 courses in the B. Tech curriculum carry a total of 5 credits, consisting of 3 credits for the Programme Elective and 2 additional credits. The additional 2 credits shall be awarded only if the student meets the eligibility conditions specified in the B. Tech. -2024 regulations. If those conditions are not fulfilled, the student will receive only 3 credits for the course.*

FIFTH SEMESTER (July-December)														
Sl. No:	**Slot**	**Course Code**	**Course Type**	**Course Category**	**Course Title (Course Name)**	**Credit Structure**				**SS**	**Total Marks**		**Credits**	**Hrs./ Week**
						L	**T**	**P**	**R**		**CIA**	**ESE**		
1	A	PCECT501	PC	PC	Electromagnetics	3	1	0	0	5	40	60	4	4
2	B	PCECT502	PC	PC	Analog & Digital Communication	3	1	0	0	5	40	60	4	4
3	C	PCECT503	PC	PC	Control Systems	3	0	0	0	4.5	40	60	3	3
4	D	PBECT504	PC-PBL	PB	Digital Signal Processing	3	0	0	1	5.5	60	40	4	4
5	E	PEECT52N	PE	PE	PE-2	3	0	0	0	4.5	40	60	3	3
6	I*	UCHUM506	HMC	UC	Constitution of India (MOOC)	-	-	-	-	2	-	-	1	-
7	L	PCECL507	PCL	PC	DSP Lab	0	0	3	0	1.5	50	50	2	3
8	Q	PCECL508	PCL	PC	Communication Lab I	0	0	3	0	1.5	50	50	2	3
9	R/M/H		VAC		Remedial/Minor/Honours Course	3	1	0	0	5			4*	4*
	S_5/ S_6	Industrial Visit (Maximum 12 Days are permitted, Not Exceeding more than 6 Working Days) /Industrial Training												
Total										**30/ 35**			**23/27***	**24/28***

****No Grade Points will be awarded for the MOOC course and I slot course.***

Industrial Training:
Students who are not participating in the industrial visit must attend industrial training during that period.

PROGRAM ELECTIVE 2: PEECT52N					
SLOT	**COURSE CODE**	**COURSES**	**L-T-P-R**	**HOURS**	**CREDIT**
E	PEECT 521	Biomedical Engineering	3-0-0-0	**3**	3
	PEECT 522	Data Structures	3-0-0-0		3
	PEECT 523	Sensors and Actuators	3-0-0-0		3
	PEECT524	ARM architecture and programming	3-0-0-0		3
	PEECT 526	High Speed Digital Design	3-0-0-0		3
	PEECT 527	Estimation and Detection	3-0-0-0		3
	PEECT 525	**ARM architecture, programming and Interfacing**	3-0-0-0		**5/3**

SIXTH SEMESTER (January-June)														
Sl. No:	**Slot**	**Course Code**	**Course Type**	**Course Category**	**Course Title (Course Name)**	**Credit Structure**				**SS**	**Total Marks**		**Credits**	**Hrs/ Week**
						L	**T**	**P**	**R**		**CIA**	**ESE**		
1	A	PCECT601	PC	PC	Advanced Communication Theory	3	1	0	0	5	40	60	4	4
2	B	PCECT602	PC	PC	Microwaves and Antennas	3	0	0	0	4.5	40	60	3	3
3	C	PEECT63N	PE	PE	PE-3	3	0	0	0	4.5	40	60	3	3
4	D	PBECT604	PC-PBL	PB	VLSI Circuit Design	3	0	0	1	5.5	60	40	4	4
5	F	GXEST605	ESC	GC	Design Thinking and Product Development (Group Specific Syllabus)	2	0	0	0	3	40	60	2	2
6	O	OEECT61N /IEECT61N	OE/ILE	OE/IE	OE/ILE-1	3	0	0	0	4.5	40	60	3	3
7	L	PCECL607	PCL	PC	Communication Lab II	0	0	3	0	1.5	50	50	2	3
8	P	PCEVP608	PWS	PC	Mini Project: Socially Relevant Project	0	0	0	3	3	50	50	2	3
9	R/ M/ H		VAC		Remedial/Minor/Honours Course	3	0	0	0	4.5			3*	3*
	S5/ S6	Industrial Visit (Maximum of 12 Days are permitted, Not Exceeding more than 6 Working Days) /Industrial Training												
Total										**32/ 36**			**23/26***	**25/28***

Note: Open Electives are such courses which will be offered by other departments. Like CSE department students have to opt open electives from ECE/ME/EEE etc. departments.

Industrial Training:
Students who are not participating in the industrial visit must attend industrial training during that period.

PROGRAM ELECTIVE 3: PEECT63N					
SLOT	**COURSE CODE**	**COURSES**	**L-T-P-R**	**HOURS**	**CREDIT**
C	PEECT 631	Computer Networks	3-0-0-0	**3**	3
	PEECT 632	Digital Image Processing	3-0-0-0		3
	PEECT 633	Secure Communication	3-0-0-0		3
	PEECT 634	Nano-Electronics	3-0-0-0		3
	PEECT 636	Optical Communication	3-0-0-0		3
	PEECT 637	Optimization Techniques	3-0-0-0		3
	PEECT 635	**Image Processing Applications**	3-0-0-0		**5/3**

OPEN ELECTIVE 1: OEECT 61N					
SLOT	**COURSE CODE**	**COURSES**	**L-T-P-R**	**HOURS**	**CREDIT**
O	OEECT 611	Entertainment Electronics	3-0-0-0	3	3
	OEECT 612	Computer Networks	3-0-0-0		3
	OEECT 613	Biomedical Engineering	3-0-0-0		3

SEVENTH SEMESTER (July-December)														
Sl. No:	**Slot**	**Course Code**	**Course Type**	**Course Category**	**Course Title (Course Name)**	**Credit Structure**				**SS**	**Total Marks**		**Credits**	**Hrs/ Week**
						L	**T**	**P**	**R**		**CIA**	**ESE**		
1	A	PEECT74N/ PEECM74N	PE	PE	PE-4 (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	3	0	0	0	4.5	40	60	3	3
2	B	PEECT75N/ PEECM75N	PE	PE	PE-5 (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	3	0	0	0	4.5	40	60	3	3
3	O	OEECT72N /IEECT72N/ OEECM72N	OE/ ILE	OE/IE	OE/ILE-2 (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	3	0	0	0	4.5	40	60	3	3
4	I*	UEHUT704 / UEHUM70N	HMC	UE	Elective (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	2	0	0	0	3	50	50	2	2
5	S	PCECS705	PWS	PC	Seminar	0	0	3	0	1.5	50	0	2	3
6	P	PCECP706/ PCECI706	PWS	PC	Option 1: Major Project Option 2: Internship (4-6 Months)	0	0	0	8	8	100	0	4	8
7	R/H		VAC		Remedial/Honours Course	3	0	0	0	4.5			3*	3*
Total										**26/ 31**			**17/20***	**22/25***

**No Grade Points will be awarded for the I slot courses*
Students can opt for the internship either in the **7th or 8th semester.*
** Option 1: Work on a Project in the institute/department under the mentorship of faculty members.*
*Option 2: Full semester Internship in an Industry/organization (**7th or 8th semester**)*

Note: Open Electives are such courses which will be offered by other departments.

PROGRAM ELECTIVE 4: PEECT74N					
SLOT	**COURSE CODE**	**COURSES**	**L-T-P-R**	**HOURS**	**CREDIT**
A	PEECT 741	Advanced Mobile Communication	3-0-0-0	**3**	3
	PEECT 742	Deep Learning	3-0-0-0		3
	PEECT 743	Robotics and Automation	3-0-0-0		3
	PEECT 744	Coding Theory	3-0-0-0		3
	PEECT 746	Advanced DSP	3-0-0-0		3
	PEECT 747	Cryptography	3-0-0-0		3
	PEECT 745	**Deep Learning Techniques**	3-0-0-0		**5/3**

PROGRAM ELECTIVE 5: PEECT75N					
SLOT	**COURSE CODE**	**COURSES**	**L-T-P-R**	**HOURS**	**CREDIT**
B	PEECT 751	Satellite and Radar Communication	3-0-0-0	**3**	3
	PEECT 752	Internet of Things	3-0-0-0		3
	PEECT 753	Real Time Operating System	3-0-0-0		3
	PEECT 754	Mixed Signal Circuits	3-0-0-0		3
	PEECT 756	Speech and Audio Processing	3-0-0-0		3
	PEECT 757	Microwave Devices and Circuits	3-0-0-0		3
	PEECT 755	**Mixed Signal Circuit Design**	3-0-0-0		**5/3**

OPEN ELECTIVE 2: OEECT72N					
SLOT	**COURSE CODE**	**COURSES**	**L-T-P-R**	**HOURS**	**CREDIT**
O	OEECT 721	Optical Communication	3-0-0-0	3	3
	OEECT 722	Digital Image Processing	3-0-0-0		3
	OEECT 723	Optimization Techniques	3-0-0-0		3

Slot I: HMC Elective	
1	Project Management: Planning, Execution, Evaluation and Control
2	Proficiency course in French. (MOOC) (B1 level)
3	Proficiency Course in German (B1 Level). (MOOC)
4	Proficiency Course in Spanish (B1 Level) (MOOC)
5	Introduction to Japanese Language and Culture (N5 level). (MOOC)

EIGHTH SEMESTER (January-June)														
Sl. No:	**Slot**	**Course Code**	**Course Type**	**Course Category**	**Course Title (Course Name)**	**Credit Structure**				**SS**	**Total Marks**		**Credits**	**Hrs/ Week**
						L	**T**	**P**	**R**		**CIA**	**ESE**		
1	A	PEECT86N/ PEECM86N	PE	PE	PE-6 (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	3	0	0	0	4.5	40	60	3	3
2	O	OEECT83N /IEECT83N/ OEECM83N	OE/ILE	OE/IE	OE/ILE-3 (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	3	0	0	0	4.5	40	60	3	3
3	I*	UEHUT803/ UEHUM803	HMC	UC	Organizational Behavior and Business Communication (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	2	0	0	0	3	50	50	1	2
4	P	PCECP806/ PCECI806/ PCECJ806	PWS	PC	Option 1: Major Project Option 2: Internship (4-6 Months) Option 3: Major Project Phase -II (For the students who have not opted for internship in S7/S8)	0	0	0	8	8	100	0	4	8
Total										**20**			**11**	**16**

****No Grade Points will be awarded for the I slot courses***

** Option 2: Full semester Internship in an Industry/organization (**7th or 8th semester**)*

PROGRAM ELECTIVE 6: PEECT86N					
SLOT	**COURSE CODE**	**COURSES**	**L-T-P-R**	**HOURS**	**CREDIT**
A	PEECT861	Wireless Sensor Networks	3-0-0-0	**3**	3
	PEECT862	RF Engineering	3-0-0-0		3
	PEECT863	Renewable Energy Systems	3-0-0-0		3
	PEECT864	Cyber-Security	3-0-0-0		3
	PEECT866	Low Power VLSI	3-0-0-0		3
	PEECT867	Blockchain	3-0-0-0		3
	PEECT868	Antenna Theory & Wave Propagation	3-0-0-0		3
	PEECT865	**Antenna Theory & Design**	3-0-0-0		**5/3**

OPEN ELECTIVE 3: OEECT83N					
SLOT	**COURSE CODE**	**COURSES**	**L-T-P-R**	**HOURS**	**CREDIT**
O	OEECT 831	Internet of Things	3-0-0-0	3	3
	OEECT 832	Satellite and Radar Communication	3-0-0-0		3
	OEECT 833	Robotics	3-0-0-0		3

HMC Courses			
Sl. No:	**Semester**	**Course Area**	**Credits**
1	**S1/S2**	Life Skills and Professional Communication	1
2	**S3/S4**	Economics for Engineers	2
3		Engineering Ethics and Sustainable Development	2
4	**S5**	Constitution Of India. (MOOC)	1
5	**S7**	Elective (Project Management/Foreign Languages)	2
6	**S8**	Organizational Behavior and Business Communication	1
Total Credits			**9**

BSC Courses			
Sl. No:	**Semester**	**Course Area**	**Credits**
1	**S1**	Group Specific Mathematics-1	3
2	**S1/S2**	Physics for Engineers	4
3		Chemistry for Engineers	4
4	**S2**	Group Specific Mathematics-2	3
5	**S3**	Group Specific Mathematics-3	3
6	**S4**	Group Specific Mathematics-4	3
Total Credits			**20**

ESC Courses (Group B)			
Sl. No:	**Semester**	**Course Area**	**Credits**
1	**S1**	Engineering Graphics and Computer Aided Drawing	3
2		Introduction to Electrical and Electronics Engineering	4
3		Algorithmic Thinking with Python	4
4		Basic Electrical and Electronics Engineering Workshop	1
5	**S2**	Foundations of Computing: From Hardware Essentials to Web Design / Engineering Mechanics (EEE, CP, RA and RU)	3
6		Programming in C	4
7		Engineering Entrepreneurship and IPR	3
8		IT Workshop	1
9	**S3**	Introduction to Artificial Intelligence and Data Science	4
10	**S6**	Design Thinking and Creativity	2
Total Credits			**29**

Program Core Courses (PC)			
Sl. No:	**Semester**	**Course Area**	**Credits**
1	**S2**	Network Theory	4
2	**S3**	Solid State Devices	4
3		Analog Circuits	4
4		Analog Circuits Lab	2
5		Logic Circuit Design Lab	2
6	**S4**	Signals and Systems	4
7		Linear Integrated Circuits	4
8		Linear Integrated Circuits Lab	2
9		Microcontroller Lab	2
10	**S5**	Electromagnetics	4
11		Analog & Digital Communication	4
12		Control Systems	3
13		DSP Lab	2
14		Communication Lab I	2

15	**S6**	Advanced Communication Theory	4
16		Microwave and Antennas	3
17		Communication Lab II	2
Total Credits (Theory -10, Lab-7)			**52**

Program Core-Project Based Learning (PBL)			
Sl. No:	**Semester**	**Course Area**	**Credits**
1	**S3**	Logic Circuit Design	4
2	**S4**	Microcontrollers	4
3	**S5**	Digital Signal Processing	4
4	**S6**	VLSI Circuit Design	4
Total Credits			**16**

Program Elective Courses (PE)			
Sl. No:	**Semester**	**Course Type**	**Credits**
1	**S4**	PE-1	3
2	**S5**	PE-2	3
3	**S6**	PE-3	3
4	**S7**	PE-4	3
5		PE-5	3
6	**S8**	PE-6	3
Total Credits			**18**

Open Elective Courses/Industry Elective(OE/IEL)			
Sl. No:	**Semester**	**Course Type**	**Credits**
1	**S6**	OE/ILE-1	3
2	**S7**	OE/ILE-2	3
3	**S8**	OE/ILE-3	3
Total Credits			**9**

Project/ Internship and Seminar			
Sl. No:	**Semester**	**Course Type**	**Credits**
1	**S6**	Mini Project	2
2	**S7**	Seminar	2
3		Major Project/Internship	4
4	**S8**	Major Project/Internship/Research Project	4
Total Credits			**12**

Activity Points				
Sl. No.	**Group**	**Courses**	**Credits**	**Minimum Credit Requirements**
1	I	NSS, NCC, NSO (National Sports Organization)	1 (40 Points)	3 Credits (One credit from each Group)
2		Arts/Sports/Games		
3		Union/Club Activities		
4	II	English Proficiency Certification (TOFEL, IELTS, BEC etc.)	1 (40 Points)	
5		Aptitude Proficiency Certification (GRE, CAT, GMAT etc.)/ Valid Gate Score.		
6		Short Term Internship (Minimum 2 weeks), Clinical Exposure/Training (Minimum 2 weeks), Conferences/Paper Presentation/ Workshop Activities/ Professional Body Activities, Participation in University level/State Level/ National Level Hackathons		
7	III	Journal Publication, Patents, Start-Up, Innovation, Winners of National/ International Level Hackathons	1 (40 Points)	
8		**Skilling Certificates** (Approved by the University)		

- ***Students are required to acquire a minimum of 120 activity points, with at least 40 points per group, to fulfill the curriculum requirement of 3 activity credits.***
- ***For B. Tech Lateral Entry students, 30 points per group are required. A minimum of 90 activity points must be acquired to obtain the 3 activity credits mandated by the curriculum.***

Course classifications of the B. Tech Programmes and Overall Credit Structure			
Sl. No	**Category**	**Code**	**Credits**
1	Humanities and Social Sciences including Management Courses	HMC	9
2	Basic Science Courses	BSC	20
3	Engineering Science Courses	ESC	29
4	Programme (Professional) Core Courses	PCC	52
5	Programme (Professional) Core Courses-Project Based Learning	PBL	16
6	Programme Elective Courses	PEC	18
7	Open Elective Courses/Industry Linked Elective	OEC/ILE	9
8	Mini Project,Project Work/Internship and Seminar	PWS	12
9	Health and Wellness	HWP	1
10	Skill Enhancement Courses (Digital 101)	SEC	1
11	Mandatory Student Activities	MSA	3
Total Credits			**170**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

(A State Government University)

B. Tech- 2024

FIRST YEAR SYLLABUS
(GROUP B)

SEMESTER 1
GROUP B

SEMESTER S1

MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE - 1
(Common to Groups B & C)

Course Code	**GYMAT101**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Basic knowledge in single variable calculus and matrix operations.	**Course Type**	Theory

Course Objectives:

1. To provide a comprehensive understanding and basic techniques of matrix theory to analyze linear systems.
2. To offer advanced knowledge and practical skills in solving second-order ordinary differential equations, applying Laplace transforms, and understanding Fourier series, enabling students to analyze and model dynamic systems encountered in engineering disciplines effectively.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Linear systems of equations: Gauss elimination, Row echelon form, Linear Independence: rank of a matrix, Solutions of linear systems: Existence, Uniqueness (without proof), The matrix Eigen Value Problem, Determining Eigen values and Eigen vector, Diagonalization of matrices. **(Text 1: Relevant topics from sections 7.3, 7.4, 7.5, 8.1, 8.4)**	**9**

2	Homogeneous linear ODEs of second order, Superposition principle, General solution, Homogeneous linear ODEs of second order with constant coefficients (Method to find general solution, solution of linear Initial Value Problem). Non homogenous ODEs (with constant coefficients) - General solution, Particular solution by the method of undetermined coefficients (Particular solutions for the functions $ke^{\gamma x}$, kx^n, $k\cos\omega x$, $k\sin\omega x$, $ke^{\alpha x}\cos\omega x$, $ke^{\alpha x}\sin\omega x$), Initial value Problem for Non-Homogeneous Second order linear ODE(with constant coefficients), Solution by variation of parameters (Second Order). **(Text 1: Relevant topics from sections 2.1, 2.2, 2.7, 2.10)**	**9**
3	Laplace Transform, Inverse Laplace Transform, Linearity property, First shifting theorem, Transform of derivatives, Solution of Initial value problems by Laplace transform (Second order linear ODE with constant coefficients with initial conditions at t=0 only), Unit step function, Second shifting theorem, Dirac delta function and its transform (Initial value problems involving unit step function and Dirac delta function are excluded), Convolution theorem (without proof) and its application to finding inverse Laplace transform of products of functions. **(Text 1: Relevant topics from sections 6.1, 6.2, 6.3, 6.4, 6.5)**	**9**
4	Taylor series representation (without proof, assuming the possibility of power series expansion in appropriate domains), Maclaurin series representation, Fourier series, Euler formulas, Convergence of Fourier series (Dirichlet's conditions), Fourier series of 2π periodic functions, Fourier series of $2l$ periodic functions, Half range sine series expansion, Half range cosine series expansion. **(Text 1: Relevant topics from sections 11.1, 11.2, Text 2: Relevant topics from section 10.8)**	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Solve systems of linear equations and diagonalize matrices.	**K3**
CO2	Solve homogeneous and non-homogeneous linear differential equation with constant coefficients.	**K3**
CO3	Compute Laplace transform and apply it to solve ODEs arising in engineering.	**K3**
CO4	Determine the Taylor series and evaluate Fourier series expansion for different periodic functions.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10^{th} edition, 2016
2	Calculus	H.Anton,I.Biven,S.Davis	Wiley	12^{th} edition, 2024

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Thomas' Calculus	Maurice D. Weir, Joel Hass, Christopher Heil, Przemyslaw Bogacki	Pearson	15th edition, 2023
2	Essential Calculus	J. Stewart	Cengage	2nd edition, 2017
3	Elementary Linear Algebra	Howard Anton, Chris Rorres	Wiley	11th edition, 2019
4	Bird's Higher Engineering Mathematics	John Bird	Taylor & Francis	9th edition, 2021
5	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39th edition, 2023
6	Calculus	H. Anton, I. Biven, S.Davis	Wiley	12th edition, 2024
7	Signals and Systems	Simon Haykin, Barry Van Veen	Wiley	2nd edition, 2002

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/111/107/111107164/
2	https://archive.nptel.ac.in/courses/111/104/111104031/
3	https://archive.nptel.ac.in/courses/111/106/111106139/
4	https://archive.nptel.ac.in/courses/111/101/111101164/

SEMESTER S1/S2

PHYSICS FOR ELECTRICAL SCIENCE
(Common to Group B)

Course Code	**GBPHT121**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory + Lab

Course Objectives:

1. To provide students with a solid background in the fundamentals of Physics and to impart this knowledge in Electrical Science disciplines.
2. To develop scientific attitudes and enable students to correlate Physics concepts with their core programs.
3. To equip students with practical knowledge that complements their theoretical studies and develop their ability to create practical applications and solutions in engineering based on their understanding of Physics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Semiconductor Physics** Intrinsic semiconductor, Derivation of density of electrons in conduction band and density of holes in valence band, Intrinsic carrier concentration, Variation of Intrinsic carrier concentration with temperature, Extrinsic semiconductor (qualitative) Formation of p-n junction, Fermi level in semiconductors-intrinsic and extrinsic, Energy band diagram of p-n junction - Qualitative description of charge flow across a p-n junction - Forward and reverse biased p-n junctions, Diode equation (Derivation), V-I Characteristics of p-n junction	**9**

2	**Semiconductor Devices** Semiconductor devices - Rectifiers- Full wave and Half wave, Zener diode - V-I characteristics - Zener breakdown and Avalanche breakdown, Tunnel diode - V-I characteristics, Applications of Zener and Tunnel diodes. Photonic devices (qualitative) - Photo detectors (Junction and PIN photodiodes), Applications, Solar cells- V-I Characteristics, Efficiency, Stringing of Solar cells to solar panel, Light Emitting Diode, Applications of LED	**9**
3	**Superconductivity & Dielectrics** Super conductivity, Transition temperature, Critical field, Meissner effect, Type I and Type II Super conductors, Applications of superconductors. Dielectric constant, Polarization, Permittivity- relative permittivity, Relation between polarization and dielectric constant, Types of Polarization, Internal fields in liquids and solids, Clausius Mossotti Relation, Dielectric loss(qualitative), Dielectric breakdown (qualitative)	**9**
4	**Laser & Fiber Optics** Optical processes - Absorption, Spontaneous emission and stimulated emission, Properties of laser, Principle of laser - conditions for sustained lasing – Population inversion, Pumping, Metastable states, Basic components of laser - Active medium- Optical resonant cavity, Construction and working of Ruby laser, Semiconductor Laser (Qualitative), Applications of laser. Optical fiber-Principle of propagation of light, Types of fibers-Step index and Graded index fibers, Numerical aperture –Derivation, Applications of optical fibers - Fiber optic communication system (block diagram)	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	10	10	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamentals of Semiconductor Physics.	**K2**
CO2	Describe the behaviour of semiconductor materials in semiconductor devices.	**K2**
CO3	Explain Superconductivity and basic theory of dielectrics	**K2**
CO4	Apply the comprehended knowledge about laser and fibre optics in various engineering applications	**K3**
CO5	Apply basic knowledge of principles and theories in physics to conduct experiments.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Concepts of Modern Physics	Arthur Beiser	Tata McGraw Hill Publications	6th Edition, 2003
2	Engineering Physics	H K Malik and A K Singh	McGraw Hill	2nd Edition, 2017
3	A Textbook of Engineering Physics	MN Avadhanulu, P G Kshirsagar, TVS Arun murthy	S. Chand	11th Edition, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Semiconductor Devices Fundamentals	Robert F Pierret	Pearson Education	1995
2	Advanced Semiconductor Fundamental	Robert F Pierret	Pearson Education	2nd Edition, 2002
3	Solid State Electronic Devices	Ben G Streetman and Sanjay Kumar Banerjee	Pearson Education 6/e	2010
4	Solid State Physics	S.O. Pillai	New age international publishers	10th Edition, 2022
5	Introduction to Solid State Physics	Charles Kittel	Wiley India Edition	2019
6	Advanced Engineering Physics	Premlet B	Phasor Books	10th Edition ,2017
7	A Text Book of Engineering Physics	I. Dominic and. A. Nahari,	Owl Books Publishers	Revised Edition, 2016

Video Links (NPTEL, SWAYAM etc)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/108106181
2	https://nptel.ac.in/courses/108108112
3	https://nptel.ac.in/courses/115103108
4	https://nptel.ac.in/courses/115102124

1. Continuous Assessment (10 Marks)

i. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

ii. Conduct of Experiments (2 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

iii. Lab Reports and Record Keeping (3 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

iv. Viva Voce (3 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

2. Evaluation Pattern for Lab Examination (5 Marks)

1. **Procedure/Preliminary Work/Conduct of Experiments (2 Marks)**
    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task
2. **Result (2 Marks)**
    - Accuracy of Results: Precision and correctness of the obtained results.
3. **Viva Voce (1 Marks)**
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

Experiment List
(Minimum 10 Experiments)

Experiment No.	Experiment
1	Diode characteristics
2	Zener diode- V-I characteristics
3	Tunnel diode –V-I characteristics
4	Half wave rectifier
5	Full wave rectifier
6	Hall effect in semiconductors
7	Determination of band gap energy of a semiconductor
8	Characteristics of LED
9	Solar Cell- V-I and Intensity Characteristics

10	Laser – Determination of wavelength using diffraction grating
11	Laser- To measure the wavelength using a millimetre scale as a grating
12	Compare the variation of current with potential difference, for a metal, filament bulb and semiconductor diode.
13	Determination of dielectric constant
14	CRO -Measurement of frequency and amplitude of wave forms
15	Photo diode- V-I Characteristics
16	Numerical aperture of optical fiber

SEMESTER S1/S2

CHEMISTRY FOR INFORMATION SCIENCE & ELECTRICAL SCIENCE

(GROUPS A & B)

Course Code	**GXCYT122**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory+ Lab

Course Objectives:

1. To equip students with a comprehensive understanding of chemistry concepts that are relevant to engineering applications.
2. To familiarize students with applied topics such as spectroscopy, electrochemistry, and instrumental methods.
3. To raise awareness among students about environmental issues, including climate change, pollution, and waste management, and their impact on the quality of life.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Electrochemistry and Corrosion Science** **Electrochemical Cell**- Electrode potential- Nernst equation for single electrode and cell (Numerical problems)- Reference electrodes – SHE & Calomel electrode –Construction and Working - Electrochemical series - Applications – Glass Electrode & pH Measurement-Conductivity-Measurement using Digital conductivity meter. Li-ion battery & H_2-O_2 fuel cell (acid electrolyte only) construction and working. **Corrosion** –Electrochemical corrosion mechanism (acidic & alkaline medium) - Galvanic series - Corrosion control methods - Cathodic Protection - Sacrificial anodic protection and impressed current cathodic protection – Electroplating of copper - Electroless plating of copper.	**9**

2	**Materials for Electronic Applications** **Nanomaterials** - Classification based on Dimension & Materials- Synthesis – Sol gel & Chemical Reduction - Applications of nanomaterials – Carbon Nanotubes, Fullerenes, Graphene & Carbon Quantum Dots – structure, properties & application. **Polymers** - Fire Retardant Polymers- Halogenated & Non-halogenated polymers (Examples only)- Conducting Polymers-Classification- Polyaniline & Polypyrrole-synthesis, properties and applications. **Organic electronic materials and devices**- construction, working and applications of Organic Light Emitting Diode (OLED) & Dye-Sensitized Solar Cells (DSSC) Materials used in Quantum computing Technology**,** Super capacitors, Spintronics	**9**
3	**Molecular Spectroscopy and Analytical Techniques** **Spectroscopy**-Types of spectra- Molecular energy levels - Beer Lambert's law – Numerical problems - Electronic Spectroscopy – Principle, Types of electronic transitions –Role of conjugation in absorption maxima- Instrumentation-Applications – Vibrational spectroscopy – Principle- Number of vibrational modes - Vibrational modes of CO_2 and H_2O – Applications **Thermal Analysis**: Dielectric Thermal Analysis (DETA) of Polymers- Working and Application. **Electron Microscopic Techniques:** SEM - Principle, instrumentation and Applications.	**9**
4	**Environmental Chemistry** **Water characteristics** - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Degree of hardness (Numericals) Water softening methods-Ion exchange process- Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. – Water disinfection methods – chlorination-Break point chlorination, ozone and UV irradiation. Dissolved oxygen (DO), BOD and COD- Definition & Significance.	**9**

	Waste Management: Sewage water treatment- Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process. E Waste, Methods of disposal – recycle, recovery and reuse. Chemistry of climate change- Greenhouse Gases- Ozone Depletion-Sustainable Development- an introduction to Sustainable Development Goals.	

Self-Study Topics (NOT TO BE INCLUDED FOR END SEMESTER EXAMINATION): Construction, working and applications of Lead acid battery, Nickel cadmium battery and Nickel metal hybrid battery.

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	**10**	**10**	**10**	**5**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the Basic Concepts of Electrochemistry and Corrosion to explore the possible applications in various engineering fields	**K2**
CO2	Describe the use of various engineering materials in different industries	**K2**
CO3	Apply appropriate analytical techniques for the synthesis and characterization of various engineering materials.	**K3**
CO4	Outline various water treatment and waste management methods	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Chemistry	B. L. Tembe, Kamaluddin, M. S. Krishnan	NPTEL Web-book	2018
2	Physical Chemistry	P. W. Atkins	Oxford University Press	International Edition-2018
3	Instrumental Methods of Analysis	H. H. Willard, L. L. Merritt	CBS Publishers	7th Edition-2005
4	Engineering Chemistry	Jain & Jain	Dhanpath Rai Publishing Company	17th Edition - 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Molecular Spectroscopy	C. N. Banwell	McGraw-Hill	4th edn., 1995
2	Principles of Physical Chemistry	B. R. Puri, L. R. Sharma, M. S. Pathania	Vishal Publishing Co	47th Edition, 2017
3	Introduction to Spectroscopy	Donald L. Pavia	Cengage Learning India Pvt. Ltd	2015
4	Polymer Chemistry: An Introduction	Raymond B. Seymour, Charles E. Carraher	Marcel Dekker Inc	4th Revised Edition, 1996
5	The Chemistry of Nanomaterials: Synthesis, Properties and Applications	Prof. Dr. C. N. R. Rao, Prof. Dr. h.c. mult. Achim Müller, Prof. Dr. A. K. Cheetham	Wiley-VCH Verlag GmbH & Co. KGaA	2014
6	Organic Electronics Materials and Devices	Shuichiro Ogawa	Springer Tokyo	2024
7	Principles and Applications of Thermal Analysis	Gabbot, P	Oxford: Blackwell Publishing	2008

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/104/106/104106137/ https://archive.nptel.ac.in/courses/113/105/113105102/ https://archive.nptel.ac.in/courses/113/104/113104082/ https://www.youtube.com/watch?v=BeSxFLvk1h0
2	https://archive.nptel.ac.in/courses/113/104/113104102/ https://archive.nptel.ac.in/courses/104/105/104105124/ https://archive.nptel.ac.in/courses/105/104/105104157/

Continuous Assessment (10 Marks)

Continuous assessment evaluations are conducted based on laboratory associated with the theory.

Mark distribution

1. **Preparation and Pre-Lab Work (2 Marks)**
   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (2 Marks)**
   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.
3. **Lab Reports and Record Keeping (3 Marks)**
   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (3 Marks)**
   - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for Lab Examination (5 Marks)

1. **Procedure/Preliminary Work/Conduct of Experiments (2 Marks)**
   - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
   - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

2. **Result (2 Marks)**
   - Accuracy of Results: Precision and correctness of the obtained results.
3. **Viva Voce (1 Marks)**
   - Proficiency in answering questions related to theoretical and practical aspects of the subject.

List of Experiments

***Minimum 10 Experiments**

Expt. Nos.	Experiment
1	Estimation of iron in iron ore
2	Estimation of copper in brass
3	Determination of cell constant and conductance of solutions
4	Calibration of pH meter and determination of pH of a solution
5	Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
6	Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
7	Determination of molar absorptivity of a compound (KMnO4 or any water-soluble food colorant)
8	Analysis of IR spectra
9	Identification of drugs using TLC

10	Estimation of total hardness of water-EDTA method
11	Estimation of dissolved oxygen by Winkler's method
12	Determination of calorific value using Bomb calorimeter
13	Determination of saponification value of a given vegetable oil
14	Determination of acid value of a given vegetable oil
15	Verification of Nernst equation for electrochemical cell.

SEMESTER S1

ENGINEERING GRAPHICS AND COMPUTER AIDED DRAWING

(Common to A, B & D)

Course Code	**GMEST103**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	2-0-2-0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory & Lab

Course Objectives:

1. To learn the principles and techniques of dimensioning and preparing engineering drawings.
2. To develop the ability to accurately interpret and understand engineering drawings.
3. To learn the features of CAD software

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing. (No questions for the end semester examination) Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of a line. Inclination of lines with reference planes. True length and true inclinations of line inclined to both the reference planes.	**9**

2	Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder only. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.	**9**
3	**Sections of Solids:** Sections of Prisms, Pyramids, Cone and Cylinder only, with axis in vertical position and cut by different section planes. True shape of the sections. (Exclude true shape given problems) **Development of Surfaces:** Development of surfaces of the solids and solids cut by different section planes. (Exclude problems with through holes)	**9**
4	**Isometric Projection:** Isometric scale- Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder, Sphere, Hemisphere and their combinations. **Computer Aided Drawing (CAD):** Introduction, Role of CAD in design and development of new products, Advantages of CAD. Creating two-dimensional drawing with dimensions using suitable software. (CAD, only internal evaluation)	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment+ Lab Exam	Internal Examination-1	Internal Examination- 2	Total
5	**10+5**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

Student can choose any one full question out of two questions from each module

2 Questions from one module.	**Total**
Total 8 Questions, each question carries 15 marks **(15x4 =60 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		**Bloom's Knowledge Level (KL)**
CO1	Understand the projection of points and lines located in different quadrants	**K2**
CO2	Prepare Multiview orthographic projections of objects by visualizing them in different positions	**K3**
CO3	Plot sectional views and develop surfaces of a given object	**K3**
CO4	Prepare pictorial drawings using the principles of isometric projection	**K3**
CO5	Sketch simple drawing using CAD tools.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Graphics	Varghese, P. I.	V I P Publishers	2018 edn
2	Engineering Graphics,	Benjamin, J.	Pentex Publishers	2016 edn
3	Engineering Graphics	John, K. C.	Prentice Hall India Publishers	2017 edn
4	Engineering Drawing,	Bhatt, N., D.	Charotar Publishing House Pvt Ltd.	60th edn 2019
5	Engineering Graphics,	Anilkumar, K. N.	Adhyuth Narayan Publishers	2022 edn

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Graphics with AutoCAD,	Kulkarni, D. M., Rastogi, A. P. and Sarkar, A. K.,	Prentice Hall India Publishers	2020
2	Engineering Drawing & Graphics	Venugopal, K.	New Age International Publishers	5th edn 2011
3	Engineering Drawing	Parthasarathy, N. S., and Murali, V.	Oxford University Press	2015 edn

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/112/102/112102304/
2	https://archive.nptel.ac.in/courses/112/102/112102304/
3	https://archive.nptel.ac.in/courses/112/102/112102304/
4	https://archive.nptel.ac.in/courses/112/102/112102304/

SEMESTER S1

INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to Group A & B)

Course Code	**GXEST104**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	4:0:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min
Prerequisites (if any)	None	**Course Type**	Group Core-Theory

Course Objectives:

1. To provide an understanding of the fundamental principles of electrical engineering
2. To introduce the working principles of fundamental electronic devices and circuits
3. To provide an overview of the basic concepts in different types of communication.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Elementary concepts of DC electric circuits:** Current and Voltage Division Rule - Relative potential Capacitors & Inductors: V-I relations and Energy stored. Ohms Law and Kirchhoff's laws - numerical problems. Star-delta conversion *(resistive networks only - derivation not required)* - numerical problems. **Analysis of DC Electric circuits:** Mesh current method – matrix representation - Solution of network equations.	**11**

	Node voltage methods-matrix representation-solution of network equations by matrix methods - numerical problems. **Elementary Concepts of Magnetic circuits:** Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - Comparison between electric and magnetic circuits - Series and parallel magnetic circuits with composite materials (*numerical problems not needed*)	
2	**Electromagnetic Induction**: Faraday's laws, Lenz's law- statically induced and dynamically induced emf – Self-inductance and mutual inductance, coefficient of coupling *(numerical problems not needed)* **Alternating Current fundamentals:** Generation of alternating voltages - Representation of sinusoidal waveforms: frequency, period, average value, RMS value and form factor - numerical problems AC Circuits: Phasor representation of sinusoidal quantities, Trigonometric, Rectangular, Polar and complex forms. **Analysis of simple AC circuits:** Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance - numerical problems. RL, RC and RLC series circuits- power factor, active, reactive and apparent power. Simple numerical problems. Three phase AC systems: Generation of three phase voltages, advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- numerical problems	**11**
3	**Introduction to Electronic devices:** Passive and active components in electronics Working of PN junction diode, V-I characteristics of PN Junction diode Zener diode and avalanche breakdown. Basics of Zener voltage regulator	**13**

	Block diagram of DC power supply, circuit and working of half wave, full wave and bridge rectifiers, ripple factor (with and without capacitor filters) Construction, working and V-I Characteristics of BJT, Input output characteristics of CE configuration, Comparison of CE, CB and CC configurations Concept of biasing and load line Transistor as a switch, Transistor as an amplifier (Circuit Diagram and working) RC coupled amplifier - Circuit diagram and frequency response Introduction to FET, Construction and working of N-channel and P-Channel MOSFETs	
4	**Modern Electronics and its applications:** General block diagram of a Communication system, Block diagram of Fiber optic Communication system Concept of AM and FM (No derivation required), Block diagram of AM and FM super-heterodyne receiver Basic concepts of Wired and Wireless communication, Block diagram of GSM Comparison of 3G, 4G, 5G and 6G communication technologies Block diagrams of Electronic instrumentation system, Digital Multimeter, Function generator Introduction to CRO and Lissajous patterns Applications of modern electronics – IoT based smart homes, healthcare and agriculture *(Case study only)*	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply fundamental concepts and circuit laws to solve simple DC/AC electric circuits	**K2**
CO2	Classify series and parallel magnetic circuits	**K2**
CO3	Understand three phase AC systems	**K2**
CO4	Describe the fundamental concepts of electronic components and devices	**K2**
CO5	Outline the principles of communication systems	**K2**
CO6	Identify various applications of modern electronics in the contemporary world	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Basic Electrical Engineering	D P Kothari and I J Nagrath	Tata McGraw Hill	4/e 2019
2	Schaum's Outline of Basic Electrical Engineering	J.J.Cathey and Syed A Nasar	Tata McGraw Hill	3/e 2010
3	Basic Electronics: Principles and Applications	Chinmoy Saha, Arindham Halder and Debarati Ganguly	Cambridge University Press	1/e 2018
4	Basic Electrical and Electronics Engineering	D. P. Kothari and I. J. Nagrath	McGraw Hill	2/e 2020
5	The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World	Michael Miller	QUE	1/e 2015
6	Basic Electronics and Linear Circuits	N N Bhargava D C Kulshreshtha and S. C. Gupta	McGraw Hill	2/e 2017
7	Electronic Communication SYstems	Kennedy and Davis	McGraw Hill	6/e 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Basic Electrical Engineering	D C Kulshreshtha	Tata McGraw Hill	2/e 2019
2	Electrical Engineering Fundamentals	Del Toro V	Pearson Education	2/e 2019
3	Basic Electrical Engineering	T. K. Nagsarkar, M. S. Sukhija	Oxford Higher Education	3/e 2017
4	Electronics: A Systems Approach	Neil Storey	Pearson	6e 2017
5	Electronic Devices and Circuit Theory	Robert L. Boylestad and Louis Nashelsky	Pearson	11e 2015
6	Principles of Electronic Communication Systems	Frenzel, L. E	MGH	4e 2016
7	Internet of Things: Architecture and Design Principles	Raj Kamal	McGraw Hill	1/e 2017
8	Electronic Communication	Dennis Roddy and John Coolen	Pearson	4/e 2008

SEMESTER S1

ALGORITHMIC THINKING WITH PYTHON

(Common to All Branches)

Course Code	**UCEST105**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To provide students with a thorough understanding of algorithmic thinking and its practical applications in solving real-world problems.
2. To explore various algorithmic paradigms, including brute force, divide-and-conquer, dynamic programming, and heuristics, in addressing and solving complex problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	PROBLEM-SOLVING STRATEGIES:- Problem-solving strategies defined, Importance of understanding multiple problem-solving strategies, Trial and Error, Heuristics, Means- Ends Analysis, and Backtracking (Working backward). THE PROBLEM-SOLVING PROCESS:- Computer as a model of computation, Understanding the problem, Formulating a model, Developing an algorithm, Writing the program, Testing the program, and Evaluating the solution.	7

	ESSENTIALS OF PYTHON PROGRAMMING:- Creating and using variables in Python, Numeric and String data types in Python, Using the math module, Using the Python Standard Library for handling basic I/O - print, input, Python operators and their precedence.	
2	ALGORITHM AND PSEUDOCODE REPRESENTATION:- Meaning and Definition of Pseudocode, Reasons for using pseudocode, The main constructs of pseudocode - Sequencing, selection (if-else structure, case structure) and repetition (for, while, repeat- until loops), Sample problems* FLOWCHARTS** :- Symbols used in creating a Flowchart - start and end, arithmetic calculations, input/output operation, decision (selection), module name (call), for loop (Hexagon), flow-lines, on-page connector, off-page connector. * - *Evaluate an expression, **d=a+b*c**, find simple interest, determine the larger of two numbers, determine the smallest of three numbers, determine the grade earned by a student based on KTU grade scale (using if-else and case structures), print the numbers from 1 to 50 in descending order, find the sum of n numbers input by the user (using all the three loop variants), factorial of a number, largest of n numbers (**Not to be limited to these exercises. More can be worked out if time permits**).* ** ***Only for visualizing the control flow of Algorithms. The use of tools like RAPTOR (https://raptor.martincarlisle.com/) is suggested. Flowcharts for the sample problems listed earlier may be discussed***	**9**
3	SELECTION AND ITERATION USING PYTHON:- if-else, elif, for loop, range, while loop. Sequence data types in Python - list, tuple, set, strings, dictionary, Creating and using Arrays in Python (using Numpy library). DECOMPOSITION AND MODULARISATION* :- Problem decomposition as a strategy for solving complex problems, Modularisation, Motivation for modularisation, Defining and using functions in Python, Functions with multiple return values	**10**

	RECURSION:- Recursion Defined, Reasons for using Recursion, The Call Stack, Recursion and the Stack, Avoiding Circularity in Recursion, Sample problems - Finding the **n**th Fibonacci number, greatest common divisor of two positive integers, the factorial of a positive integer, adding two positive integers, the sum of digits of a positive number **. --- * The idea should be introduced and demonstrated using Merge sort, the problem of returning the top three integers from a list of **n>=3** integers as examples. (**Not to be limited to these two exercises. More can be worked out if time permits**). ** ***Not to be limited to these exercises. More can be worked out if time permits***.	
4	COMPUTATIONAL APPROACHES TO PROBLEM-SOLVING(*Introductory diagrammatic/algorithmic explanations only. Analysis not required*) :- Brute-force Approach - - *Example: Padlock, Password guessing* Divide-and-conquer Approach - - *Example: The Merge Sort Algorithm* - Advantages of Divide and Conquer Approach - Disadvantages of Divide and Conquer Approach Dynamic Programming Approach - *Example: Fibonacci series* - Recursion vs Dynamic Programming Greedy Algorithm Approach - *Example: Given an array of positive integers each indicating the completion time for a task, find the maximum number of tasks that can be completed in the limited amount of time that you have.* - Motivations for the Greedy Approach	**10**

	- Characteristics of the Greedy Algorithm - Greedy Algorithms vs Dynamic Programming Randomized Approach - *Example 1: A company selling jeans gives a coupon for each pair of jeans. There are n different coupons. Collecting **n** different coupons would give you free jeans. How many jeans do you expect to buy before getting a free one?* *Example 2: **n** people go to a party and drop off their hats to a hat-check person.* *When the party is over, a different hat-check person is on duty and returns the **n** hats randomly back to each person. What is the expected number of people who get back their hats?* -Motivations for the Randomized Approach	

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment (Accurate Execution of Programming Tasks)	Internal Examination-1 (Written Examination)	Internal Examination-2 (Written Examination)	Internal Examination-3 (Lab Examination)	Total
5	5	10	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Utilize computing as a model for solving real-world problems.	**K2**
CO2	Articulate a problem before attempting to solve it and prepare a clear and accurate model to represent the problem.	**K3**
CO3	Utilize effective algorithms to solve the formulated models and translate algorithms into executable programs.	**K3**
CO4	Interpret the problem-solving strategies, a systematic approach to solving computational problems, and essential Python programming skills	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Problem solving & programming concepts	Maureen Sprankle, Jim Hubbard	Pearson	2012
2	How to Solve It: A New Aspect of Mathematical Method	George Pólya	Princeton University Press	2015
3	Creative Problem Solving: An Introduction	Donald Treffinger., Scott Isaksen, Brian Stead-Doval	Prufrock Press	2005
4	Psychology (Sec.. Problem Solving.)	Spielman, R. M., Dumper, K., Jenkins, W., Lacombe, A., Lovett, M., & Perlmutter, M	H5P Edition	2021
5	Computer Arithmetic Algorithms	Koren, Israel	AK Peters/CRC Press	2018
6	Introduction to Computation and Programming using Python	Guttag John V	PHI	2/e., 2016
7	Python for Everyone	Cay S. Horstmann, Rance D. Necaise	Wiley	3/e, 2024
8	Computational Thinking: A Primer for Programmers and Data Scientists	G Venkatesh Madhavan Mukund	Mylspot Education Services Pvt Ltd	2020

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://opentextbc.ca/h5ppsychology/chapter/problem-solving/
2	https://onlinecourses.nptel.ac.in/noc21_cs32/preview

1. Continuous Assessment (5 Marks)

Accurate Execution of Programming Tasks

- Correctness and completeness of the program
- Efficient use of programming constructs
- Handling of errors
- Proper testing and debugging

2. Evaluation Pattern for Lab Examination (10 Marks)

1. **Algorithm (2 Marks)**

   Algorithm Development: Correctness and efficiency of the algorithm related to the question.

2. **Programming (3 Marks)**

   Execution: Accurate execution of the programming task.

3. **Result (3 Marks)**

   Accuracy of Results: Precision and correctness of the obtained results.

4. **Viva Voce (2 Marks)**

   Proficiency in answering questions related to theoretical and practical aspects of the subject.

Sample Classroom Exercises:

1. Identify ill-defined problem and well-defined problems
2. How do you differentiate the methods for solving algorithmic problems: introspection, simulation, computer modelling, and experimentation?
3. Use cases for Trial and error, Algorithm, Heuristic and Means-ends analysis can be applied in proffering solution to problems

4. Use a diagram to describe the application of Tower of Hanoi in choosing and analysing an action at a series of smaller steps to move closer to the goal
5. What effect will be generated if the stage that involves program writing is not observed in the problem-solving process?
6. What effect will be generated if the stage that involves program writing is not observed in the problem-solving process?
7. Evaluate different algorithms based on their efficiency by counting the number of steps.
8. Recursive function that takes a number and returns the sum of all the numbers from zero to that number.
9. Recursive function that takes a number as an input and returns the factorial of that number.
10. Recursive function that takes a number 'n' and returns the nth number of the Fibonacci number.
11. Recursive function that takes an array of numbers as an input and returns the product of all the numbers in the list.

LAB Experiments:

1. Demonstrate about Basics of Python Programming
2. Demonstrate about fundamental Data types in Python Programming. (i.e., int, float, complex, bool and string types)
3. Demonstrate different Arithmetic Operations on numbers in Python.
4. Create, concatenate, and print a string and access a sub-string from a given string.
5. Familiarize time and date in various formats (Eg. "Sun May 29 02:26:23 IST 2017")
6. Write a program to create, append, and remove lists in Python using numPy.
7. Programs to find the largest of three numbers.
8. Convert temperatures to and from Celsius, and Fahrenheit. [Formula: c/5 = f-32/9]
9. Program to construct the stars (*) pattern, using a nested for loop
10. Program that prints prime numbers less than 20.
11. Program to find the factorial of a number using Recursion.
12. Recursive function to add two positive numbers.
13. Recursive function to multiply two positive numbers
14. Recursive function to the greatest common divisor of two positive numbers.
15. Program that accepts the lengths of three sides of a triangle as inputs. The program output should indicate whether or not the triangle is a right triangle (Recall from the Pythagorean Theorem that in a right triangle, the square of one side equals the sum of the squares of the other two sides). Implement using functions.

16. Program to define a module to find Fibonacci Numbers and import the module to another program.
17. Program to define a module and import a specific function in that module to another program.
18. Program to check whether the given number is a valid mobile number or not using functions?

    Rules:

    1. Every number should contain exactly 10 digits.
    2. The first digit should be 7 or 8 or 9

SEMESTER S1

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING WORKSHOP

(Common to All Groups except for Civil Engineering Branch)

Course Code	**GXESL106**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:2:0	**ESE Marks (Internal only)**	50
Credits	1	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Lab

Course Objectives:

1. To create awareness and familiarity with electrical wiring and safety measures to be taken.
2. To Identify various electronic components and to operate various measuring instruments
3. Learn to setup simple electronic circuits on breadboard and PCB

Expt. No.	Experiments
	Electrical Workshop (Minimum of 7 Experiments to be done)
1	a) Demonstrate the precautionary steps adopted in case of Electrical shocks. b) Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB, familiarize the ratings.
2	Wiring of a simple light circuit for light/ fan point (PVC conduit wiring) and a 6A plug socket with individual control.
3	Wiring of light/fan circuit using two-way switches. (Staircase wiring)
4	Wiring of fluorescent lamp and a power plug (16 A) socket with a control switch.
5	Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6	Familiarisation of step up and step-down transformers, (use low voltage transformers) Measurement and representation of voltage and waveform to scale in graph sheet with the help of CRO
7	Familiarisation of rheostats, measurement of potential across resistance elements and introducing the concept of relative potential using a DC circuit.

8	a) Identify battery specifications using different types of batteries. (Lead acid, Li Ion, NiCd etc.) b) Familiarize different types of earthing (Pipe, Plate Earthing, Mat Schemes) and ground enhancing materials (GEM).
ELECTRONICS WORKSHOP **(Minimum of 7 Experiments to be done)**	
1	Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol and cost of -Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)
2	Drawing of electronic circuit diagrams using BIS/IEEE symbols and Interpret data sheets of discrete components and IC's
3	Familiarization/Application of testing instruments and commonly used tools. - Multimeter, Function generator, Power supply, CRO, DSO. Soldering iron, Desoldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station
4	Testing of electronic components using multimeter - Resistor, Capacitor, Diode, Transistor and JFET.
5	Printed circuit boards (PCB) - Types, Single sided, Double sided, PTH, Processingmethods. Design and fabrication of a single sided PCB for a simple circuit.
6	Inter-connection methods and soldering practice. Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions. Soldering practice in connectors and general-purpose PCB, Crimping.

7	Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (Any two)- Fixed voltage power supply with transformer • Rectifier diode • Capacitor filter • Zener/IC regulator Square wave generation using IC 555 timer in IC base.
8	Assembling of electronic circuits using SMT (Surface Mount Technology) stations.
9	Introduction to EDA tools (such as KiCad or XCircuit)

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work, experiments, Viva and Timelycompletion of Lab Reports / Record (Continuous Assessment)	Total
5	**45**	**50**

End Semester Examination Marks (ESE): (Internal evaluation only)

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified Lab record.

Pass Criteria:

- *A student must score a minimum of 50% overall, combining marks from both Continuous Internal Evaluation (CIE) and End Semester Examination (ESE).*
- ***In addition, the student must secure at least 40% in the End Semester Examination (ESE).***

The ESE shall be conducted internally, with evaluation carried out by a panel of faculty members. This panel must include at least one faculty member who was not involved in the Continuous Internal Evaluation (CIE) of the lab course.

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Demonstrate safety measures against electrical shocks	K2
CO2	Familiarise with transformers, rheostats, batteries and earthing schemes	K2
CO3	Illustrate the connection diagram and identify the suitable accessories necessary for wiring simple electric circuits	K3
CO4	Identify various electronic components	K2
CO5	Operate various measuring instruments	K3
CO6	Apply the design procedure of simple electronic circuits on breadboard and PCB	K3
CO7	Build the ability to work in a team with good interpersonal skills	K3

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3						2
CO2	1					2	1					2
CO3	2					1						2
CO4	3					2						3
CO5	3				3	2			2			3
CO6	3		3	1	3	2	1		2			3
CO7									3	2		2

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electrical Design Estimating and Costing	K B Raina and S KBhattacharya	New Age International Publishers	2/e 2024
2	Electrical Systems Design	M K Giridharan	I K International Publishing House Pvt. Ltd	3/e 2022
3	Basic Electrical Engineering	D P Kothari and I J Nagrath	Tata McGraw Hill	4/e 2019
4	Basic Electronics and Linear Circuits	NN Bhargava, D C Kulshreshtha and S C Gupta	Mc Graw Hill	2/e 2017

Continuous Assessment with equal weightage for both specializations (45 Marks)

1. Preparation and Pre-Lab Work (10 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, andtroubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

2. Lab Reports and Record Keeping (10 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentationof experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

3. Viva Voce (10 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Evaluation Pattern for End Semester Examination with equal weightage in both specializations (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

- Procedure Understanding and Description: Clarity in explaining the procedure and understandingeach step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

- Setup and Execution: Proper setup and accurate execution of the experiment or programmingtask.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality ofprogram output.

4. **Viva Voce (10 Marks)**

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S1/S2

HEALTH AND WELLNESS

(Common to all Groups)

Course Code	**UCHWT127**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	1:0:1:0	**ESE Marks**	0
Credits	1	**Exam Hours**	Nil
Prerequisites (if any)	None	**Course Type**	

Course Objectives:

1. To provide essential knowledge on physical activity, health, and wellness.
2. To ensure students understand body systems, exercise principles, nutrition, mental health, and disease management.
3. To educate students on the benefits of yoga, the risks of substance abuse and basic first aid skills.
4. To equip students with the ability to lead healthier lifestyles.
5. To enable students to design effective and personalized exercise programs.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Human Body Systems related to Physical activity and its functions: Respiratory System - Cardiovascular System. Musculoskeletal System and the Major Muscle groups of the Human Body. Quantifying Physical Activity Energy Expenditure and Metabolic equivalent of task (MET) Exercise Continuum: Light-intensity physical activity, Moderate - intensity physical activity, Vigorous -intensity physical activity. Defining Physical Activity, Aerobic Physical Activity, Anaerobic Physical Activity, Exercise and Health-Related Physical Fitness. FITT principle to design an Exercise programme Components of Health related Physical Fitness: - Cardiorespiratory Fitness- Muscular strength- Muscular endurance- Flexibility- Body composition.	**4**

2	Concept of Health and Wellness: Health and wellness differentiation, Factors affecting health and wellness. Mental health and Factors affecting mental health. Sports and Socialization: Sports and character building - Leadership through Physical Activity and Sports Diet and nutrition: Exploring Micro and Macronutrients: Concept of Balanced diet Carbohydrate & the Glycemic Index Animal & Plant - based Proteins and their Effects on Human Health Dietary Fats & their Effects on Human Health Essential Vitamins and Minerals	**2**
3	Lifestyle management strategies to prevent / manage common hypokinetic diseases and disorders - Obesity - cardiovascular diseases (e.g., coronary artery disease, hypertension) - Diabetes - Osteoporosis - Musculoskeletal disorders (e.g., osteoarthritis, Low back pain, Kyphosis, lordosis, flat foot, Knock knee) Meaning, Aims and objectives of yoga - Classification and importance of of Yogic Asanas (Sitting, Standing, lying) Pranayama and Its Types - Active Lifestyle and Stress Management Through Yoga Understanding on substance abuse and addiction - Psychoactive substances & its ill effects- Alcohol- Opioids- Cannabis -Sedative - Cocaine -Other stimulants, including caffeine -Hallucinogens - Tobacco -Volatile solvents.	**4**
4	First aid and principles of First Aid: Primary survey: ABC (Airway, Breathing, Circulation). Qualities of a Good First Aider First aid measures for: - Cuts and scrapes - Bruises - Sprains - Strains - Fractures - Burns - Nosebleeds. First Aid Procedures: Cardiopulmonary Resuscitation (CPR)- Heimlich Maneuver - Applying a sling Sports injuries: Classification (Soft Tissue Injuries - Abrasion, Contusion, Laceration, Incision, Sprain & Strain)	**2**

Additional Topics

- Need and Importance of Physical Education and its relevance in interdisciplinary context. Understanding of the Endocrine System
- Developing a fitness profile
- Healthy foods habits for prevention and progression of Lifestyle Diseases. Processed foods and unhealthy eating habits.
- Depression - Anxiety - Stress
- Different ways of carrying an injured person. Usage of Automated external defibrillator

Course Assessment Method
(CIE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Case Study/Micro project/Presentation	Activity evaluation	Total
10	20	20	50

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the different human body systems and describe various types of physical activities along with methods to measure and quantify these activities.	**K2**
CO2	Explain how to maintain or improve health and wellness through psychological practices, dietary habits, and sports activities.	**K2**
CO3	Discuss about common hypokinetic disorders and musculoskeletal disorders, and describe the importance of leading a healthy lifestyle through the practice of yoga and abstaining from addictive substances.	**K2**
CO4	Explain the basics of first aid and describe common sports injuries	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1				2		3		3	3	2		2
CO2				2		3		2	2			2
CO3				0		3		3				2
CO4				2		3						2

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Foundations of Nutrition	Bhavana Sabarwal	Commonwealth Publishers	1999
2	Anatomy and physiology in health and illness.	Ross and Wilson	Waugh, A., & Grant, A.	2022

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fit to be Well Essential Concept	Thygerson, A. L., Thygerson, S. M., & Thygerson, J. S.	Jones & Bartlett Learning.	2018
2	Introduction to physical education, fitness, and sport.	Siedentop, D., & Van der Mars, H.	Human kinetics.	2022
3	Substance Use Disorders. Manual for Physicians.	Lal, R., & Ambekar, A. (2005).	National Drug Dependence Treatment Centre, New Delhi	2005
4	The exercise health connection-how to reduce your risk of disease and other illnesses by making exercise your medicine.	Nieman, D. C., & White, J. A	Public Health	1998
5	ACSM's resource manual for guidelines for exercise testing and prescription.	Lippincott Williams & Wilkins.	American College of Sports Medicine.	2012
6	Exercise Physiology: energy, nutrition and human performance.	Katch, F. I., Katch, V. L., & McArdle, W. D.	Lippincott Williams & Wilkins	2010

Continuous Internal Evaluation Marks (CIE): for the Health and Wellness course

Title	Method of Evaluation
Attendance	Students must attend at least 75% of both theory and practical classes. They will receive 10 marks based on their class attendance. Students who do not meet the minimum attendance requirement for a course, as specified in the B. Tech regulations, will not be eligible to proceed to the next criteria.
Assignment / Presentation	Assignments will be given to students to assess their understanding of the subjects taught. Students will be required to make presentations on the subjects taught in class, and their understanding of the subjects will be assessed. Based on the Assignments and Presentations the students will be awarded marks out of 20.
Activity Evaluation	The Assignment / Presentation faculty handling the class will use the tests from the Fitness Protocols and Guidelines for ages 18+ to 65 years, as set forth by FIT India. Measurements will be taken for all the tests of the FIT India Fitness Protocol and the evaluation will be based on the benchmark score received for the following tests: 1. V Sit Reach Test 2. Partial Curl Up - 30 seconds 3. Push Ups (Male) and Modified Push Up (Female) 4. Two (2) Km Run/Walk Students who achieve a total benchmark score of 8 across the aforementioned 4 tests will be awarded pass marks for activity evaluation. Students who score better will be awarded a maximum mark of 20.

Activity Evaluation - Special Circumstances	Physically challenged and medically unfit students can opt for an objective test to demonstrate their knowledge of the subjects taught. Based on their performance in the objective test, they will be awarded marks out of 20.
Activity Evaluation - Special Considerations - NCC	Students who enrolled themselves in the NCC during the course period (between the start and end dates of the program) and attended 5 college level parades will be awarded pass marks for activity evaluation. Students who attend more parades will be eligible for a maximum mark of 20 based on their parade attendance.

Tests to evaluated as per Criterion - 2 and Benchmark Scores

V Sit Reach Test

How to Perform:

1. The subject removes their shoes and sits on the floor with the measuring line between their legs and the soles of their feet placed immediately behind the baseline, heels 8-12" apart.

2. The thumbs are clasped so that hands are together, palms facing down and placed on the measuring line.

3. With the legs held flat by a partner, the subject slowly reaches forward as far as possible, keeping the fingers on baseline and feet flexed.

4. After three tries, the student holds the fourth reach for three seconds while that distance is recorded.

5. Make sure there are no jerky movements, and that the fingertips remain level and the legs flat.

Infrastructure/Equipment Required:

1. A tape for marking the ground, marker pen, and ruler.

2. With the tape mark a straight line two feet long on the floor as the baseline, and a measurement line perpendicular to the midpoint of the baseline extending two feet on each side.

3. Use the marker pen to indicate every centimeter and millimeter along the measurement line. The point where the baseline and the measuring line intersect is the zero point.

Scoring: The score is recorded in centimeters and millimeters as the distance reached by the hand, which is the difference between the zero point (where the baseline and measuring line intersect) and the final position.

Scoring for V Sit Reach Test for Males

Level	Benchmark Score	Measurement (cm)
1	2	<11
2	4	12-13
3	6	14-17
4	7	18-19
5	8	20-21
6	9	22
7	10	>22

Scoring for V Sit Reach Test for Females

Level	Benchmark Score	Measurement (cm)
1	2	<14
2	4	15-16
3	6	17-19
4	7	20-21
5	8	22
6	9	23
7	10	>23

Partial Curl Up - 30 seconds

How to Perform:

1. The subject lies on a cushioned, flat, clean surface with knees flexed, usually at 90 degrees, with hands straight on the sides (palms facing downwards) closer to the ground, parallel to the body.

2. The subject raises the trunk in a smooth motion, keeping the arms in position, curling up the desired amount (at least 6 inches above/along the ground towards the parallel strip).

3. The trunk is lowered back to the floor so that the shoulder blades or upper back touch the floor.

Infrastructure/Equipment Required:

Flat clean cushioned surface with two parallel strips (6 inches apart), Stopwatch Scoring:

Record the maximum number of Curl ups in a certain time period 30 seconds.

Scoring for Partial Curl Up - 30 seconds Test for Males

Level	Benchmark Score	Numbers
1	2	<25
2	4	25-30
3	6	31-34
4	7	35-38
5	8	39-43
6	9	44-49
7	10	>49

Scoring for Partial Curl Up - 30 seconds Test for Females

Level	Benchmark Score	Numbers
1	2	**<18**
2	4	18-24
3	6	25-28
4	7	29-32
5	8	33-36
6	9	37-43
7	10	>43

Push Ups for Male/Modified Push Ups for Female

How to Perform:

1. A standard push up begins with the hands and toes touching the floor, the body and legs in a straight line, feet slightly apart, the arms at shoulder width apart, extended and at a right angle to the body.

2. Keeping the back and knees straight, the subject lowers the body to a predetermined point, to touch some other object, or until there is a 90-degree angle at the elbows, then returns back to the starting position with the arms extended.

3. This action is repeated, and the test continues until exhaustion, or until they can do no more in rhythm or have reached the target number of push-ups.

4. For Female: push-up technique is with the knees resting on the ground.

Infrastructure/Equipment Required:

Flat clean cushioned surface/Gym mat

Scoring: Record number of correctly completed pushups.

Scoring for Push Ups for Male

Level	Benchmark Score	Numbers
1	2	<4
2	4	04- 10
3	6	11 -18
4	7	19-34
5	8	35-46
6	9	47-56
7	10	>56

Scoring for Modified Push Ups for Female

Level	Benchmark Score	Numbers
1	2	0-1
2	4	2 - 5
3	6	6 -10
4	7	11 - 20
5	8	21-27
6	9	27-35
7	10	>35

2 Km Run/Walk

How to Perform:

1. Participants are instructed to run or walk 2 kms in the fastest possible pace.

2. The participants begin on signal (Starting point)- "ready, start". As they cross the finish line, elapsed time should be announced to the participants.

3. Walking is permitted but the objective is to cover the distance in the shortest possible time.

Infrastructure/Equipment Required:

Stopwatch, whistle, marker cone, lime powder, measuring tape, 200 or 400 m with 1.22 m (minimum 1 m) width preferably on a flat and even playground with a marking of starting and finish line. You can also use any application on your mobile phone that tells you the distance.

Scoring: Time taken for completion (Run or Walk) in min, sec.

Scoring for 2Km Run/walk for Male

Level	Benchmark Score	Minutes: Seconds
1	2	> 11:50
2	4	10:42
3	6	09:44
4	7	08:59
5	8	08:33
6	9	07:37
7	10	>07:37

Scoring for 2Km Run/walk for Female

Level	Benchmark Score	Minutes: Seconds
1	2	>13:47
2	4	12:51
3	6	12:00
4	7	11:34
5	8	10:42
6	9	09:45
7	10	>09:45

SEMESTER - S1/S2

LIFE SKILLS AND PROFESSIONAL COMMUNICATION
(Common to all Branches)

Course Code	**UCHUT128**	**CIE Marks**	100
Teaching Hours/Week (L: T:P: R)	2:0:1:0	**ESE Marks**	0
Credits	1	**Exam Hours**	-
Prerequisites (if any)	None	**Course Type**	Activity-based learning

Course objectives:

1. To foster self-awareness and personal growth, enhance communication and interpersonal connection skills, promote effective participation in groups and teams, develop critical thinking, problem-solving, and decision-making skills, and cultivate the ability to exercise emotional intelligence.
2. To equip students with the necessary skills to listen, read, write & speak, to comprehend and successfully convey any idea, technical or otherwise.
3. To equip students to build their profile in line with the professional requirements and standards.

Continuous Internal Evaluation Marks (CIE):

- Continuous internal evaluation is based on the individual and group activities as detailed in the activity table given below.
- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. They should use online collaboration tools for group activities, report/presentation making and work management.
- Activities are to be distributed between 3 class hours (2L+1P) and 3.5 Self-study hours.
- Marks given against each activity should be awarded fully if the students successfully complete the activity.
- Students should maintain a portfolio file with all the reports and other textual materials generated

from the activities. Students should also keep a journal related to the activities undertaken.

- Portfolio and journal are mandatory requirements for passing the course, in addition to the minimum marks required.
- The portfolio and journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through the HMC courses and Mini project course.
- Self-reflection questionnaire shall be given at the beginning of the semester, in between and at the end of the semester based on the guidelines in the manual of the course.

Table 1: Activity Table

Sl. No.	Activity	Class room (L) / Self Study (SS)	Week of completion	Group / Individual (G/I)	Marks	Skills	CO
1.1	Group formation and self-introduction among the group members	L	1	G	-	• Connecting with group members • Time management - Gantt Chart	
1.2	Familiarizing the activities and preparation of the time plan for the activities	L	1	G	-		
1.3	Preparation of Gantt chart based on the time plan	SS	1	G	2		
2.1	Take an online personality development test, self reflect and report	SS	1	I	2	• Self-awareness Writing	CO1
2.2	Role-storming exercise 1: Students assume 2 different roles given below and write about their ● Strengths, ● Areas for improvement, ● Concerns, ● Areas in which he/she hesitates to take advice, ● Goals/Expectations,	L	1	I	2	●Goal setting - Identification of skills and setting goal ●Self-awareness ●Discussion in groups ●Group work- Compiling of ideas • Mind mapping	CO1

	from the point of view of the following assumed roles i) their parent/guardian/mentor ii) their friend/sibling/cousin						
2.3	Role-storming exercise 2: Students assume the role of their teacher and write about the ● Skills required as a B.Tech graduate ● Attitudes, habits, approaches required and activities to be practised during their B.Tech years, in order to achieve the set goals	SS	1	I	2		CO1
2.4	Discuss the skills identified through rolestorming excercise by each one within their own group and improvise the list of skills	L	1	G	2		CO1
2.5	Prepare a mind map based on the role-storming exercise and exhibit/present it in class	SS	2	G	2		CO1
3	Prepare a presentation on instances of empathy they have observed in their own life or in other's life	L	2 to 4	I	2	● Empathy	CO2
4.1	Each student connects and networks with a minimum of 3 professionals from industry/public sector organizations/other agencies/NGOs /academia (atleast 1 through LinkedIn)	SS	3	I	2	● Workplace awareness ● Listening ● Communication - interacting with people ● Networking through various media including LinkedIn ● Discussion in groups ● Report preparation ● Creativity Goal setting - Preparation of	
4.2	Interact with them to understand their workplace details including ● workplace skills required ● their work experience ● activities they have done to enhance their employability during their B.Tech years ● suggestions on the different activities to be done during B.Tech years	SS	3	I	4		CO2

	Prepare a documentation of this					action plan	
4.3	Discuss the different workplace details & work readiness activities assimilated by each through the interactions within their group and compile the inputs collected by the individuals Prepare the Minutes of the discussions	SS	3	G	2		CO2
4.4	Report preparation based on the discussions	SS	4	G	3		CO4
4.5	Perform a role-play based on the workplace dynamics assimilated through interactions and group discussions	L	5	G	4		CO3
4.6	Identify their own goal and prepare an action plan for their undergraduate journey to achieve the goal	SS	5	I	2		CO1
5.1	Select a real-life problem that requires a technical solution and list the study materials needed	L	6	G	2		CO3
5.2	Listen to TED talks & video lectures from renowned Universities related to the problem and prepare a one-page summary (Each group member should select a different resource)	SS	6	I	2		CO4
5.3	Use any online tech forum to gather ideas for solving the problem chosen	SS	6	G	2		CO5
5.4	Arrive at a possible solution using six thinking hat exercise	L	7	G	3		CO3
5.5	Prepare a report based on the problem-solving experience	SS	7	G	2		CO4
6.1	Linkedin profile creation	SS	1	I	2	Profile-building	CO6
6.2	Resume preparation	SS	8	I	2		CO6
6.3	Self-introduction video	SS	8	I	3		CO6
7	Prepare a presentation on instances of demonstration of emotional intelligence	SS	9	I	2	Emotional intelligence	CO2

8	Prepare a short video presentation on diversity aspects observed in our society (3 to 5 minutes)	SS	10	G	3	Diversity	CO2, CO5
9	Take online Interview skills development sessions like robotic interviews; self-reflect and report	SS	10	I	2	• Interview skills	CO6
10	Take an online listening test, self-reflect and report	SS	11	I	2	Listening skills	CO6
11.1	Activities to improve English vocabulary of students	L	8	I/G	4	• English vocabulary • English language skills • Writing • Presentation • Group work • Self-reflection	CO4
11.2	Activities to help students identify errors in English language usage	L	9	I/G	2		CO4
11.3	Activity to help students identify commonly mispelled words, commonly mispronounced words and confusing words	L	10	I/G	2		CO4
11.4	Write a self-reflection report on the improvement in English language communication through this course	SS	12	I	2		CO4
11.5	Presentation by groups on the experience of using online collaboration tools in various group activities and time management experience as per the Gantt chart prepared	L	11 to 12	G	2		CO4, CO5
12.1	Each group prepares video content for podcasts on innovative technological interventions/research work tried out in Kerala context by academicians/professionals/Govt. agencies/research institutions/private agencies/NGOs/other agencies	SS	12	G	4	• Audio-visual presentations creations with the use of technology tools • Effective use of social media platforms • Profile building	CO2, CO4, CO5
12.2	Upload the video content to podcasting platforms or YouTube	SS	12	G	1		CO5
12.3	Add the link of the podcast in their LinkedIn profile	SS	12	G	1		CO5

Table 2. Lab hour Activities (P): 24 Marks

Sl No	Activity	Marks	Skill	CO
1	Hands-on sessions on day-to-day engineering skills and a self-reflection report on the experience gained: 1. Drilling practice using electric hand drilling machines. 2. Cutting of MS rod and flat using electric hand cutters. 3. Filing, finishing and smoothening using electrically operated hand grinders. 4. MS rod cutting using Hack saw by holding the work in bench wise. 5. Study and handling different types of measuring instruments. 6. Welding of MS, SS work pieces. 7. Pipe bending practice (PVC and GI). 8. Water tap fitting. 9. Water tap rubber seal changing practice. 10. Union and valves connection practice in pipes. 11. Foot valve fitting practice. 12. Water pump seal and bearing changing practice.	**24**	Basic practical engineering skills	**3**
2	Language Lab sessions	**-**	Language Skills	**4**

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to know & understand oneself, show confidence in one's potential & capabilities, set goals and develop plans to accomplish tasks	**K5**
CO2	Develop the ability to communicate and connect with others, participate in groups/teams, empathise, respect diversity, be responsible and understand the need to exercise emotional intelligence	**K5**
CO3	Develop thinking skills, problem-solving and decision-making skills	**K5**
CO4	Develop listening, reading, writing & speaking skills, ability to comprehend & successfully convey any idea, and ability to analyze, interpret & effectively summarize textual, audio & visual content	**K6**
CO5	Develop the ability to create effective presentations through audio-visual mediums with the use of technology tools and initiate effective use of social media platforms & tech forums for content delivery and discussions	**K6**
CO6	Initiate profile-building exercises in line with the professional requirements, and start networking with professionals/academicians	**K6**

CO-PO Mapping

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

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Life Skills & Personality Development	Maithry Shinde et.al.	Cambridge University Press	First Edition, 2022
2	Emotional Intelligence: Why it can matter more than IQ	Daniel Goleman	Bloomsbury, Publishing PLC	25th Anniversary Edition December 2020
3	Think Faster, Talk Smarter: How to speak successfully when you are put on the spot	Matt Abrahams	Macmillan Business	September 2023
4	Deep Work: Rules for focused success in a distracted world	Cal Newport	PIATKUS	January 2016
5	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education	2nd Edition 2017
6	Interchange	Jack C. Richards, With Jonathan Hull, Susan Proctor	Cambridge publishers	5th Edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Life Skills for Engineers	Remesh S., Vishnu R.G.	Ridhima Publications	First Edition, 2016
2	Soft Skills & Employability Skills	Sabina Pillai and Agna Fernandez	Cambridge University Press	First Edition, 2018
3	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education	2nd Edition 2017
4	English Grammar in Use	Raymond Murphy,	Cambridge University Press India PVT LTD	5th Edition 2023
5	Guide to writing as an Engineer	David F. Beer and David McMurrey	John Willey. New York	2004

SEMESTER 2

GROUP B

SEMESTER S2

MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE - 2

(Common to Group B & C)

Course Code	**GYMAT201**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Basic knowledge in single variable calculus.	**Course Type**	Theory

Course Objectives:

1. To provide a comprehensive understanding of partial derivatives, multiple integrals, and the differentiation and integration of vector-valued functions, emphasizing their applications in engineering contexts.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Limits and continuity, Partial derivatives, Partial derivatives of functions with two variables, Partial derivatives viewed as rate of change and slopes, Partial derivatives of functions with more than two variables, Higher order partial derivatives, Local Linear approximations, Chain rule, Implicit differentiation, Maxima and minima of functions of two variables - relative maxima and minima **(Text 1: Relevant topics from sections 13.2, 13.3, 13.4, 13.5, 13.8)**	**9**

2	Double integrals, Reversing the order of integration in double integrals, change of coordinates in double integrals (Cartesian to polar), Evaluating areas using Double integrals, Finding volumes using double integration, Triple integrals, Volume calculated as triple integral, Triple integral in Cartesian and cylindrical coordinates. **(Text 1: Relevant topics from section 14.1, 14.2, 14.3, 14.5, 14.6)**	**9**
3	Vector valued function of single variable - derivative of vector valued function, Concept of scalar and vector fields, Gradient and its properties, Directional derivative, Divergent and curl, Line integrals of vector fields, Work done as line integral, Conservative vector field, independence of path, Potential function (results without proof). **(Text 1: Relevant topics from section 12.1, 12.2, 13.6, 15.1, 15.2, 15.3)**	**9**
4	Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals, finding areas using Greens theorem, Surface integrals over surfaces of the form $z = g(x, y)$, Flux integrals over surfaces of the form $z = g(x, y)$, Divergence theorem (without proof), Using Divergence theorem to find flux, Stokes theorem (without proof) **(Text 1: Relevant topics from section 15.4, 15.5, 15.6, 15.7,15.8)**	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Compute the partial and total derivatives and maxima and minima of multivariable functions and to apply in engineering problems.	**K3**
CO2	Understand theoretical idea of multiple integrals and to apply them to find areas and volumes of geometrical shapes.	**K3**
CO3	Compute the derivatives and line integrals of vector functions and to learn their applications.	**K3**
CO4	Apply the concepts of surface and volume integrals and to learn their inter-relations and applications.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Calculus	H. Anton, I. Biven, S.Davis	Wiley	12th edition, 2024

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Thomas' Calculus	Maurice D. Weir, Joel Hass, Christopher Heil, Przemyslaw Bogacki	Pearson	15th edition, 2023
2	Essential Calculus	J. Stewart	Cengage	2nd edition, 2017
3	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10th edition, 2016
4	Bird's Higher Engineering Mathematics	John Bird	Taylor & Francis	9th edition, 2021
5	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39th edition, 2023

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/111107108
2	https://nptel.ac.in/courses/111107108
3	https://nptel.ac.in/courses/111107108
4	https://nptel.ac.in/courses/111107108

SEMESTER S1/S2

PHYSICS FOR ELECTRICAL SCIENCE

(Common to Group B)

Course Code	**GBPHT121**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory + Lab

Course Objectives:

1. To provide students with a solid background in the fundamentals of Physics and to impart this knowledge in Electrical Science disciplines.
2. To develop scientific attitudes and enable students to correlate Physics concepts with their core programs.
3. To equip students with practical knowledge that complements their theoretical studies and develop their ability to create practical applications and solutions in engineering based on their understanding of Physics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Semiconductor Physics** Intrinsic semiconductor, Derivation of density of electrons in conduction band and density of holes in valence band, Intrinsic carrier concentration, Variation of Intrinsic carrier concentration with temperature, Extrinsic semiconductor (qualitative) Formation of p-n junction, Fermi level in semiconductors-intrinsic and extrinsic, Energy band diagram of p-n junction - Qualitative description of charge flow across a p-n junction - Forward and reverse biased p-n junctions, Diode equation (Derivation), V-I Characteristics of p-n junction	**9**
2	**Semiconductor Devices** Semiconductor devices - Rectifiers- Full wave and Half wave, Zener	**9**

	diode - V-I characteristics - Zener breakdown and Avalanche breakdown, Tunnel diode - V-I characteristics, Applications of Zener and Tunnel diodes. Photonic devices (qualitative) - Photo detectors (Junction and PIN photodiodes), Applications, Solar cells- V-I Characteristics, Efficiency, Stringing of Solar cells to solar panel, Light Emitting Diode, Applications of LED	
3	**Superconductivity & Dielectrics** Super conductivity, Transition temperature, Critical field, Meissner effect, Type I and Type II Super conductors, Applications of superconductors. Dielectric constant, Polarization, Permittivity- relative permittivity, Relation between polarization and dielectric constant, Types of Polarization, Internal fields in liquids and solids, Clausius Mossotti Relation, Dielectric loss(qualitative), Dielectric breakdown (qualitative)	**9**
4	**Laser & Fiber Optics** Optical processes - Absorption, Spontaneous emission and stimulated emission, Properties of laser, Principle of laser - conditions for sustained lasing – Population inversion, Pumping, Metastable states, Basic components of laser - Active medium- Optical resonant cavity, Construction and working of Ruby laser, Semiconductor Laser (Qualitative), Applications of laser. Optical fiber-Principle of propagation of light, Types of fibers-Step index and Graded index fibers, Numerical aperture –Derivation, Applications of optical fibers - Fiber optic communication system (block diagram)	**9**

Course Assessment Method
(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	10	10	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamentals of Semiconductor Physics.	**K2**
CO2	Describe the behaviour of semiconductor materials in semiconductor devices.	**K2**
CO3	Explain Superconductivity and basic theory of dielectrics	**K2**
CO4	Apply the comprehended knowledge about laser and fiber optics in various engineering applications	**K3**
CO5	Apply basic knowledge of principles and theories in physics to conduct experiments.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Concepts of Modern Physics	Arthur Beiser	Tata McGraw Hill Publications	6th Edition, 2003
2	Engineering Physics	H K Malik and A K Singh	McGraw Hill	2nd Edition, 2017
3	A Textbook of Engineering Physics	MN Avadhanulu, P G Kshirsagar, TVS Arun murthy	S. Chand	11th Edition, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Semiconductor Devices Fundamentals	Robert F Pierret	Pearson Education	1995
2	Advanced Semiconductor Fundamental	Robert F Pierret	Pearson Education	2nd Edition, 2002
3	Solid State Electronic Devices	Ben G Streetman and Sanjay Kumar Banerjee	Pearson Education 6/e	2010
4	Solid State Physics	S.O. Pillai	New age international publishers	10th Edition, 2022
5	Introduction to Solid State Physics	Charles Kittel	Wiley India Edition	2019
6	Advanced Engineering Physics	Premlet B	Phasor Books	10th Edition ,2017
7	A Text Book of Engineering Physics	I. Dominic and. A. Nahari,	Owl Books Publishers	Revised Edition, 2016

Video Links (NPTEL, SWAYAM etc)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/108106181
2	https://nptel.ac.in/courses/108108112
3	https://nptel.ac.in/courses/115103108
4	https://nptel.ac.in/courses/115102124

1. Continuous Assessment (10 Marks)

i. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

ii. Conduct of Experiments (2 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.

- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

iii. Lab Reports and Record Keeping (3 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

iv. Viva Voce (3 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

2. Evaluation Pattern for Lab Examination (5 Marks)

1. Procedure/Preliminary Work/Conduct of Experiments (2 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Setup and Execution: Proper setup and accurate execution of the experiment or programming task

2. Result (2 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.

3. Viva Voce (1 Marks)

- Proficiency in answering questions related to theoretical and practical aspects of the subject.

Experiment List

(Minimum 10 Experiments)

Experiment No.	Experiment
1	Diode characteristics
2	Zener diode- V-I characteristics
3	Tunnel diode –V-I characteristics
4	Half wave rectifier
5	Full wave rectifier
6	Hall effect in semiconductors
7	Determination of band gap energy of a semiconductor
8	Characteristics of LED
9	Solar Cell- V-I and Intensity Characteristics
10	Laser – Determination of wavelength using diffraction grating
11	Laser- To measure the wavelength using a millimetre scale as a grating
12	Compare the variation of current with potential difference, for a metal, filament bulb and semiconductor diode.
13	Determination of dielectric constant
14	CRO -Measurement of frequency and amplitude of wave forms
15	Photo diode- V-I Characteristics
16	Numerical aperture of optical fiber

SEMESTER S1/S2

CHEMISTRY FOR INFORMATION SCIENCE AND ELECTRICAL SCIENCE

(Common to Group A & B)

Course Code	**GXCYT122**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory+ Lab

Course Objectives:

1. To equip students with a comprehensive understanding of chemistry concepts that are relevant to engineering applications.
2. To familiarize students with applied topics such as spectroscopy, electrochemistry, and instrumental methods.
3. To raise awareness among students about environmental issues, including climate change, pollution, and waste management, and their impact on the quality of life.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Electrochemistry and Corrosion Science (9 Hours)** **Electrochemical Cell**- Electrode potential- Nernst equation for single electrode and cell (Numerical problems)- Reference electrodes – SHE & Calomel electrode –Construction and Working - Electrochemical series - Applications – Glass Electrode & pH Measurement-Conductivity-Measurement using Digital conductivity meter. Li-ion battery & H_2-O_2 fuel cell (acid electrolyte only) construction and working. **Corrosion** –Electrochemical corrosion mechanism (acidic & alkaline medium) - Galvanic series - Corrosion control methods - Cathodic Protection - Sacrificial anodic protection and impressed current cathodic protection – Electroplating of copper - Electroless plating of copper.	**9**

2	**Materials for Electronic Applications (9 Hrs)** **Nanomaterials** - Classification based on Dimension & Materials- Synthesis – Sol gel & Chemical Reduction - Applications of nanomaterials – Carbon Nanotubes, Fullerenes, Graphene & Carbon Quantum Dots – structure, properties & application. **Polymers** - Fire Retardant Polymers- Halogenated & Non-halogenated polymers (Examples only)- Conducting Polymers-Classification-Polyaniline & Polypyrrole-synthesis, properties and applications. **Organic electronic materials and devices**- construction, working and applications of Organic Light Emitting Diode (OLED) & Dye-Sensitized Solar Cells (DSSC) Materials used in Quantum computing Technology**,** Super capacitors, Spintronics	**9**
3	**Molecular Spectroscopy and Analytical Techniques (9 Hours)** **Spectroscopy**- Types of spectra- Molecular energy levels - Beer Lambert's law – Numerical problems - Electronic Spectroscopy – Principle, Types of electronic transitions –Role of conjugation in absorption maxima- Instrumentation-Applications – Vibrational spectroscopy – Principle- Number of vibrational modes - Vibrational modes of CO_2 and H_2O – Applications **Thermal Analysis**: Dielectric Thermal Analysis (DETA) of Polymers- Working and Application. **Electron Microscopic Techniques:** SEM - Principle, instrumentation and Applications.	**9**
4	**Environmental Chemistry (9Hrs)** **Water characteristics** - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Degree of hardness (Numericals) Water softening methods-Ion exchange process- Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. – Water disinfection methods – chlorination-Break point chlorination, ozone and UV irradiation. Dissolved oxygen (DO), BOD and COD- Definition & Significance.	**9**

	Waste Management: Sewage water treatment- Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process. E Waste, Methods of disposal – recycle, recovery and reuse. Chemistry of climate change- Greenhouse Gases- Ozone Depletion-Sustainable Development- an introduction to Sustainable Development Goals.	

Self Study Topics (NOT TO BE INCLUDED FOR END SEMESTER EXAMINATION): Construction, working and applications of Lead acid battery, Nickel cadmium battery and Nickel metal hybrid battery.

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	10	10	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the Basic Concepts of Electrochemistry and Corrosion to explore the possible applications in various engineering fields	**K2**
CO2	Describe the use of various engineering materials in different industries	**K2**
CO3	Apply appropriate analytical techniques for the synthesis and characterization of various engineering materials.	**K3**
CO4	Outline various water treatment and waste management methods	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Chemistry	B. L. Tembe, Kamaluddin, M. S. Krishnan	NPTEL Web-book	2018
2	Physical Chemistry	P. W. Atkins	Oxford University Press	International Edition-2018
3	Instrumental Methods of Analysis	H. H. Willard, L. L. Merritt	CBS Publishers	7th Edition-2005
4	Engineering Chemistry	Jain & Jain	Dhanpath Rai Publishing Company	17th Edition - 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Molecular Spectroscopy	C. N. Banwell	McGraw-Hill	4th edn., 1995
2	Principles of Physical Chemistry	B. R. Puri, L. R. Sharma, M. S. Pathania	Vishal Publishing Co	47th Edition, 2017
3	Introduction to Spectroscopy	Donald L. Pavia	Cengage Learning India Pvt. Ltd	2015
4	Polymer Chemistry: An Introduction	Raymond B. Seymour, Charles E. Carraher	Marcel Dekker Inc	4th Revised Edition, 1996
5	The Chemistry of Nanomaterials: Synthesis, Properties and Applications	Prof. Dr. C. N. R. Rao, Prof. Dr. h.c. mult. Achim Müller, Prof. Dr. A. K. Cheetham	Wiley-VCH Verlag GmbH & Co. KGaA	2014
6	Organic Electronics Materials and Devices	Shuichiro Ogawa	Springer Tokyo	2024
7	Principles and Applications of Thermal Analysis	Gabbot, P	Oxford: Blackwell Publishing	2008

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/104/106/104106137/ https://archive.nptel.ac.in/courses/113/105/113105102/ https://archive.nptel.ac.in/courses/113/104/113104082/ https://www.youtube.com/watch?v=BeSxFLvk1h0
2	https://archive.nptel.ac.in/courses/113/104/113104102/ https://archive.nptel.ac.in/courses/104/105/104105124/ https://archive.nptel.ac.in/courses/105/104/105104157/

Continuous Assessment (10 Marks)

Continuous assessment evaluations are conducted based on laboratory associated with the theory.

Mark distribution

1. **Preparation and Pre-Lab Work (2 Marks)**

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (2 Marks)**

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (3 Marks)**

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (3 Marks)**

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for Lab Examination (5 Marks)

1. **Procedure/Preliminary Work/Conduct of Experiments (2 Marks)**

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

2. Result (2 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.

3. Viva Voce (1 Marks)

- Proficiency in answering questions related to theoretical and practical aspects of the subject.

List of Experiments

***Minimum 10 Experiments**

Expt. Nos.	Experiment
1	Estimation of iron in iron ore
2	Estimation of copper in brass
3	Determination of cell constant and conductance of solutions
4	Calibration of pH meter and determination of pH of a solution
5	Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
6	Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
7	Determination of molar absorptivity of a compound (KMnO4 or any water-soluble food colorant)
8	Analysis of IR spectra
9	Identification of drugs using TLC
10	Estimation of total hardness of water-EDTA method

11	Estimation of dissolved oxygen by Winkler's method
12	Determination of calorific value using Bomb calorimeter
13	Determination of saponification value of a given vegetable oil
14	Determination of acid value of a given vegetable oil
15	Verification of Nernst equation for electrochemical cell.

SEMESTER S2

FOUNDATIONS OF COMPUTING: FROM HARDWARE ESSENTIALS TO WEB DESIGN

(Common to Group A & B)

Course Code	**GXEST203**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To introduce the students to the fundamental building blocks of an IT infrastructure including the computing systems, its peripherals, Operating Systems and Networking.
2. To make the learners capable of developing and deploying simple and dynamic websites.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Computer Hardware – CPU, Memory - Memory hierarchy: registers, cache, RAM, virtual memory, Motherboard - Computer Peripherals - I/O devices, Storage devices- HDDs, SSDs, optical drives, I/O communication and device management, Interface cards – Buses – Firmware - Boot process	**9**
2	Binary representation of data and numbers, Integer Representation, Data storage units - bits, bytes, kilobytes, etc., ASCII and Unicode, CPU Architecture and Instruction Set: Basic CPU architecture - ALU, registers, control unit, Instruction format and assembly language (basics only) Fetch-execute cycle and instruction execution.	**9**

3	Computer System Software - Operating Systems, Basic commands in Linux / Windows, Shell scripting (bash). Computer Communications – LAN, MAN, WAN, Client/Server networks, Peer-to-Peer networks, Topologies. Basics of IP addresses, DHCP, NAT, Network Security (Desktop & Perimeter), DNS, VPN, Routers, Client-Server, Internet, WWW, Web servers.	**9**
4	Web Design (Basics of HTML, CSS, and JavaScript) – Understanding the web content delivery, Understanding HTML and XHTML Connections, Understanding Cascading Style Sheets, Understanding JavaScript	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the fundamental components and the working of an IT environment.	**K2**
CO2	Explain the data representations, CPU architectures, and the basic functioning of a computer.	**K2**
CO3	Explain the operating systems, computer network architecture, and necessary protocols used.	**K2**
CO4	Develop simple interactive web pages and validate the inputs.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Invitation to Computer Science	G.Michael Schneider, Judith Gersting	Cengage	Ed 2, 2020
2	The Architecture of Computer Hardware, Systems Software, & Networking: An Information Technology Approach	Irv Englander	Wiley	Ed 5, 2014
3	HTML, CSS, and JavaScript All in One, Sams Teach Yourself	Julie C. Meloni Jennifer Kyrnin	Pearson	Ed 1, 2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Elements of Computing Systems, second edition: Building a Modern Computer from First Principles	Noam Nisan and Shimon Schocken	The MIT Press	2nd Edn, 2021
2	Peter Norton's Introduction to Computers	Peter Notron	McGrawHill	6th Edn, 2010
3	Web Design with HTML, CSS, JavaScript and Jquery	Jon Duckett	Wiley	First Ed., 2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.nand2tetris.org/
2	https://onlinecourses.swayam2.ac.in/nou20_cs05/preview

SEMESTER S2

ENGINEERING MECHANICS

(Common to EEE, CP, BR, RA & RU)

Course Code	**GBEST213**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To enable students to analyze basic mechanics problems and apply a vector-based approach to solve them.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to statics:** Introduction to branches of mechanics, concept of rigid body scalars and vectors, vector operations, forces in space. Support reactions of beams (point load and UDL on Simply supported and cantilever beams) **Force systems:** Rectangular components in 2D and 3D, moment and couple, resultants Equilibrium: system isolation and the free-body diagram, equilibrium conditions 2D and 3D	**10**
2	**Friction:** -Laws of friction – analysis of blocks and ladder Centroid of composite areas- – moment of inertia- parallel axis and perpendicular axis theorems. Polar moment of inertia, radius of gyration, mass moment of inertia-ring and disc	**10**

3	**Dynamics** – Rectilinear translation - equations of motion in kinematics and kinetics – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Combined motion of translation and rotation.	**8**
4	**Mechanical vibration** - Free and forced vibration, degree of freedom. Simple harmonic motion - spring mass model,period, stiffness, frequency, simple numerical problems of single degree of freedom	**8**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the vector representation of forces and moments	**K2**
CO2	Identify and describe the components of system of forces acting on the rigid body	**K3**
CO3	Apply the conditions of equilibrium to different force system.	**K3**
CO4	Identify appropriate principles to solve problems of mechanics.	**K3**
CO5	Develop the understanding of fundamental principles of rigid body dynamics	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Mechanics	Timoshenko and Young	McGraw Hill Publishers	5th Edition 2017
2	Engineering Mechanics: Combined Statics and Dynamics	Russell C. Hibbeler	Pearson Education	14th Edition 2015
3	Engineering Mechanics - Statics and Dynamics	Shames, I. H.	Prentice Hall of India	4th Edition 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Mechanics Statics	J. L. Meriam, L. G. Kraige	Wiley	*9th Edition 2020*
2	Engineering Mechanics	Chandramouli	PHI Learning	*2011*

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/112106286
2	https://nptel.ac.in/courses/112106286
3	https://nptel.ac.in/courses/112106286
4	https://nptel.ac.in/courses/112106286

SEMESTER S2

PROGRAMMING IN C

(Common to Group A & B)

Course Code	**GXEST204**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To prepare learner to write versatile C programs for solving computational problems that they come across in their professional life.
2. To equip the learner to write efficient C programs using suitable language constructs to solve real world computational problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**C Fundamentals** - Character Set, Constants, Identifiers, Keywords, Basic Data types, Variables, Operators and its precedence, Bit-wise operators, Expressions; Statements - Input and Output statements; Structure of a C program; Simple programs. **Control Statements** - if, if-else, nested if, switch, while, do-while, for, break & continue, nested loops.	9
2	**Arrays** - Single dimensional arrays, Defining an array, Array initialization, Accessing array elements; Enumerated data type; Type Definition; Two-dimensional arrays – Defining a two-dimensional array; Programs for matrix processing; Programs for sequential search; Bubble sort; **Strings** - Declaring a string variable, Reading and displaying strings, String	9

	related library functions – Programs for string matching.	
3	**Functions** - Function definition, Function call, Function prototype, Parameter passing; Recursion; Passing array to function; Macros - Defining and calling macros; Command line Arguments. **Structures** - Defining a Structure variable, Accessing members, Array of structures, Passing structure to function; Union. **Storage Class** - Storage Classes associated with variables: automatic, static, external and register.	**9**
4	**Pointers -** Declaration, Operations on pointers, Passing pointer to a function, Accessing array elements using pointers, Processing strings using pointers, Pointer to pointer, Array of pointers, Pointer to function, Pointer to structure, Dynamic Memory Allocation. **Files**- Different types of files in C, Opening & Closing a file, Writing to and Reading from a file, Processing files, Library functions related to file – fseek(), ftell(), fread(), fwrite().	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment (Lab)	Internal Examination-1 (Written Examination)	Internal Examination-2 (Written Examination)	Internal Examination-3 (Lab Examination)	Total
5	**5**	**10**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Infer a computational problem and develop C programs from them using basic constructs of C language including the control statements.	**K2**
CO2	Develop C programs using arrays, matrices, and strings.	**K3**
CO3	Utilize functions to find solution to the computational problems by dividing it into a number of modules and abstract data types.	**K3**
CO4	Develop C programs using pointers for dynamic data handling.	**K3**
CO5	Use files in C to permanently store and manipulate data.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Programming with C	Byron S Gottfried	Mc Graw Hill Education	4th Edition July 2018
2	The C Programming Language	Brian W. Kernighan and Dennis Ritchie	Pearson	2nd Edition January 2015
3	C The Complete Reference	Herbert Schildt	Mc Graw Hill Education	4th Edition July 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Programming In Ansi C	E Balagurusamy	Mc Graw Hill	8th Edition March 2019
2	Programming in C	Kamthane	Pearson	3rd Edition January 2015
3	Let us C	Yashavant Kanetkar	Bpb publishers	19th Edition December 2022
4	Computer Programming in C	V Rajaraman	PHI Learning Private Limited	2nd July 2019

SEMESTER S2

ENGINEERING ENTREPRENEURSHIP AND IPR
(Common to all Branches)

Course Code	**UCEST206**	**CIE Marks**	60
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	40
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Develop a framework for identifying, curating and validating engineering-based business ideas.
2. Learn essential tools for understanding product-market fit and customer needs.
3. Create a comprehensive business plan for a new venture.
4. Gain foundational knowledge of Intellectual Property Rights (IPR) and their importance for startups.
5. Develop skills for prototyping, stakeholder engagement, and team collaboration.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Ideation, Innovation & Entrepreneurship** ● What is Ideation? ● Understanding Innovation ● Frameworks for Innovation ● The Entrepreneurial Mindset ● Starting a Business, types formation statutory compliances. ● Resources for Aspiring Entrepreneurs	9

	Introduction to Intellectual Property Rights (IPR) ● Types of IPR: Patents, trademarks, copyrights, trade secrets ● Strategies for protecting intellectual property based on the type of innovation ● Role of IPR in securing funding and competitive advantage **Importance of building a strong team** ● Identifying roles ● Skill sets ● Team dynamics **Identifying Pain Points and problem statement** ● Idea Generation Techniques ● Developing and Refining Ideas ● Develop strategies for bringing your innovation to life	
2	**Problem and solution canvas preparation** ● Orientation and canvas introduction ● Customer needs assessment ● Market segmentation ● Value proposition ● Competitive analysis ● Market entry strategy ● Market validation ● Regulatory and legal considerations **Customer profiling** ● Review of market research ● Customer segmentation ● Customer profiling ● Persona development ● Validation and feedback ● Prioritisation and selection ● Communication and messaging **Competitor analysis** ● Identify competitors ● Competitor profiling	**9**

	• SWOT analysis • Market positioning • Customer feedback and reviews • Pricing analysis • Differentiation strategy • Benchmarking and improvement	
3	**Business plan preparation** • Business plan framework • Market analysis • Product/ service description • Marketing and sales strategy • Operations plan • Financial projections • Risk management **Prototype development plan preparation** • Prototype requirements analysis • Technical specifications • Development approach • Development timeline • Resource allocation • Testing and quality assurance • Iterative development and feedback loop • Documentation and version control	**9**
4	**Prototype development Stakeholder engagement strategies** • Investors • Partners • Customers • Advisors & Mentors	**9**

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Micro Project	Internal Ex-1	Internal Ex-2	Total
5	35	10	10	60

Micro project / Comprehensive Business Plan:

The course will be evaluated based on a comprehensive Business Plan Report submitted and prototype development evaluation at the end of the course. The report should integrate learnings and activities from each module, demonstrating a deep understanding of the concepts and your ability to apply them to a chosen engineering venture.

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• Minimum 1 and Maximum 2 Questions from each module. • Total of 6 Questions, each carrying 2 **(6x2 =12 marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. • Each question carries 7 marks. **(4x7 = 28 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Gain foundational knowledge of Innovation and Entrepreneurship, Intellectual Property Rights (IPR) and their importance for startups.	**K2**
CO2	Develop a framework for identifying, curating and validating engineering-based business ideas.	**K3**
CO3	Learn essential tools for understanding product-market fit and customer needs.	**K3**
CO4	Create a comprehensive business plan for a new venture.	**K6**
CO5	Develop skills for prototyping, stakeholder engagement, and team collaboration.	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Engineering Handbook	Richard C.Dorf	CRC Press	2nd Edn, 2004
2	The Innovator's DNA	Clayton M. Christensen and Jeffrey H. Dyer	Harvard Business Review Press;	Revised edition (June 4, 2019)
3	Start with Why	Simon sinek	Portfolio	Reprint edition (December 27, 2011)
4	Business Model Generation	Alexander Osterwalder & Yves Pigneur	Wiley	2010
5	The Engineering Entrepreneur: A Practical Guide to Starting and Running a Successful Engineering Business in India	Saibal Gupta and Ashok Jhunjhunwala	Sage Publications	2011
6	Innovation and Entrepreneurship for Engineers	Bharat Bhushan and Seema Bhushan	CRS Press	2016
7	Indian Patent Law	P. Narayanan	Eastern Book Company	2nd edn/ 2020
8	The Law of Copyright and Designs	B.L. Wadehra	Universal Law	5th edn/2010
9	Intellectual Property Rights (Including IPR in the Digital Age)	Prabuddha Ganguli	Tata McGraw-Hill Education	2001
10	The Startup India Manifesto: A Guide to the Indian Startup Ecosystem	Rashmi Bansal and Deepinder Goyal	Westland Publications	2020

SEMESTER S1/S2

HEALTH AND WELLNESS

(Common to all Groups)

Course Code	**UCHWT127**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	1:0:1:0	**ESE Marks**	0
Credits	1	**Exam Hours**	Nil
Prerequisites (if any)	None	**Course Type**	

Course Objectives:

1. To provide essential knowledge on physical activity, health, and wellness.
2. To ensure students understand body systems, exercise principles, nutrition, mental health, and disease management.
3. To educate students on the benefits of yoga, the risks of substance abuse and basic first aid skills.
4. To equip students with the ability to lead healthier lifestyles.
5. To enable students to design effective and personalized exercise programs.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Human Body Systems related to Physical activity and its functions: Respiratory System - Cardiovascular System. Musculoskeletal System and the Major Muscle groups of the Human Body. Quantifying Physical Activity Energy Expenditure and Metabolic equivalent of task (MET) Exercise Continuum: Light-intensity physical activity, Moderate - intensity physical activity, Vigorous -intensity physical activity. Defining Physical Activity, Aerobic Physical Activity, Anaerobic Physical Activity, Exercise and Health-Related Physical Fitness. FITT principle to design an Exercise programme Components of Health related Physical Fitness : - Cardiorespiratory	**4**

	Fitness- Muscular strength- Muscular endurance- Flexibility- Body composition.	
2	Concept of Health and Wellness: Health and wellness differentiation, Factors affecting health and wellness. Mental health and Factors affecting mental health. Sports and Socialization: Sports and character building - Leadership through Physical Activity and Sports Diet and nutrition: Exploring Micro and Macronutrients: Concept of Balanced diet Carbohydrate & the Glycemic Index Animal & Plant - based Proteins and their Effects on Human Health Dietary Fats & their Effects on Human Health , Essential Vitamins and Minerals	**2**
3	Lifestyle management strategies to prevent / manage common hypokinetic diseases and disorders - Obesity - Cardiovascular diseases (e.g., coronary artery disease, hypertension) - Diabetes - Osteoporosis - Musculoskeletal disorders (e.g., osteoarthritis, Low back pain, Kyphosis, lordosis, flat foot, Knock knee) Meaning, Aims and objectives of yoga - Classification and importance of of Yogic Asanas (Sitting, Standing, lying) Pranayama and Its Types - Active Lifestyle and Stress Management Through Yoga Understanding on substance abuse and addiction - Psychoactive substances & its ill effects- Alcohol- Opioids- Cannabis -Sedative - Cocaine -Other stimulants, including caffeine -Hallucinogens - Tobacco -Volatile solvents.	**4**
4	First aid and principles of First Aid: Primary survey: ABC (Airway, Breathing, Circulation). Qualities of a Good First Aider First aid measures for: - Cuts and scrapes - Bruises - Sprains - Strains - Fractures - Burns - Nosebleeds. First Aid Procedures: Cardiopulmonary Resuscitation (CPR) - Heimlich Maneuver - Applying a sling Sports injuries: Classification (Soft Tissue Injuries - Abrasion, Contusion, Laceration, Incision, Sprain & Strain)	**2**

Additional Topics

- Need for and Importance of Physical Education and its relevance in interdisciplinary context. Understanding of the Endocrine System
- Developing a fitness profile
- Healthy foods habits for prevention and progression of Lifestyle Diseases. Processed foods and unhealthy eating habits.
- Depression - Anxiety - Stress
- Different ways of carrying an injured person. Usage of Automated external defibrillator

Course Assessment Method
(CIE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Case Study/Micro project/Presentation	Activity evaluation	Total
10	**20**	**20**	**50**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the different human body systems and describe various types of physical activities along with methods to measure and quantify these activities.	**K2**
CO2	Explain how to maintain or improve health and wellness through psychological practices, dietary habits, and sports activities.	**K2**
CO3	Discuss about common hypokinetic disorders and musculoskeletal disorders, and describe the importance of leading a healthy lifestyle through the practice of yoga and abstaining from addictive substances.	**K2**
CO4	Explain the basics of first aid and describe common sports injuries	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				2		3		3	3	2		2
CO2				2		3		2	2			2
CO3				0		3		3				2
CO4				2		3						2

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Foundations of Nutrition	Bhavana Sabarwal	Commonwealth Publishers	1999
2	Anatomy and physiology in health and illness.	Ross and Wilson	Waugh, A., & Grant, A.	2022

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fit to be Well Essential Concept	Thygerson, A. L., Thygerson, S. M., & Thygerson, J. S.	Jones & Bartlett Learning.	2018
2	Introduction to physical education, fitness, and sport.	Siedentop, D., & Van der Mars, H.	Human kinetics.	2022
3	Substance Use Disorders. Manual for Physicians.	Lal, R., & Ambekar, A. (2005).	National Drug Dependence Treatment Centre, New Delhi	2005
4	The exercise health connection-how to reduce your risk of disease and other illnesses by making exercise your medicine.	Nieman, D. C., & White, J. A	Public Health	1998
5	ACSM's resource manual for guidelines for exercise testing and prescription.	Lippincott Williams & Wilkins.	American College of Sports Medicine.	2012
6	Exercise Physiology: energy, nutrition and human performance.	Katch, F. I., Katch, V. L., & McArdle, W. D.	Lippincott Williams & Wilkins	2010

Continuous Internal Evaluation Marks (CIE): for the Health and wellness course

Students will be evaluated as follows.

Title	Method of Evaluation
Attendance	Students must attend at least 75% of both theory and practical classes. They will receive 10 marks based on their class attendance. Students who do not meet the minimum attendance requirement for a course, as specified in the B. Tech regulations, will not be eligible to proceed to the next criteria.
Assignment / Presentation	Assignments will be given to students to assess their understanding of the subjects taught. Students will be required to make presentations on the subjects taught in class, and their understanding of the subjects will be assessed. Based on the Assignments and Presentations the students will be awarded marks out of 20
Activity Evaluation	The Assignment / Presentation faculty handling the class will use the tests from the Fitness Protocols and Guidelines for ages 18+ to 65 years, as set forth by FIT India. Measurements will be taken for all the tests of the FIT India Fitness Protocol and the evaluation will be based on the benchmark score received for the following tests: 1. V Sit Reach Test 2. Partial Curl Up - 30 seconds 3. Push Ups (Male) and Modified Push Up (Female) 4. Two (2) Km Run/Walk Students who achieve a total benchmark score of 8 across the aforementioned 4 tests will be awarded pass marks for activity evaluation. Students who score better will be awarded a maximum mark of 20.

Activity Evaluation - Special Circumstances	Physically challenged and medically unfit students can opt for an objective test to demonstrate their knowledge of the subjects taught. Based on their performance in the objective test, they will be awarded marks out of 20.
Activity Evaluation - Special Considerations - NCC	Students who enrolled themselves in the NCC during the course period (between the start and end dates of the program) and attended 5 college level parades will be awarded pass marks for activity evaluation. Students who attend more parades will be eligible for a maximum mark of 20 based on their parade attendance.

Tests to evaluated as per Criterion - 2 and Benchmark Scores

V Sit Reach Test

How to Perform:

1. The subject removes their shoes and sits on the floor with the measuring line between their legs and the soles of their feet placed immediately behind the baseline, heels 8-12" apart.
2. The thumbs are clasped so that hands are together, palms facing down and placed on the measuring line.

3. With the legs held flat by a partner, the subject slowly reaches forward as far as possible, keeping the fingers on baseline and feet flexed.

4. After three tries, the student holds the fourth reach for three seconds while that distance is recorded.

5. Make sure there are no jerky movements, and that the fingertips remain level and the legs flat.

Infrastructure/Equipment Required:

1. A tape for marking the ground, marker pen, and ruler.

2. With the tape mark a straight line two feet long on the floor as the baseline, and a measurement line perpendicular to the midpoint of the baseline extending two feet on each side.

3. Use the marker pen to indicate every centimeter and millimeter along the measurement line. The point where the baseline and the measuring line intersect is the zero point.

Scoring: The score is recorded in centimeters and millimeters as the distance reached by the hand, which is the difference between the zero point (where the baseline and measuring line intersect) and the final position.

Scoring for V Sit Reach Test for Males

Level	Benchmark Score	Measurement (cm)
1	2	<11
2	4	12-13
3	6	14-17
4	7	18-19
5	8	20-21
6	9	22
7	10	>22

Scoring for V Sit Reach Test for Females

Level	Benchmark Score	Measurement (cm)
1	2	<14
2	4	15-16
3	6	17-19
4	7	20-21
5	8	22
6	9	23
7	10	>23

Partial Curl Up - 30 seconds

How to Perform:

1. The subject lies on a cushioned, flat, clean surface with knees flexed, usually at 90 degrees, with hands straight on the sides (palms facing downwards) closer to the ground, parallel to the body.

2. The subject raises the trunk in a smooth motion, keeping the arms in position, curling up the desired amount (at least 6 inches above/along the ground towards the parallel strip).

3. The trunk is lowered back to the floor so that the shoulder blades or upper back touch the floor.

Infrastructure/Equipment Required:

Flat clean cushioned surface with two parallel strips (6 inches apart), Stopwatch Scoring:

Record the maximum number of Curl ups in a certain time period 30 seconds.

Scoring for Partial Curl Up - 30 seconds Test for Males

Level	Benchmark Score	Numbers
1	2	<25
2	4	25-30
3	6	31-34
4	7	35-38
5	8	39-43
6	9	44-49
7	10	>49

Scoring for Partial Curl Up - 30 seconds Test for Females

Level	Benchmark Score	Numbers
1	2	**<18**
2	4	18-24
3	6	25-28
4	7	29-32
5	8	33-36
6	9	37-43
7	10	>43

Push Ups for Male/Modified Push Ups for Female

How to Perform:

1. A standard push up begins with the hands and toes touching the floor, the body and legs in a straight line, feet slightly apart, the arms at shoulder width apart, extended and at a right angle to the body.

2. Keeping the back and knees straight, the subject lowers the body to a predetermined point, to touch some other object, or until there is a 90-degree angle at the elbows, then returns back to the starting position with the arms extended.

3. This action is repeated, and the test continues until exhaustion, or until they can do no more in rhythm or have reached the target number of push-ups.

4. For Female: push-up technique is with the knees resting on the ground.

Infrastructure/Equipment Required:

Flat clean cushioned surface/Gym mat

Scoring: Record number of correctly completed pushups.

Scoring for Push Ups for Male

Level	Benchmark Score	Numbers
1	2	<4
2	4	04- 10
3	6	11 -18
4	7	19-34
5	8	35-46
6	9	47-56
7	10	>56

Scoring for Modified Push Ups for Female

Level	Benchmark Score	Numbers
1	2	0-1
2	4	2 - 5
3	6	6 -10
4	7	11 - 20
5	8	21-27
6	9	27-35
7	10	>35

2 Km Run/Walk

How to Perform:

1. Participants are instructed to run or walk 2 kms in the fastest possible pace.

2. The participants begin on signal (Starting point)- "ready, start". As they cross the finish line, elapsed time should be announced to the participants.

3. Walking is permitted but the objective is to cover the distance in the shortest possible time.

Infrastructure/Equipment Required:

Stopwatch, whistle, marker cone, lime powder,

measuring tape, 200 or 400 m with 1.22 m (minimum 1 m) width preferably on a flat and even playground with a marking of starting and finish line. You can also use any application on your mobile phone that tells you the distance.

Scoring: Time taken for completion (Run or Walk) in min, sec.

Scoring for 2Km Run/walk for Male

Level	Benchmark Score	Minutes : Seconds
1	2	> 11:50
2	4	10:42
3	6	09:44
4	7	08:59
5	8	08:33
6	9	07:37
7	10	>07:37

Scoring for 2Km Run/walk for Female

Level	Benchmark Score	Minutes: Seconds
1	2	>13:47
2	4	12:51
3	6	12:00
4	7	11:34
5	8	10:42
6	9	09:45
7	10	>09:45

SEMESTER - S1/S2

LIFE SKILLS AND PROFESSIONAL COMMUNICATION
(Common to all Branches)

Course Code	**UCHUT128**	**CIE Marks**	100
Teaching Hours/Week (L: T:P: R)	2:0:1:0	**ESE Marks**	0
Credits	1	**Exam Hours**	-
Prerequisites (if any)	None	**Course Type**	Activity-based learning

Course objectives:

1. To foster self-awareness and personal growth, enhance communication and interpersonal connection skills, promote effective participation in groups and teams, develop critical thinking, problem-solving, and decision-making skills, and cultivate the ability to exercise emotional intelligence.
2. To equip students with the necessary skills to listen, read, write & speak, to comprehend and successfully convey any idea, technical or otherwise.
3. To equip students to build their profile in line with the professional requirements and standards.

Continuous Internal Evaluation Marks (CIE):

- Continuous internal evaluation is based on the individual and group activities as detailed in the activity table given below.
- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. They should use online collaboration tools for group activities, report/presentation making and work management.
- Activities are to be distributed between 3 class hours (2L+1P) and 3.5 Self-study hours.
- Marks given against each activity should be awarded fully if the students successfully complete the activity.
- Students should maintain a portfolio file with all the reports and other textual materials generated from the activities. Students should also keep a journal related to the activities undertaken.
- Portfolio and journal are mandatory requirements for passing the course, in addition to the minimum

marks required.

- The portfolio and journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through the HMC courses and Mini project course.
- Self-reflection questionnaire shall be given at the beginning of the semester, in between and at the end of the semester based on the guidelines in the manual of the course.

Table 1: Activity Table

Sl. No.	Activity	Class room (L) / Self Study (SS)	Week of completion	Group / Individual (G/I)	Marks	Skills	CO
1.1	Group formation and self-introduction among the group members	L	1	G	-	• Connecting with group members • Time management - Gantt Chart	
1.2	Familiarizing the activities and preparation of the time plan for the activities	L	1	G	-		
1.3	Preparation of Gantt chart based on the time plan	SS	1	G	2		
2.1	Take an online personality development test, self reflect and report	SS	1	I	2	• Self-awareness Writing	CO1
2.2	Role-storming exercise 1: Students assume 2 different roles given below and write about their ● Strengths, ● Areas for improvement, ● Concerns, ● Areas in which he/she hesitates to take advice, ● Goals/Expectations, from the point of view of the following assumed roles i) their parent/guardian/mentor ii) their friend/sibling/cousin	L	1	I	2	●Goal setting - Identification of skills and setting goal ●Self-awareness ●Discussion in groups ●Group work- Compiling of ideas • Mind mapping	CO1
2.3	Role-storming exercise 2:						CO1

	Students assume the role of their teacher and write about the ● Skills required as a B.Tech graduate ● Attitudes, habits, approaches required and activities to be practised during their B.Tech years, in order to achieve the set goals	SS	1	I	2		
2.4	Discuss the skills identified through rolestorming excercise by each one within their own group and improvise the list of skills	L	1	G	2		CO1
2.5	Prepare a mind map based on the role-storming exercise and exhibit/present it in class	SS	2	G	2		CO1
3	Prepare a presentation on instances of empathy they have observed in their own life or in other's life	L	2 to 4	I	2	● Empathy	CO2
4.1	Each student connects and networks with a minimum of 3 professionals from industry/public sector organizations/other agencies/NGOs /academia (atleast 1 through LinkedIn)	SS	3	I	2	● Workplace awareness ● Listening ● Communication - interacting with people ● Networking through various media including LinkedIn ● Discussion in groups ● Report preparation ● Creativity Goal setting - Preparation of action plan	
4.2	Interact with them to understand their workplace details including ● workplace skills required ● their work experience ● activities they have done to enhance their employability during their B.Tech years ● suggestions on the different activities to be done during B.Tech years Prepare a documentation of this	SS	3	I	4		CO2
4.3	Discuss the different workplace details & work readiness activities assimilated by each through the interactions within their group and compile the inputs collected by the individuals	SS	3	G	2		CO2

	Prepare the Minutes of the discussions						
4.4	Report preparation based on the discussions	SS	4	G	3		CO4
4.5	Perform a role-play based on the workplace dynamics assimilated through interactions and group discussions	L	5	G	4		CO3
4.6	Identify their own goal and prepare an action plan for their undergraduate journey to achieve the goal	SS	5	I	2		CO1
5.1	Select a real-life problem that requires a technical solution and list the study materials needed	L	6	G	2		CO3
5.2	Listen to TED talks & video lectures from renowned Universities related to the problem and prepare a one-page summary (Each group member should select a different resource)	SS	6	I	2		CO4
5.3	Use any online tech forum to gather ideas for solving the problem chosen	SS	6	G	2		CO5
5.4	Arrive at a possible solution using six thinking hat exercise	L	7	G	3		CO3
5.5	Prepare a report based on the problem-solving experience	SS	7	G	2		CO4
6.1	Linkedin profile creation	SS	1	I	2	Profile-building	CO6
6.2	Resume preparation	SS	8	I	2		CO6
6.3	Self introduction video	SS	8	I	3		CO6
7	Prepare a presentation on instances of demonstration of emotional intelligence	SS	9	I	2	Emotional intelligence	CO2
8	Prepare a short video presentation on diversity aspects observed in our society (3 to 5 minutes)	SS	10	G	3	Diversity	CO2, CO5
9	Take online Interview skills development sessions like robotic interviews; self-reflect and report	SS	10	I	2	• Interview skills	CO6
10	Take an online listening test, self reflect	SS	11	I	2	Listening skills	CO6

	and report						
11.1	Activities to improve English vocabulary of students	L	8	I/G	4	• English vocabulary • English language skills • Writing • Presentation • Group work • Self-reflection	CO4
11.2	Activities to help students identify errors in English language usage	L	9	I/G	2		CO4
11.3	Activity to help students identify commonly mispelled words, commonly mispronounced words and confusing words	L	10	I/G	2		CO4
11.4	Write a self-reflection report on the improvement in English language communication through this course	SS	12	I	2		CO4
11.5	Presentation by groups on the experience of using online collaboration tools in various group activities and time management experience as per the Gantt chart prepared	L	11 to 12	G	2		CO4, CO5
12.1	Each group prepares video content for podcasts on innovative technological interventions/research work tried out in Kerala context by academicians/professionals/Govt. agencies/research institutions/private agencies/NGOs/other agencies	SS	12	G	4	• Audio-visual presentations creations with the use of technology tools • Effective use of social media platforms • Profile building	CO2, CO4, CO5
12.2	Upload the video content to podcasting platforms or YouTube	SS	12	G	1		CO5
12.3	Add the link of the podcast in their LinkedIn profile	SS	12	G	1		CO5

Table 2. Lab hour Activities (P): 24 Marks

Sl No	Activity	Marks	Skill	CO
1	Hands-on sessions on day-to-day engineering skills and a self-reflection report on the experience gained: 1. Drilling practice using electric hand drilling machines. 2. Cutting of MS rod and flat using electric hand cutters. 3. Filing, finishing and smoothening using electrically operated hand grinders. 4. MS rod cutting using Hack saw by holding the work in bench wise. 5. Study and handling different types of measuring instruments. 6. Welding of MS, SS work pieces. 7. Pipe bending practice (PVC and GI). 8. Water tap fitting. 9. Water tap rubber seal changing practice. 10. Union and valves connection practice in pipes. 11. Foot valve fitting prfouactice. 12. Water pump seal and bearing changing practice.	**24**	Basic practical engineering skills	**3**
2	Language Lab sessions	**-**	Language Skills	**4**

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to know & understand oneself, show confidence in one's potential & capabilities, set goals and develop plans to accomplish tasks	**K5**
CO2	Develop the ability to communicate and connect with others, participate in groups/teams, empathies, respect diversity, be responsible and understand the need to exercise emotional intelligence	**K5**
CO3	Develop thinking skills, problem-solving and decision-making skills	**K5**
CO4	Develop listening, reading, writing & speaking skills, ability to comprehend & successfully convey any idea, and ability to analyze, interpret & effectively summarize textual, audio & visual content	**K6**
CO5	Develop the ability to create effective presentations through audio-visual mediums with the use of technology tools and initiate effective use of social media platforms & tech forums for content delivery and discussions	**K6**
CO6	Initiate profile-building exercises in line with the professional requirements, and start networking with professionals/academicians	**K6**

CO-PO Mapping

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

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Life Skills & Personality Development	Maithry Shinde et.al.	Cambridge University Press	First Edition, 2022
2	Emotional Intelligence: Why it can matter more than IQ	Daniel Goleman	Bloomsbury, Publishing PLC	25th Anniversary Edition December 2020
3	Think Faster, Talk Smarter: How to speak successfully when you are put on the spot	Matt Abrahams	Macmillan Business	September 2023
4	Deep Work: Rules for focused success in a distracted world	Cal Newport	PIATKUS	January 2016
5	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education	2nd Edition 2017
6	Interchange	Jack C. Richards, With Jonathan Hull, Susan Proctor	Cambridge publishers	5th Edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Life Skills for Engineers	Remesh S., Vishnu R.G.	Ridhima Publications	First Edition, 2016
2	Soft Skills & Employability Skills	Sabina Pillai and Agna Fernandez	Cambridge University Press	First Edition, 2018
3	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education	2nd Edition 2017
4	English Grammar in Use	Raymond Murphy,	Cambridge University Press India PVT LTD	5th Edition 2023
5	Guide to writing as an Engineer	David F. Beer and David McMurrey	John Willey. New York	2004

SEMESTER S2

IT WORKSHOP

(Common to Group A&B)

Course Code	**GXESL208**	**CIE Marks**	50
Teaching Hours/Week(L: T:P: R)	0:0:2:0	**ESE Marks** **(Internal Only)**	50
Credits	1	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Lab

Course Objectives:

1. To provide a basic understanding about computer hardware, software, and computer network.
2. To familiarize the learner with the web development process using HTML, CSS, and Javascript.

Details of Experiments

Expt. No	Experiment (Minimum 10 Experiments)
1	Practice Computer Hardware – Familiarization CPU Box, Motherboard, CPU & Chip-set, Interface cards, Card slots, Hard disk, Cables, SMPS, NIC, Various ports, etc. Computer Peripherals - I/O Devices. Storage devices, Interface cards – Buses – Firmware
2	Familiarization of Boot process
3	Familiarizing installation of Linux and Windows operating systems
4	Familiarizing basic Unix/Linux commands - ls, mkdir, cp, mv, grep, rmdir, chmod, useradd, passwd, history, dmesg, cpuinfo, uname, du, time, write, fdisk
5	Familiarizing networking hardware - RJ45, UTP, fibre, switch, NIC, router, Wireless Access Point (WAP), modem
6	Familiarizing basic networking commands - ifconfig, ping, traceroute, nslookup, ssh, scp, telnet, ftp
7	View network traffic using Wireshark/Packet tracer

8	Familiarizing the steps how to configure and establishing a network connecting
9	Shell programming in Linux(bash)
10	Create a web page and deploy on a local web server.
11	Use Javascript to validate forms.
12	Create an image slider using HTML, CSS, and JavaScript. Allow users to navigate between images using previous and next buttons.
13	Familiarisation of LaTeX - Basic only
14	Familiarisation of Development Environments - Visual studio code, Sublime Text, Atom
15	Introducing Repositories - Git / Bitbucket

Course Assessment Method
(CIE: 50 Marks, ESE: 50 Marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record. (Continuous Assessment)	Internal Exam	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified Lab record.

Pass Criteria:

- *A student must score a minimum of 50% overall, combining marks from both Continuous Internal Evaluation (CIE) and End Semester Examination (ESE).*
- ***In addition, the student must secure at least 40% in the End Semester Examination (ESE).***

The ESE shall be conducted internally, with evaluation carried out by a panel of faculty members.

This panel must include at least one faculty member who was not involved in the Continuous Internal Evaluation (CIE) of the lab course.

Course Outcomes (COs)

At the end of the course the student will be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Experiment with the fundamental hardware components of a computer and how to interface them with software systems.	**K3**
CO2	Make use of the command line of Linux operating system and shell programming.	**K3**
CO3	Experiment with the data network communication scenarios using Wireshark.	**K3**
CO4	Develop basic websites using HTML, CSS & JavaScript and manage the versions.	**K3**

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table

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

1: Slight (Low),2: Moderate (Medium),3: Substantial (High), : No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Invitation to ComputerScience	G. Michael Schneider, Judith Gersting	Cengage	2/e, 2020
2	LINUX for Developers: Jumpstart Your LinuxProgramming Skills	William Rothwell	Pearson	1/e, 2018
3	HTML, CSS, and JavaScript -All in One, Sams Teach Yourself	Julie C. Meloni Jennifer Kyrnin	Pearson	1/e, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Architecture of Computer Hardware, Systems Software, & Networking: An Information Technology Approach	Irv Englander	Wiley	5/e, 2014
2	Mastering Git : Attain expertlevel proficiency with Git forenhanced productivity and efficient collaboration	Jakub Narębski	Packt	1/e, 2016
3	Web Design with HTML, CSS, JavaScript, and Jquery.	Jon Duckett	Wiley	1/e, 2014

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://overthewire.org/wargames/bandit/
2	https://www.w3schools.com/

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**

   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understandingof the theoretical background related to the experiments.

2. **Conduct of Experiments (7 Marks)**

   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, andtroubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**

   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record andmaintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**

   - Oral Examination: Ability to explain the experiment, results and underlying principlesduring a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, andrecord are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizingmaterials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to theexperiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or qualityof program output.

4. **Viva Voce (10 Marks)**

    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of thesubject.

5. **Record (5 Marks)**

- Completeness, clarity, and accuracy of the lab record submitted

PROGRAMME CORE 1

SEMESTER S2

NETWORK THEORY

(COMMON TO EC, EA, AE, EV BRANCHES)

Course Code	**PCECT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To analyze electrical networks using Mesh / Nodal methods /network theorems
2. To analyze transient behavior of electrical networks using Laplace transform
3. To identify the network functions and parameters of single-port and two-port networks.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Network fundamentals and analysis methods:** Concept of networks and circuits, Circuit variables, Ideal and practical sources, Independent and dependent sources, Source transformation, Kirchhoff's laws. Mesh analysis, Node analysis, Super-mesh analysis and super-node analysis applied to both DC and AC networks containing independent and dependent sources.	**11**

2	**Network theorems and applications**: Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Millman's theorem and Maximum power transfer theorem for the analysis of DC and AC networks having independent and dependent sources.	**11**
3	**Laplace transforms and transient analysis:** Laplace transforms of standard signals and common functions, Laplace transform theorems (proof not required), Inverse Laplace transforms, Solution of differential equations. Transformation of basic signals and circuits to s – domain with and without initial conditions. Transient analysis of RL, RC and RLC networks with DC, impulse, step and sinusoidal inputs. Analysis of low pass and high pass RC circuits using Laplace transforms.	**11**
4	**Network functions and two-port parameters:** Network functions for single-port and two-port networks, Properties of driving point and transfer functions, Significance of poles and zeros of network functions, Pole-zero plot. Impedance, Admittance, Hybrid and Transmission parameters of two-port networks, Reciprocity and symmetry conditions (derivation not required), Inter-relationships between parameters, Series and parallel connections of two-port networks.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyze electrical networks using mesh and node methods	**K4**
CO2	Apply network theorems to analyze electrical networks	**K3**
CO3	Analyze transient behavior of electrical networks using Laplace transforms	**K4**
CO4	Identify the network functions and parameters of single-port and two-port networks	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Basic Engineering Circuit Analysis	R. Mark Nelms, J. David	Irwin Wiley	12/e, 2020
2	Network Analysis and Synthesis	Franklin F. Kuo	Wiley	2/e, 2012
3	Circuits and Networks-Analysis and Synthesis	Sudhakar A and Shyammohan S. P	McGraw Hill	5/e, 2015
4	Network Analysis	Van Valkenburg M.E	Prentice Hall India	Revised 3/e,2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Circuit Theory Analysis and Synthesis	Abhijit Chakrabarti	Dhanpat Rai & Co.	Revised 7/e, 2018
2	Electric Circuits – Schaum's Outline Series	Joseph A. Edminister, K. Rao and M. Nahvi	McGraw-Hill	5/e, 2017
3	Electric Circuits and Networks	K. S. Suresh Kumar	Pearson	2008
4	Network analysis and synthesis	Ravish R	McGraw-Hil	2/e,2015

SEMESTER 2

MEASUREMENTS AND INSTRUMENTATION

(ELECTRICAL AND ELECTRONICS ENGINEERING)

Course Code	**PCEET205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3-1-0-0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	**Course Type**	PC -Theory

Course Objectives:

1. To introduce the concepts of electrical measurement systems and instrumentation.
2. To discuss the principles of operation and construction of basic instruments for measuring circuit parameters, magnetic quantities, and passive parameters using bridge circuits, sensors, and transducers.
3. To introduce modern digital instrumentation systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Functional Elements of Measurements Systems- Block Schematic and brief operation of building blocks Standards of Measurements- Static characteristics (accuracy, precision, linearity, resolution), Need for calibration, Types of errors Instruments- Classification; Operating Forces and Torques: deflecting, controlling and damping torques- Gravity and spring control; air, fluid friction and eddy current damping. Measurement of Voltage and Current- Moving Coil and Moving Iron types., Range Extension – shunts and multipliers (Include simple problems of range extension)	**11**
2	Magnetic Measurement- Flux Meter, Determination of BH Curve - Hysteresis Loop (Method of Reversal). Measurement of Resistance,	**11**

	Wheatstone's Bridge, Kelvin's Double Bridge (Simple Problems), Loss of Charge Method, Measurement of Earth Resistance. Measurement of Inductance- Maxwell's Inductance Bridge, Measurement of Capacitance - Schering's Bridge, Measurement of Frequency- Wien Bridge (Include Simple Problems) Q-meter, LCR Meters (Description only)	
3	Measurement of Power and Energy: Measurement of Power using Dynamometer type wattmeter, Three phase Power Measurement using Two Wattmeter Method (Include Phasor Diagrams and Expressions, Include simple problems of two wattmeter method) Measurement of Energy Using Induction type Energy Meter, Two Element Energy Meter Instrument Transformers-CT and PT- Principle of Operation- Range Extension Basic Principles of Electronic Multimeter, Digital Voltmeter Digital Energy Meter, TOD Meter, Smart Metering, Bidirectional Meters (Description Only)	**11**
4	Block Schematic of electronic instrumentation system – role of sensors and transducers Classification of Temperature transducers- Principle of operation of Thermistors and RTD Classification of flow transducers- Principle of operation of Electromagnetic and ultrasonic types Strain gauge: Basic working principle, types and applications; Measurement of angular speed and luminous intensity Principles of Digital Data Acquisition systems - Role of Signal conditioning systems (Basic Principles only)- Phasor Measurement Unit (Block Schematic and Description Only) CRO, DSO and Harmonic Analyzers: Block Diagram, Basic Principles and applications only Virtual Instrumentation Systems: Block schematic and Description only IOT and Data analytics for Industrial Process- Case study on Smart Grid	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Classify various parameters and errors associated with measuring instruments.	**K2**
CO2	Apply suitable methods for the measurement of current, voltage, power and energy.	**K3**
CO3	Understand suitable methods for the measurement of magnetic quantities, resistance, inductance and capacitance.	**K2**
CO4	Describe the working principle, selection criteria and applications of various sensors and transducers in relation to measurements systems.	**K2**
CO5	Explain the operation of digital measurement systems.	**K2**
CO6	Discuss the applications of modern instrumentation schemes for industrial process	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	A course in Electrical and Electronic Measurements & Instrumentation	K. Sawhney	Dhanpat Rai & Co.	2023
2	A course in Electrical & Electronic Measurement & Instrumentation	J. B. Gupta	S K Kataria & Sons	14th Ed., 2014
3	Electrical Measurements & Measuring Instruments	Golding E.W and Widdis	Wheeler Pub.	3rd Ed.,2011
4	Electronic Instrumentation	H. S. Kalsi	McGraw Hill, New Delhi	4th Ed., 2019
5	Principles of Electrical Measurement	S Tumanski	Taylor & Francis.	2006
6	Electronic Instrumentation and Measurements	David A Bel	Oxford	3rd Ed,, 2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Electronic Instrumentation and Measurement Techniques	Albert D. Helfrick, Cooper William D	Prentice Hall of India	2016
2	Basic Electrical Measurements	Stout M.B	Prentice Hall	2012
3	Electronic Measurements & Instrumentation	Oliver & Cage	McGraw Hill	2017
4	Doebelin's Measurements Systems	E.O Doebelin and D.N Manik	McGraw Hill Education (India) Pvt. Ltd.	7th Ed., 2019
5	Electrical and Electronics Measurements and Instrumentation	P.Purkait, B.Biswas, S.Das and C. Koley	McGraw Hill Education (India) Pvt. Ltd.,	2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/105/108105153/ https://archive.nptel.ac.in/courses/108/108/108108147/
2	https://archive.nptel.ac.in/courses/108/105/108105153/
3	https://archive.nptel.ac.in/courses/108/105/108105153/
4	https://archive.nptel.ac.in/courses/108/108/108108147/ https://archive.nptel.ac.in/courses/106/105/106105166/

SEMESTER S2

ANATOMY AND PHYSIOLOGY FOR BIOMEDICAL ENGINEERING

(BIOMEDICAL ENGINEERING)

Course Code	**PCBMT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To serve as a foundation course for engineers in health care field.
2. To introduce the basic anatomy of the major systems of engineering importance in human body.
3. To study the basic physiological concepts of these systems.
4. To explore the basic engineering principles related to human physiology

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Anatomy & Physiology: Definitions, structural & functional organization of human body – cells, tissues, organs & systems, Cell: Basic structure, organelles & their functions. Cell membrane – structure, transport across cell membranes – passive transport (passive diffusion and facilitated diffusion) active transport – primary – Na^+-K^+ pump & secondary transport - co transport & counter transport. Skeletal system: functions of skeletal system, Bone – classification & composition, structure of long bone – compact and spongy bone. Joints in human body – classification and possible movements.	**11**

2	Nervous System: General organization, Neurons – structure & types, Central nervous system – Brain - structure and functions of each parts, Spinal cord - structure – spinal and cranial nerves, spinal reflex, Brain Stem – basic structure & functions. Peripheral nervous system: Efferent & afferent division. Autonomic nervous system: Sympathetic & Parasympathetic nervous system Special senses –Organ of vision, hearing & equilibrium, taste and smell – structure & basic mechanisms. Integumentary system (basic structure & function only)	**11**
3	Blood - the composition of blood (blood proteins and blood cells & their function), blood groups. Blood clotting. Lymphatic system and its functions. Cardiovascular system - major blood vessels, Heart- structure of heart and its electrical activity (ECG, Heart rate – normal & abnormal), Heart sounds & murmurs, Stroke volume & cardiac output, blood pressure. Circulatory systems-Systemic circulation and pulmonary circulation. Respiratory system - structure and organization of organs concerned with respiration, structure of lungs, mechanics of respiration, Gaseous exchange, Gas transport.	**11**
4	Muscular System - Types of muscles, Skeletal muscle - levels of organization, structure, mechanism of muscle contraction & relaxation. Urinary System - Structure and function of organs, kidneys, nephron – structure and types, Basic renal processes involved in urine formation, micturition (definition only) Digestive system – Anatomy and Functions of Components of the Digestive System – basic digestive processes: motility, secretion, digestion, and absorption	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Introduce the functional organization of human body and understand the structure and functions of skeletal system	**K2**
CO2	Understand the structure and functions of nervous system	**K2**
CO3	Identify the components of blood and physiology of cardiovascular and respiratory systems	**K3**
CO4	Interpret the structure and functions of muscular, urinary systems and digestive system.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Human Physiology: From Cells to Systems	Laura lee Sherwood	Cengage Learning, USA	9th ed., 2014
2	Textbook of Medical Physiology	Arthur C. Guyton, John E. Hall	W.B. Saunders Company	10th ed., 2000

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ross and Wilson: Anatomy and Physiology in Health and Illness	Anne Waugh, Allison Grant	Churchill Livingstone	9th ed., 2001
2	Essentials of Anatomy and Physiology	Tina Sanders, Dr Valerie Scanlon	F.A. Davis Company	5th ed., 2006

SEMESTER S2

BASIC ANATOMY & PHYSIOLOGY FOR BIOMEDICAL ENGINEERS

(ELECTRONICS AND BIOMEDICAL ENGINEERING)

Course Code	**PCEBT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To serve as a foundation course for engineers in health care field.
2. To introduce the basic anatomy of the major systems in human body.
3. To analyze and understand the functioning of the major systems.
4. To explore the basic engineering principles related to human physiology.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Anatomy & Physiology:** Definition & relationship of structural & functional organization of human body. **Homeostasis:** Body fluids ICF & ECF, fluid compartments in human body, – Homeostatic control System- negative & positive feedback and feed forward mechanisms. **Cell:** Structure, membrane & Transport mechanisms. RMP - Action potentials – ionic basis of generation - Nernst potential, Goldman Hodgkin Katz equation.	**11**

2	**Nervous System:** General organization - Central nervous system, Cerebrum – Cerebral cortex — motor, sensory, language & association areas – major functions. Basal ganglia, Thalamus & Hypothalamus – functions. Cerebellum, Brain Stem – basic structure& functions. Spinal cord - spinal reflex. Neurons – structure & types, Mechanisms of Nerve impulses, Synapses & Neuronal Integration Synaptic potentials – EPSP & IPSP -Neurotransmitters – types **Special senses:** Organ of vision, hearing & equilibrium, taste and smell – structure & basic mechanisms	**11**
3	**Blood:** The composition of blood (blood proteins and blood cells & their function), hematocrit, blood groups, blood clotting. Major arteries & veins **Lymph and its function.** **Cardiovascular system**: Major blood vessels, Circulatory Systems- Systemic circulation and pulmonary circulation Heart- structure of heart and its electrical activity, Auto rhythmic cells - cardiac action potentials, cardiac cycle (ECG, Heart rate – normal & abnormal), myocardial ischemia & infraction, atherosclerosis, Heart sounds & murmurs, Stroke volume & cardiac output, blood pressure. **Respiratory system**: Structure and organization of organs, mechanics of respiration, Basics of gas exchange	**11**
4	**Skeletal system:** functions of skeletal system, Bone – classification & composition- structure of long bone – compact and spongy bone. Types of joints and function. Types of cartilage and function. **Muscular System:** Organization, Types of muscles - skeletal, cardiac and smooth muscles, mechanism of muscle contraction & relaxation. **Urinary System:** Structure and function of organs, kidneys- nephron – structure, components, Basic renal processes involved in urine formation, micturition – definition and mechanism	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Familiarize the functional organization of human body and understand the basic principles of human anatomy & physiology.	**K2**
CO2	Understand the structure and functions of nervous system and special senses.	**K2**
CO3	Identify the components of blood and understand the structure and functions of cardiovascular and respiratory systems	**K2**
CO4	Understand the structure and functions of skeletal, muscular and urinary systems.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table: (Mapping of Course Outcomes to Program Outcomes)

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Human Physiology: From Cells to Systems	Laura lee Sherwood	Cengage Learning, USA	9e/, 2014
2	Textbook of Medical Physiology	Arthur C. Guyton, John E. Hall	W.B. Saunders Company	10e/ 2000

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ross and Wilson: Anatomy and Physiology in Health and Illness	Anne Waugh, Allison Grant	Churchill Livingstone	9e/ 2001
2	Essentials of Anatomy and Physiology	Tina Sanders, Dr Valerie Scanlon	F.A. Davis Company	5e/ 2006

SEMESTER S2

ANATOMY AND PHYSIOLOGY FOR BIOMEDICAL ENGINEERING

(BIOMEDICAL AND ROBOTIC ENGINEERING)

Course Code	**PCBRT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	NIL	**Course Type**	Theory

Course Objectives:

1. To serve as a foundation course for engineers in health care field.
2. To introduce the basic anatomy of the major systems of engineering importance in human body.
3. To study the basic physiological concepts of systems.
4. To explore the basic engineering principles related to human physiology.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Importance of Anatomy& Physiology for Biomedical Engineering. Introduction to Anatomy & Physiology: Definitions, structural & functional organization of human body – cells, tissues, organs & systems, Cell: Basic structure, organelles & their functions. Cell membrane – structure, transport across cell membranes – passive transport (passive diffusion and facilitated diffusion) active transport – primary – Na^+-K^+ pump & secondary transport - co transport & counter transport. Skeletal system: functions of skeletal system, Bone – classification & composition, structure of long bone– compact and spongy bone. Joints in human body – classification and possible movements.	**11**

2	Nervous System: General organization, Neurons – structure & types, Central nervous system – Brain - structure and functions of each parts, Spinal cord - structure – spinal and cranial nerves, spinal reflex, Brain Stem – basic structure & functions. Peripheral nervous system: Efferent & afferent division. Autonomic nervous system: Sympathetic & Parasympathetic nervous system Special senses –Organ of vision, hearing & equilibrium, taste and smell – structure & basic mechanisms. Integumentary system (basic structure & function only)	**11**
3	Blood - the composition of blood (blood proteins and blood cells & their function), blood groups. Blood clotting. Lymphatic system and its functions. Cardiovascular system - major blood vessels, Heart- structure of heart and its electrical activity (ECG, Heart rate – normal & abnormal), Heart sounds & murmurs, Stroke volume & cardiac output, blood pressure. Circulatory systems-Systemic circulation and pulmonary circulation. Respiratory system - structure and organization of organs concerned with respiration, structure of lungs, mechanics of respiration, Gaseous exchange, Gas transport.	**11**
4	Muscular System - Types of muscles, Skeletal muscle-levels of organization, structure, mechanism of muscle contraction & relaxation. Urinary System-Structure and function of organs, kidneys, nephron – structure and types, Basic renal processes involved in urine formation, micturition (definition only) Digestive system – Anatomy and Functions of Components of the Digestive System – basic digestive processes: motility, secretion, digestion, and absorption. Applications of Anatomy & Physiology in medical technology for improving patient care.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Introduce the functional organization of human body and understand the structure and functions of skeletal system	**K2**
CO2	Understand the structure and functions of nervous system.	**K2**
CO3	Identify the components of blood and physiology of cardiovascular and respiratory systems	**K3**
CO4	Interpret the structure and functions of muscular, urinary systems and digestive system.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Human Physiology: From Cells to Systems	Laura lee Sherwood	Cengage Learning, USA	9th ed., 2014
2	Textbook of Medical Physiology	Arthur C. Guyton, John E. Hall	W.B. Saunders Company	10th ed., 2000
3	Ross and Wilson: Anatomy and Physiology in Health and Illness	Anne Waugh, Allison Grant	Churchill Livingstone	9th ed., 2001

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Essentials of Anatomy and Physiology	Tina Sanders, Dr Valerie Scanlon	F.A. Davis Company	5th ed., 2006
2	Anatomy and physiology in health and illness.	Ross and Wilson	Waugh & Grant	2022

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.skillmd.com/course/anatomy-nptel-video-lessons/, https://www.youtube.com/watch?v=ydZkJzl4IVk,
2	https://nptel.ac.in/courses/109104029,
3	http://www.digimat.in/nptel/courses/video/103103133/L01.html, http://www.digimat.in/nptel/courses/video/103103133/L01.html
4	https://www.youtube.com/watch?v=aIS5aBKsIwk, https://www.youtube.com/watch?v=QjihqB2rHX8,http://acl.digimat.in/nptel/courses/video/102104058/L57.html

SEMESTER S2

LOGIC CIRCUIT DESIGN

(ELECTRONICS AND INSTRUMENTATION)

Course Code	**PCEIT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	GYEST104 Introduction to Electrical & Electronics Engineering	**Course Type**	Theory

Course Objectives:

1. To understand the number systems in digital systems.
2. To introduce the basic postulates of Boolean algebra, digital logic gates and Boolean expressions
3. To design and implement combinational and sequential circuits.
4. To familiarize different logic families.
5. To study the basics of Verilog HDL.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Digital systems - Binary and hexadecimal number systems, Methods of base conversions, Binary and hexadecimal arithmetic, Representation of signed numbers(1's complement, 2's complement,9's complement, 10's complement forms). Fixed and floating point numbers, decimal codes – BCD, Gray codes, Excess 3 code, ASCII code. Boolean Algebra - Basic definitions and axiomatic definition of Boolean algebra, Basic theorems and properties of Boolean algebra,	**11**

	De-Morgan's Theorems, Boolean functions, canonical and standard forms, Digital logic gates and their truth table. Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS), Karnaugh map Minimization.	
2	Combinational Logic Systems – Half and full adders, 4 bit ripple carry adder, Subtractors, BCD Adder, Magnitude Comparators, Decoders and Encoders, Multiplexers and Demultiplexer. Basic Introduction to Programmable logic devices (PLD) and FPGA. Verilog HDL – Basic language elements, identifiers and operators. Verilog implementation of logic gates and combinational circuits.	**11**
3	Latches and Flipflops – SR Latch, SR Flipflop, JK, D and T flipflops, Master slave JK FF, Excitation table and characteristic equation, conversion of flipflops. Registers - Shift registers-SIPO, SISO, PISO, PIPO, Bidirectional. Verilog modeling of flipflops	**11**
4	Counters- Ripple counter, Mod 10 Counter, Ring counter and Johnsons-Design of Asynchronous and Synchronous counters, Mod N counter, sequence generator. Verilog modelling of asynchronous and synchronous counters. Verilog implementation of sequence generator. Electrical characteristics of TTL and CMOS logic families – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power delay product. TTL inverter - circuit description and operation, CMOS inverter - circuit description and operation, CMOS NAND, CMOS NOR.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the elements of digital system abstractions such as digital representations of information, digital logic and Boolean algebra	**K2**
CO2	Design and implement combinational logic circuits	**K3**
CO3	Design and implement sequential logic circuits	**K3**
CO4	Design and implement combinational and sequential logic using Verilog HDL	**K4**
CO5	Compare different logic families	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Fundamentals	Thomas L. Floyd	Pearson Education	11th Edition, 2017
2	Introduction to logic circuits and logic design with verilog	Brock J. Lameres	Springer	2nd Edition, 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog	M Morris Mano, Michael D. Ciletti	Pearson Education	6th Edition, 2018
2	Digital Design Verilog HDL and Fundamentals	Joseph Cvanagh	CRC Press	1st Edition, 2008
3	Fundamentals of digital circuits	Kumar A. Anand	PHI	4th Edition, 2016
4	Verilog HDL: A Guide to Digital Design And Synthesis	Samir Palnitkar	Pearson	2nd Edition, 2003

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/106/117106086/ https://archive.nptel.ac.in/courses/106/105/106105185/
2	https://archive.nptel.ac.in/courses/117/106/117106086/ https://archive.nptel.ac.in/courses/106/105/106105185/
3	https://archive.nptel.ac.in/courses/117/106/117106086/ https://archive.nptel.ac.in/courses/106/105/106105185/
4	https://archive.nptel.ac.in/courses/117/106/117106086/ https://archive.nptel.ac.in/courses/106/105/106105185/

SEMESTER S 2

BASIC OF INSTRUMENTATION ENGINEERING

(INSTRUMENTATION AND CONTROL ENGINEERING)

Course Code	**PCICT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understand the Fundamentals of Instrumentation and Control Engineering and functional elements of measurement systems.
2. Describe about functions of a control system and master Instrument Characteristics.
3. Study input-output configuration of instruments and develop Proficiency in Calibration
4. Analyse and Mitigate Measurement Errors and measurement noise.

SYLLABUS

Module No.	**Syllabus Description**	**Contact Hours**
1	INTRODUCTION TO INSTRUMENTATION & CONTROL ENGINEERING- Definition-scope and importance- application of instrumentation in different fields like petrochemical, Biomedical, pharmaceutical and food processing. FUNCTIONAL ELEMENTS OF MEASUREMENT SYSTEM: Introduction to instrument systems - Typical applications of instrument systems. Basic description of the functional elements of the measurement	**12**

	system with examples. TRANSDUCERS AND INSTRUMENT TYPES: Definition of transducers. Role of transducers in instrumentation. Classification of instruments: Active and passive instruments - Null-type and deflection-type instruments - Analogue and digital instruments - Indicating instruments and instruments with a signal output -Manually operated and automatic type, Self-generating and power operated types, Contacting and non-contacting types - Smart and non-smart instruments	
2	FUNCTIONAL ELEMENTS OF CONTROL SYSTEM: Need of Control systems – Role of error detectors – Block diagram for a control system with examples. MEASUREMENT SYSTEM PERFORMANCE: Static characteristics of instruments. Accuracy and precision, static sensitivity, linearity, hysteresis, threshold, dead time, dead zone, resolution or discrimination. static error, static correction. Scale range and span, reproducibility and drift, repeatability. Dynamic characteristics of instruments. Understating of (1) Zero order instrument (2) First order instrument (3) Second order instrument.	**10**
3	CALIBRATION OF MEASURING SENSORS AND INSTRUMENTS: Standards and calibration – Necessity of calibration- Careful instrument design, Principles of calibration-Control of calibration environment- Calibration chain and traceability-Calibration records - Intelligent instruments. TYPES OF INPUTS: Input output configuration of measuring instruments and measurement systems. Desired inputs, interfering inputs, modifying inputs. Methods of correction for interfering and modifying inputs. Loading effects. Input and output impedances. Input impedances, input admittance, output impedances, output admittance.	**11**

4	MEASUREMENT NOISE: Noise, signal to noise ratio, sources of noise, Johnson noise, power spectrum density. Sources of measurement noise-Inductive Coupling-Capacitive (electrostatic) coupling - Noise due to multiple earths-Noise in the form of voltage. ERRORS DURING THE MEASUREMENT PROCESS: Errors in measurements, true value, Limiting errors (Guarantee errors). Relative (fractional) limiting error. Combination of quantities with limiting errors. Known errors, types of errors, gross errors, systematic errors, instrumental errors, environmental errors, observational errors. Random (residual) errors. Reduction of systematic errors - Careful instrument design - Method of opposing inputs -Calibration - Manual correction of output reading.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate a comprehensive understanding of instrumentation and control engineering principles and the performance characteristics of different types of instruments.	**K2**
CO2	Develop a thorough understanding of the static and dynamic characteristics of instruments enabling effective evaluation and utilization of instrumentation in various applications.	**K2**
CO3	Develop a deep understanding of the principles of calibration and analysing input-output relationships in measurement systems	**K2**
CO4	Demonstrate a comprehensive understanding of noise and errors in measurement.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Measurements and Instrumentation Principles.	Alan S Morris	Elsevier Butterworth Heinemann	3rd edition, 2001
2	A course in Mechanical Measurement and Instrumentation.	A.K Sawhney	Dhanpat Rai & Co.	12th edition, 2017
3	Instrumentation Devices & Systems.	C.S. Rangan, G.R. Sarma, V.S.V. Mani,	Tata McGraw- Hill publishing company Ltd.	2017
4	Mechanical Measurements	S P Venkateshan	Ane Books	2nd edition, 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Measurement systems: Application and design,	Ernest. O Doeblin	McGraw Hill Higher Education	5th edition, 2003
2	Transducers and Instrumentation	D V S Murty	Prentice Hall India Learning Private Limited	2nd edition, 2008

Video Links (NPTEL, SWAYAM…)	
	Link ID
1	https://nptel.ac.in/courses/108102191

SEMESTER S2

SENSORS AND ACTUATORS

(CYBER PHYSICAL)

Course Code	**PCCPT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Provide a comprehensive understanding of fundamental concepts of sensors and actuators.
2. Explore various types of sensors, including mechanical, electromechanical, thermal, inductive, and gas sensors
3. Apply knowledge of actuators in different systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Sensors, Transducers and Actuators: Basics of Energy transformation: Transducers, Sensors and Actuators , Principles, Classification, Parameters, and Characteristics, Environmental Parameters (EP), Characterization. Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges	**11**
2	Inductive Sensors- Sensitivity and Linearity of the Sensor, Types- Capacitive Sensors, Electrostatic Transducer, Force/Stress Sensors using	**11**

	Quartz Resonators, Ultrasonic Sensors. Thermal Sensors: Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor. Introduction – Basic Characteristics – Types of Photosensistors /Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors	
3	Gas sensors: Optical gas sensor, Metal oxide semiconductor gas sensor, Field effect transistor gas sensor, Piezoelectric gas sensor, Polymer gas sensor, Nano-structured based gas sensors Design and fabrication process of Microsensors: Force Sensors, Pressure Sensors, Strain gauges and practical applications	**11**
4	Working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications Pneumatic and Hydraulic Actuation Systems- Actuation systems, Pneumatic and hydraulic systems, Directional Control valves, Pressure control valves, Cylinders, Servo and proportional control valves, Process control valves, Rotary actuators.	**11**

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)
Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Remember Fundamental Concepts of Sensors and Actuators	**K1**
CO2	Understand Mechanical and Electromechanical Sensors	**K2**
CO3	Explain Thermal and Inductive Sensors	**K2**
CO4	Identify Different Gas Sensors	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Sensors and Transducers,	D. Patranabis	PHI Learning Private Limited.	Second edition
2	Mechatronics	W. Bolton	Pearson Education Limited.	
3	Sensors and Actuators: Engineering System Instrumentation	Clarence W. de Silva	CRC Press	2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	MEMS: A Practical Guide to Design, Analysis, and Applications	Jan Korvink and Oliver Paul	Springer	2018
2	Handbook of Modern Sensors: Physics, Designs, and Applications	Jacob Fraden	Springer	5th edition, 2016
3	Principles of Measurement Systems	John P. Bentley	Pearson	4th edition, 2005
4	Piezoelectric Sensors and Actuators: Fundamentals and Applications	Stefan Johann Rupitsch	Springer	2018

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
Module - I	https://onlinecourses.nptel.ac.in/noc21_ee32/preview
Module - IV	https://onlinecourses.nptel.ac.in/noc21_ee32/preview

SEMESTER S2

DIGITAL ELECTRONICS

(ELECTRONICS AND COMPUTER ENGINEERING)

Course Code	**PCERT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	**Course Type**	Theory

Course Objectives:

1. Understand the fundamental building blocks of Digital Electronics and Boolean algebra for manipulating digital information.
2. Design digital circuits (combinational and sequential) for processing and storing information.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Number Systems: Introduction to number systems (decimal, binary, octal, hexadecimal) and their bases - conversion methods between decimal, binary, octal and hexadecimal number systems. Arithmetic - Binary Addition, Binary Multiplication and Binary Division. Addition of BCD, Octal and Hexadecimal numbers. Representing Negative Numbers - Signed Numbers & Complements, Subtraction with Complements (Binary, BCD, Octal and Hexadecimal). Introduction to alternative coding schemes - BCD, Gray codes, and Excess-3 codes.	**11**

2	Introduction to Boolean Algebra - Postulates (Idempotence, Commutativity, Associativity, Distributive Property, etc.) and Basic Theorems (like De-Morgan's Theorem), Minimization of Boolean expressions - Canonical and Standard Forms, Karnaugh map Minimization (up to four variables), Don't-Care Conditions. Digital Logic Gates – Implementation of Boolean functions (including those simplified using Karnaugh maps) using combinations of basic logic gates & implementation using universal gates.	**11**
3	Combinational and Arithmetic Circuits Combinatorial Logic Systems - Data Encoders and Decoders, Data Selection and Distribution (Mux & Demux), Code Converters, Comparators. Arithmetic Circuits - Half and Full Adder, Half & Full Subtractor, Binary Parallel Adder, BCD Adder.	**10**
4	Sequential Logic Circuits: Sequential Circuits Fundamentals, Flip-flops - SR, JK, T and D, Conversion of Flipflops, Excitation table and characteristic equation. Asynchronous (Binary and BCD counters) and Synchronous counter design (Binary up, down and up-down counter, BCD counter), timing sequences and state diagrams, Mod N counter. Shift registers - SIPO, SISO, PISO, PIPO, timing sequences and state diagrams. Shift Registers with parallel Load/Shift, Ring counter and Johnson counter	**12**

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamental concepts of number systems (decimal, binary, octal, hexadecimal) including their bases and conversion techniques.	**K2**
CO2	Utilize Boolean postulates and theorems to simplify logic expressions and implement circuits using basic logic gates	**K3**
CO3	Implement combinational logic circuits for data processing and manipulation.	**K3**
CO4	Describe the operation of different flip-flops and implement basic sequential circuits.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Design	Mano M.M, Ciletti M.D	Pearson India	4th Edition, 2006
2	Digital Fundamentals	Thomas L Floyd, Digital	Pearson Education	10th Edition , 2009
3	Modern digital Electronics	R.P. Jain	Tata McGraw Hill,	4th Edition, 2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Principles and Design	Donald D Givone	Tata McGraw Hill	1st Edition, 2003
2	Fundamentals of Digital Circuits	A. Ananthakumar	Prentice Hall	2nd Edition, 2016
3	Digital Design: Principles and Practices	Wakerly J.F	Pearson India	4th edition, 2008
4	Digital Electronics – An introduction to theory and practice	W.H. Gothmann,	PHI	2nd Edition,2006

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	NPTEL course: "Digital Circuits and Systems" by Prof. S. Srinivasan, Video Lecture No: 1, Introduction To Digital Circuits (https://nptel.ac.in/courses/117106086)
2	NPTEL course: "Digital Circuits and Systems" by Prof. S. Srinivasan, Video Lecture No: 7, Logic Minimization Using Karnaugh Maps (https://nptel.ac.in/courses/117106086)
3	NPTEL course: "Digital Circuits and Systems" by Prof. S. Srinivasan, Video Lecture No: 9, Code Converters (https://nptel.ac.in/courses/117106086)
4	NPTEL course: "Digital Circuits and Systems" by Prof. S. Srinivasan, Video Lecture No: 20, Up/ Down Counters (https://nptel.ac.in/courses/117106086)

SEMESTER S2

SENSORS AND ACTUATORS FOR ROBOTICS

(ROBOTICS AND ARTIFICIAL ENGINEERING)

Course Code	**PCRAT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understand and discuss the fundamental elementary concepts of Robotics
2. Provide insight into different types of robots
3. Understand basic laws and phenomena on which sensors operate
4. Understand the working principle of different actuators used in robotics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Robotics and Automation: - laws of robot, brief history of robotics, robotic system components, safety measures in robotics Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, humanoids, Cobots, Autonomous robots and Swarm robots, Robotics Applications.	**10**
2	Transducers and sensors: - Static and Dynamic Characteristics, Classification of sensors, Robotic Sensors Proximity sensor- Eddy current proximity sensor, Inductive Proximity sensor, Capacitive Proximity sensor, Force Sensor, Piezoelectric Sensor, Tactile sensor- Touch Sensor/Contact Sensor. Temperature Sensors: Thermistors, Thermocouples	**11**

3	Motion sensor: Encoder sensors, LVDT, Accelerometer, gyroscope-working principle only, PIR sensor, Range Sensors: RF beacons, Ultrasonic Ranging, Reflective beacons Optical sensors: Photoconductive cell, photovoltaic, Photo resistive, Photodiodes, Phototransistors, Laser Range Sensor (LIDAR) Special sensors: Acoustic Sensors, vision and imaging sensors, micro and nano sensors.	**11**
4	Definition, Types, characteristics and selection of Actuators; linear; rotary; cylindrical, Logical and Continuous Actuators, Pneumatic actuator and Electro-Pneumatic actuator; Mechanical actuation systems: Hydraulic actuator - Control valves; applications. Electrical actuating systems: Electric motors as actuators Overview of electric motors. Solid-state switches, Solenoids, - Piezoelectric Actuator.	**12**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the significance, social impact and future prospects of robotics and automation in various engineering applications	**K2**
CO2	Demonstrate the working principle and characteristics of proximity, force and pressure sensors	**K2**
CO3	Categorize and choose the suitable sensor to measure position, motion, and range of the obstacles	**K2**
CO4	Describe the working principle of different actuators used in robotics	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Sensors and actuators: Engineering system instrumentation	De Silva, Clarence W	CRC Press	2nd edition 2015
2	Instrumentation: Devices and Systems	Rangan& Mani	McGraw Hill	2nd edition, 2017
3	Process Control Instrumentation Technology	Curtis D. Johnson	Prentice Hall India	8th edition, 2005
4	Industrial Robots - Technology, Programming and Applications	Mikell P. Groover et. al	McGraw Hill, Special Edition	2nd edition, 2017
5	Robotics Technology and flexible automation	S.R. Deb	Tata McGraw-Hill Education	2nd edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Sensor, Actuators and their Interfaces: A Multidisciplinary Introductions. (1st eds)	Ida.N	SciTech, Edison	
2	Fundamentals of robotics – Analysis and control	Robert. J. Schilling	Prentice Hall of India	1996

SEMESTER S2

SENSOR TECHNOLOGY FOR ROBOTICS

(ROBOTICS AND AUTOMATION)

Course Code	**PCRUT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understand and discuss the fundamental elementary concepts of Robotics.
2. Provide insight into different types of robots
3. Understand basic laws and phenomena on which sensors operate
4. Understand operation of sensors to measure various physical parameters

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Robotics and Automation: -laws of robot, brief history of robotics, robotic system components, safety measures in robotics Types of robots: Manipulator, Legged robot, wheeled robot, aerial robots, Industrial robots, humanoids, Cobots, Autonomous robots and Swarm robots, Robotics Applications.	**11**

2	Transducers and sensors: -Static and Dynamic Characteristics, Classification of sensors, Robotic Sensors Proximity sensor- Eddy current proximity sensor, Inductive Proximity sensor, Capacitive Proximity sensor, Force Sensor, Piezoelectric Sensor, Tactile sensor- Touch Sensor/Contact Sensor.	**11**
3	Temperature Sensors: Thermistors, Thermocouples Motion sensor: Encoder sensors, LVDT, Accelerometer, gyroscope-working principle only, PIR sensor, Range Sensors: RF beacons, Ultrasonic Ranging, Reflective beacons	**11**
4	Optical sensors: Photo conductive cell, photo voltaic, Photo resistive, Photodiodes, Phototransistors, Laser Range Sensor (LIDAR), Special sensors: Acoustic Sensors, vision and imaging sensors, micro and nano sensors.	**11**

Course Assessment Method
(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Understand the significance, social impact and future prospects of robotics and automation in various engineering applications	**K2**
CO2	Demonstrate the working principle and characteristics of proximity, force and pressure sensors	**K2**
CO3	Categorize and choose the suitable sensor to measure position, motion, and range of the obstacles	**K2**
CO4	Describe the working principle of optical sensor, vision and imaging sensors and micro sensors	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Sensors and actuators: Engineering system instrumentation	De Silva, Clarence W	CRC Press	2nd edition 2015
2	Instrumentation: Devices and Systems	Rangan& Mani	McGraw Hill	2nd edition, 2017
3	Process Control Instrumentation Technology	Curtis D. Johnson	Prentice Hall India	8th edition, 2005
4	Industrial Robots - Technology, Programming and Applications	Mikell P. Groover et. al	McGraw Hill, Special Edition	2nd edition, 2017
5	Robotics Technology and flexible automation	S.R. Deb	Tata McGraw-Hill Education	2nd edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Sensor, Actuators and their Interfaces: Multidisciplinary Introductions. (1st eds)	Ida.N	SciTech, Edison	2011
2	Fundamentals of robotics – Analysis and control	Robert. J. Schilling	Prentice Hall of India	1996

SEMESTER - S2

ANALOG ELECTRONICS CIRCUITS

Course Code	**PCEOT205**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

- At the end of the course the student will be able to explain the working and design of various electronic circuits using BJT, FET, OP-Amp

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Review of Diodes** – Diode circuits – Wave shaping circuits – Rectifiers - Clippers – clampers, Zener diodes – Zener voltage regulators **Introduction to BJT** – BJT Operation- BJT Terminal Voltages and transistor currents – BJT voltage and current amplification – BJT Switching **BJT Biasing** – DC load line and Bias Point- Biasing circuits - fixed bias, voltage divider bias, role of emitter resistance in bias stabilization. Stability factor (derivation of stability factors for voltage divider biasing only) - Numerical problems.	**12**
2	**Introduction to Amplifiers** – BJT amplifier configurations – -Amplifier classifications **RC Coupled Amplifier** – AC load line concepts – Small signal low frequency ac equivalent circuit of CE amplifier –Role of coupling capacitors and emitter bypass capacitor. Calculation of amplifier gains and impedances using h parameter equivalent circuit. **Introduction to FET** - JFET common drain amplifier-Analysis of common drain amplifier using voltage divider biasing. **Multistage amplifiers**: Direct, RC, transformer coupled amplifiers. **Feedback in amplifiers** – Feedback topologies - Effect of positive and negative feedbacks. **Oscillators**: Barkhausen's criterion– RC oscillators (RC Phase shift	**12**

	oscillator and Wein Bridge oscillator) –LC oscillators (Hartley and Colpitt's) – Expression of frequency of oscillations- Crystal oscillator.	
3	**Operational Amplifiers**: Block diagram of Op-Amp. Properties of ideal and practical Op-amps - Gain, CMRR and Slew rate. Open loop and Closed loop Configurations - concept of virtual ground - Negative feedback in Op-amps. Inverting and non- inverting amplifier circuits. Summing and difference amplifiers, Instrumentation amplifier	**12**
4	**OP-AMP Circuits**: Differentiator and Integrator circuits-practical circuits Comparators: Zero crossing and voltage level detectors, Schmitt trigger. Wave form generation using Op-Amps: Square, triangular and ramp generator circuits using Op-Amp- Effect of slew rate on waveform generation. **Timer 555 IC**: Internal diagram of 555IC–Astable and Monostable multi-vibrators using555 IC	**9**

Course Assessment Method
(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro projects	Internal Ex-1	Internal Ex-2	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to explain the working and design of various electronic circuits using BJT, FET, OP-Amp.

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Design of diode circuits	**K3**
CO2	Model BJT and FET amplifier circuits.	**K3**
CO3	Design amplifier and oscillator circuits using BJT	**K3**
CO4	Explain the basic concepts of Operational amplifier (OPAMP)	**K3**
CO5	Design and develop various OPAMP application circuits.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Devices and Circuits	David A Bell	Oxford Higher Education	
2	Fundamentals of Analog Circuits	Floyd T.L.	Pearson Education	3
3	Electronic Devices and Circuit Theory	Boylestad R. L. and L. Nashelsky	Pearson Education India	
4	Linear Integrated Circuits	Choudhury R.	New Age International Publishers	
5	Op-Amps and Linear Integrated Circuits	Gayakwad R. A.	PHI Learning Pvt. Ltd.	

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Devices and Circuits	David A Bell	Oxford Higher Education	
2	Fundamentals of Analog Circuits	Floyd T.L.	Pearson Education	3
3	Electronic Devices and Circuit Theory	Boylestad R. L. and L. Nashelsky	Pearson Education India	
4	Linear Integrated Circuits	Choudhury R.	New Age International Publishers	
5	Op-Amps and Linear Integrated Circuits	Gayakwad R. A.	PHI Learning Pvt. Ltd.	

SEMESTER 3

ELECTRONICS & COMMUNICATION ENGINEERING

SEMESTER S3

MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE – 3

(Common to B & C Groups)

Course Code	**GYMAT301**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Basic knowledge in complex numbers.	**Course Type**	Theory

Course Objectives:

1. To introduce the concept and applications of Fourier transforms in various engineering fields.
2. To introduce the basic theory of functions of a complex variable, including residue integration and conformal transformation, and their applications

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fourier Integral, From Fourier series to Fourier Integral, Fourier Cosine and Sine integrals, Fourier Cosine and Sine Transform, Linearity, Transforms of Derivatives, Fourier Transform and its inverse, Linearity, Transforms of Derivative. **(Text 1: Relevant topics from sections 11.7, 11.8, 11.9)**	9
2	Complex Function, Limit, Continuity, Derivative, Analytic functions, Cauchy-Riemann Equations (without proof), Laplace's Equations, Harmonic functions, Finding harmonic conjugate, Conformal mapping, Mappings of $w= z^2$, $w=e^z$, $w=\frac{1}{z}$, $w= sinz$. **(Text 1: Relevant topics from sections 13.3, 13.4, 17.1, 17.2, 17.4)**	9
3	Complex Integration: Line integrals in the complex plane (Definition & Basic properties), First evaluation method, Second evaluation method, Cauchy's integral theorem (without proof) on simply connected domain, Independence of path, Cauchy integral theorem on multiply connected domain (without proof), Cauchy Integral formula (without proof). **(Text 1: Relevant topics from sections 14.1, 14.2, 14.3)**	9

4	Taylor series and Maclaurin series, Laurent series (without proof), Singularities and Zeros – Isolated Singularity, Poles, Essential Singularities, Removable singularities, Zeros of Analytic functions – Poles and Zeros, Formulas for Residues, Residue theorem (without proof), Residue Integration- Integral of Rational Functions of $cos\theta$ and $sin\theta$. **(Text 1: Relevant topics from sections 15.4, 16.1, 16.2, 16.3, 16.4)**	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering.	**K3**
CO2	Understand the analyticity of complex functions and apply it in conformal mapping.	**K3**
CO3	Compute complex integrals using Cauchy's integral theorem and Cauchy's integral formula.	**K3**
CO4	Understand the series expansion of complex function about a singularity and apply residue theorem to compute real integrals.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10^{th} edition, 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Complex Analysis	Dennis G. Zill, Patrick D. Shanahan	Jones & Bartlett	3rd edition, 2015
2	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39th edition, 2023
3	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th edition, 2018
4	Fast Fourier Transform - Algorithms and Applications	K.R. Rao, Do Nyeon Kim, Jae Jeong Hwang	Springer	1st edition, 2011

SEMESTER S3

SOLID STATE DEVICES

Course Code	PCECT302	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Mins
Prerequisites (if any)	Physics of Electrical Science (GBPHT121)	Course Type	Theory

Course Objectives:

1. This course explains the physical processes and working principles of semiconductor devices, while relating the device performance to material parameters and design criteria.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Review of Semiconductor physics:** Equilibrium and steady state conditions, Concept of effective mass and Fermi level, Density of states & Effective density of states, Equilibrium concentration of electrons and holes. **Excess carriers in semiconductors:** Generation and recombination mechanisms of excess carriers, quasi-Fermi levels. **Carrier transport in semiconductors**: Drift, conductivity and mobility, variation of mobility with temperature and doping, Hall Effect. Diffusion, Einstein relations, Poisson equations, Continuity equations, Current flow equations, Diffusion length, Gradient of quasi-Fermi level.	13
2	**PN junctions**: Contact potential, Electrical Field, Potential and Charge distribution at the junction, Biasing and Energy band diagrams, Ideal diode equation. **Bipolar junction transistor**: Transistor action, Base width modulation, Current components in a BJT, Derivation of current components.	12
3	**Metal Semiconductor contacts**: Electron affinity and work function, Ohmic and Rectifying Contacts, current voltage characteristics. **Ideal MOS capacitor**: band diagrams at equilibrium, accumulation, depletion and inversion, surface potential, CV characteristics, effects of real surfaces,	11

	threshold voltage, body effect. **MOSFET**- Drain current equation of enhancement type MOSFET (derivation)- linear and saturation region, Drain characteristics, transfer characteristics.	
4	**MOSFET scaling**: Need for scaling, constant voltage scaling and constant field scaling. Sub- threshold conduction in MOS. **Short channel effects in MOSFETs**: Channel length modulation, Drain Induced Barrier Lowering, Velocity Saturation, Threshold Voltage Variations and Hot Carrier Effects. **MESFET and FinFET**: Structure, operation and advantages.	**8**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply Fermi-Dirac statistics to compare equilibrium carrier concentration.	**K3**
CO2	State different carrier transport mechanisms in extrinsic semiconductors and obtain the current densities due to this transport.	**K3**
CO3	Apply the concept of semiconductor physics to solve the current components in semiconductor devices.	**K3**
CO4	Analyze the response of semiconductor devices for different biasing conditions	**K3**
CO5	Outline the effects of scaling in semiconductor devices.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Semiconductor device Fundamentals	Robert Pierret	Pearson Education	1/e, 1996
2	Physics of Semiconductor Devices	Michael shur	Pearson Education	1/e, 2019
3	Semiconductor Physics and Devices, 3ed, An Indian Adaptation	S.M. Sze, M.K. Lee	Wiley	3/e, 2021

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Semiconductor Physics and Devices	Neamen	McGraw Hill	4/e, 2017
2	Physics of Semiconductor Devices	Sze S.M	John Wiley	3/e, 2015
3	Semiconductor Devices: Physics and Technology	Sze S.M	John Wiley	3/e, 2016
4	Operation and Modelling of the MOS Transistor	Yannis Tsividis	Oxford University Press	3/e,2010
5	Semiconductor Physics and Devices, ,	Sze S.M., M.K. Lee,	An Indian Adaptation	3ed, 2021
6	Fundamentals of Semiconductor Devices,	Achuthan, K N Bhat,	McGraw Hill	1e,2015

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117106091
2	https://nptel.ac.in/courses/117106091
3	https://nptel.ac.in/courses/117106091
4	https://nptel.ac.in/courses/117106091

SEMESTER S3

ANALOG CIRCUITS

Course Code	PCECT303	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	BEE/ (GYEST104)	Course Type	Theory

Course Objectives:

1. To introduce and verify basic principles, operation and applications of the various analog electronic circuits and devices
2. To understand and analyze the design and working of amplifiers and their configurations.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Wave Shaping Circuits:** RC differentiating and integrating circuits, Analysis of First order RC low pass and high pass filter for step input -rise time, band width. Diode Clipping and clamping circuits. **BJT/MOSFET Biasing:** Need for biasing, DC load line, operating point, BJT biasing (CE configuration)– fixed bias & voltage divider bias (Design & analysis). MOSFET biasing,	10
2	**BJT Amplifiers:** Design of RC coupled CE amplifier - Small signal analysis of CE amplifier using hybrid- π model (low and mid frequency`). The high-frequency hybrid-π model of BJT, Miller effect, High frequency response of single stage CE amplifier, short circuit current gain, cut-off frequency f_β & unity gain bandwidth f_T . **MOSFET Amplifiers:** Design of CS amplifier, Small signal analysis using hybrid- π model (mid frequency only), Small signal voltage gain, input & output impedance, CS stage with current source load and diode connected load. **Multistage BJT Amplifiers:** Types of multistage amplifiers, Effect of cascading on gain and bandwidth.	12

	Small signal voltage gain, input & output impedance of BJT cascode amplifier using hybrid-π model.	
3	**Feedback amplifiers:** The general feedback structure, Effect of negative feedback on gain, bandwidth, noise reduction and distortion. The four basic feedback topologies, Analysis of discrete BJT circuits in voltage-series and voltage-shunt feedback topologies - voltage gain, input and output impedance. **Oscillators:** Classification, criterion for oscillation, Wien bridge oscillator, Hartley and Crystal oscillator. (working principle and design equations of the circuits; analysis of Wien bridge oscillator only required).	**11**
4	**Power amplifiers:** Classification, Transformer coupled class A power amplifier, push pull class B and class AB power amplifiers, complementary- symmetry class B and Class AB power amplifiers, class C and D power amplifier - efficiency and distortion (no analysis required) **Linear Voltage Regulators:** Types of voltage regulators- series and shunt - working and design, load & line regulation, short circuit protection and fold back protection.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Design wave shaping circuits using first order RC network and diodes.	**K3**
CO2	Analyze single stage and multistage BJT amplifier circuits using equivalent models.	**K3**
CO3	Apply the principles of feedback in the design of oscillators.	**K3**
CO4	Design power amplifiers and voltage regulator circuits.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Devices and Circuit Theory.	Robert Boylestad and L Nashelsky	Pearson	11th edition, 2015
2	Microelectronic Circuits	Sedra A. S. and K. C. Smith,	Oxford University Press, 2013	6th edition, 2013
3	Electronic Circuits and Devices	Theodore F. Bogart; Beasley, Jeffrey S.; Guillermo Rico	Pearson Education India	6th edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Microelectronics	Razavi B.	Wiley	2nd edition, 2015
2	Electronic Devices and Circuits	David A Bell	Oxford University Press	5th edition, 2008
3	Electronic Circuits Analysis and Design 1	D. Meganathan	Yes Dee Publishing	1st edition, 2023
4	Analysis and Design of Electronic Circuits	K. Gopakumar	OWL Books	1st edition, 2023

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/106/108106188/
2	https://archive.nptel.ac.in/courses/108/106/108106188/
3	https://archive.nptel.ac.in/courses/108/106/108106188/

SEMESTER S3

LOGIC CIRCUIT DESIGN

Course Code	**PBECT304**	**CIE Marks**	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	**ESE Marks**	40
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	GYEST104 Introduction to Electrical & Electronics Engineering	**Course Type**	Theory

Course Objectives:

1. To understand the number systems in digital systems
2. To introduce the basic postulates of Boolean algebra, digital logic gates and Boolean expressions
3. To design and implement combinational and sequential circuits.
4. To design and implement digital circuits using Hardware Descriptive Language like Verilog on FPGA

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to digital circuits:** Review of number systems representation-conversions, Arithmetic of Binary number systems, Signed and unsigned numbers, BCD. **Boolean algebra:** Theorems, sum of product and product of sum - simplification, canonical forms- min term and max term, Simplification of Boolean expressions - Karnaugh map (upto 4 variables), Implementation of Boolean expressions using universal gates.	**9**
2	**Combinational logic circuits**- Half adder and Full adders, Subtractors, BCD adder, Ripple carry and carry look ahead adders, Decoders, Encoders, Code converters, Comparators, Parity generator, Multiplexers, De-multiplexers, Implementation of Boolean algebra using MUX. Introduction to Verilog HDL – Basic language elements, Basic implementation of logic gates and combinational circuits.	**9**

3	**Sequential Circuits:** SR Latch, Flip flops - SR, JK, Master-Slave JK, D and T Flip flops. Conversion of Flip flops, Excitation table and characteristic equation. Shift registers-SIPO, SISO, PISO, PIPO and Universal shift registers. Ring and Johnsons counters. Design of Asynchronous, Synchronous and Mod N counters.	**9**
4	**Finite state machines** - Mealy and Moore models, State graphs, State assignment, State table, State reduction. **Logic Families:** -Electrical characteristics of logic gates (Noise margin, Fan-in, Fan-out, Propagation delay, Transition time, Power -delay product) -TTL, ECL, CMOS. Circuit description and working of TTL and CMOS inverter, CMOS NAND and CMOS NOR gates.	**9**

Suggestion on Project Topics

- **A random sequence generator**
- **Traffic light controller**
- **Multiplexer based person priority check in system at airport**
- **Waveform generator**
- **Object/Visitor counter**
- **Fast adders**
- **Hamming code-based parity checker**
- **Arithmetic Logic Unit using FPGA**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**30**	**12.5**	**12.5**	**60**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16marks)**	• Each question carries 6 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the knowledge of digital representation of information and Boolean algebra to deduce optimal digital circuits.	**K3**
CO2	Design and implement combinational logic circuits, sequential logic circuits and finite state machines.	**K5**
CO3	Design and implement digital circuits on FPGA using hardware description language (HDL).	**K5**
CO4	Outline the performance of logic families with Respect to different parameters.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Fundamentals	Thomas L. Floyd	Pearson Education	11th Edition, 2017
2	Fundamentals of Digital Logic with Verilog Design	Stephen Brown	McGraw Hill Education	2nd Edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog	M Morris Mano, Michael D. Ciletti	Pearson India	6th Edition, 2018
2	Fundamentals of Digital Circuits	A. Ananthakumar	PHI	4th Edition, 2016
3	Introduction to Logic Circuits & Logic Design with Verilog	Brock J. LaMeres	Springer	2nd Edition, 2019
4	Digital Design Verilog HDL and Fundamentals	Joseph Cavanagh	CRC Press	1st Edition, 2008
5	Digital Circuits and Systems	D.V. Hall	Tata McGraw Hill	1989

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/106/117106086/ https://archive.nptel.ac.in/courses/106/105/106105185/
2	https://archive.nptel.ac.in/courses/117/106/117106086/ https://archive.nptel.ac.in/courses/106/105/106105185/
3	https://archive.nptel.ac.in/courses/117/106/117106086/ https://archive.nptel.ac.in/courses/106/105/106105185/
4	https://archive.nptel.ac.in/courses/117/106/117106086/ https://archive.nptel.ac.in/courses/106/105/106105185/

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation / Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	**5**
2	Contribution in Progress Presentations and Question Answer Sessions	**4**
3	Involvement in the project work and Team Work	**3**
4	Execution and Implementation	**10**
5	Final Presentations	**5**
6	Project Quality, Innovation and Creativity	**3**
Total		**30**

Project Assessment and Evaluation criteria (30 Marks)

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**

    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**

    - Active participation and individual contribution
    - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**

    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result

5. **Final Presentation (5 Marks)**

    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions

6. **Project Quality, Innovation, and Creativity (3 Marks)**

    - Overall quality and technical excellence of the project
    - Innovation and originality in the project
    - Creativity in solutions and approaches

SEMESTER S3

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Course Code	**GNEST305**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Demonstrate a solid understanding of advanced linear algebra concepts, machine learning algorithms and statistical analysis techniques relevant to engineering applications, principles and algorithms.
2. Apply theoretical concepts to solve practical engineering problems, analyze data to extract meaningful insights, and implement appropriate mathematical and computational techniques for AI and data science applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to AI and Machine Learning**: Basics of Machine Learning - types of Machine Learning systems-challenges in ML- Supervised learning model example- regression models- Classification model example- Logistic regression-unsupervised model example- K-means clustering. Artificial Neural Network- Perceptron- Universal Approximation Theorem (statement only)- Multi-Layer Perceptron- Deep Neural Network- demonstration of regression and classification problems using MLP.(Text-2)	11
2	**Mathematical Foundations of AI and Data science**: Role of linear algebra in Data representation and analysis – Matrix decomposition- Singular Value Decomposition (SVD)- Spectral decomposition- Dimensionality reduction technique-Principal Component Analysis (PCA). (Text-1)	11

3	**Applied Probability and Statistics for AI and Data Science**: Basics of probability-random variables and statistical measures - rules in probability- Bayes theorem and its applications- statistical estimation-Maximum Likelihood Estimator (MLE) - statistical summaries- Correlation analysis- linear correlation (direct problems only)- regression analysis- linear regression (using least square method) (Text book 4)	**11**
4	**Basics of Data Science**: Benefits of data science-use of statistics and Machine Learning in Data Science- data science process - applications of Machine Learning in Data Science- modelling process- demonstration of ML applications in data science- Big Data and Data Science. (For visualization the software tools like Tableau, PowerBI, R or Python can be used. For Machine Learning implementation, Python, MATLAB or R can be used.)(Text book-5)	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the concept of machine learning algorithms including neural networks and supervised/unsupervised learning techniques for engineering applications.	**K3**
CO2	Apply advanced mathematical concepts such as matrix operations, singular values, and principal component analysis to analyze and solve engineering problems**.**	**K3**
CO3	Analyze and interpret data using statistical methods including descriptive statistics, correlation, and regression analysis to derive meaningful insights and make informed decisions.	**K3**
CO4	Integrate statistical approaches and machine learning techniques to ensure practically feasible solutions in engineering contexts.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Linear Algebra	Gilbert Strang	Wellesley-Cambridge Press	6th edition, 2023
2	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Media, Inc.	2nd edition,2022
3	Mathematics for machine learning	Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong	Cambridge University Press	1st edition. 2020
4	Fundamentals of mathematical statistics	Gupta, S. C., and V. K. Kapoor	Sultan Chand & Sons	9th edition, 2020
5	Introducing data science: big data, machine learning, and more, using Python tools	Cielen, Davy, and Arno Meysman	Simon and Schuster	1st edition , 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data science: concepts and practice	Kotu, Vijay, and Bala Deshpande	Morgan Kaufmann	2nd edition, 2018
2	Probability and Statistics for Data Science	Carlos Fernandez-Granda	Center for Data Science in NYU	1st edition, 2017
3	Foundations of Data Science	Avrim Blum, John Hopcroft, and Ravi Kannan	Cambridge University Press	1st edition, 2020
4	Statistics For Data Science	James D. Miller	Packt Publishing	1st edition, 2019
5	Probability and Statistics - The Science of Uncertainty	Michael J. Evans and Jeffrey S. Rosenthal	University of Toronto	1st edition, 2009
6	An Introduction to the Science of Statistics: From Theory to Implementation	Joseph C. Watkins	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.math.arizo	Preliminary Edition.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106198/
2	https://archive.nptel.ac.in/courses/106/106/106106198/ https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/resources/lecture-29-singular-value-decomposition/
3	https://ocw.mit.edu/courses/18-650-statistics-for-applications-fall-2016/resources/lecture-19-video/
4	https://archive.nptel.ac.in/courses/106/106/106106198/

SEMESTER S3

ENGINEERING ECONOMICS

(Common to All Branches)

Course Code	**UCHUT346**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	6
2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	6

3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators-SENSEX and NIFTY	**6**
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	**6**

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case study/Micropr oject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	**15**	**12.5**	**12.5**	**50**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• Minimum 1 and Maximum 2 Questions from each module. • Total of 6 Questions, each carrying 3 marks **(6x3 =18marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 8 marks. **(4x8 = 32 marks)**	**50**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	**K2**
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	**K3**
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	**K2**
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	**UCHUT347**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of ethics** - Personal vs. professional ethics, Civic Virtue, Respect for others, **Profession and Professionalism,** Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, **Technology and digital revolution**-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, **High technologies: connecting people and places**-accessibility and social impacts, **Managing conflict**, Collective bargaining, **Confidentiality**, Role of confidentiality in moral integrity, **Codes of Ethics**. **Basic concepts in Gender Studies** - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, **Gender disparity and discrimination in education**, employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations**, Ethical values and practices in connection with gender** - equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	**6**
2	**Introduction to Environmental Ethics:** Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). **Sustainable Engineering Principles:** Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. **Ecosystems and Biodiversity:** Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. **Landscape and Urban Ecology:** Principles of landscape	**6**

	ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	
3	**Hydrology and Water Management:** Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. **Zero Waste Concepts and Practices:** Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. **Circular Economy and Degrowth:** Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. **Mobility and Sustainable Transportation:** Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	**6**
4	**Renewable Energy and Sustainable Technologies:** Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. **Climate Change and Engineering Solutions:** Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. **Environmental Policies and Regulations:** Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. **Case Studies and Future Directions:** Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	**6**

Course Assessment Method
(CIE: 50 marks , ESE: 50)

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis**: Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts**: Ability to apply course concepts to real-world problems and local contexts.
- **Creativity**: Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills**: Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	**K3**
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	**K4**
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	**K5**
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	**K4**
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessmen	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:
Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S3
ANALOG CIRCUITS LAB

Course Code	**PCECL307**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Lab

Course Objectives:

1. Familiarise the students with the analog circuits design using discrete components.
2. Familiarise the students with simulation of basic analog circuits

Expt. No.	**Experiments**
Part A – List of Experiments using discrete components (Any *Six* experiments mandatory)	
1	RC Integrating and Differentiating Circuits – (Transient analysis with different inputs and frequency response)
2	Diode Clipping and Clamping Circuits (Transient and transfer characteristics)
3	CE amplifier – Design for a specific voltage gain and plot frequency response characteristics
4	CS MOSFET amplifier - Design for a specific voltage gain and plot frequency response characteristics
5	Cascaded amplifier (CE – CE) - Design for a specific voltage gain and plot frequency response characteristics
6	Cascode amplifier - Design for a specific voltage gain and plot frequency response characteristics
7	Feedback amplifiers (current series & voltage series) - Design for a specific voltage gain and plot frequency response characteristics
8	RC oscillators – RC phase shift or wien bridge oscillator
9	Power amplifiers (Transformer less) – Class B & Class AB

10	Transistor series voltage regulator – Design for a specific output voltage with & without short circuit protection (plot load & line regulation characteristics).
Part B – Simulation Experiments (Any *Six* experiments mandatory) The experiments shall be conducted using Open-Source Tools such as QUCS, KiCad, LT SPICE, or variants of SPICE tools.	
1	RC Integrating and Differentiating Circuits – (Transient analysis with different inputs and frequency response)
2	Diode Clipping and Clamping Circuits (Transient and transfer characteristics)
3	CE amplifier – Design for a specific voltage gain and plot frequency response characteristics
4	CS MOSFET amplifier - Design for a specific voltage gain and plot frequency response characteristics
5	Cascaded amplifier (CE – CE) - Design for a specific voltage gain and plot frequency response characteristics
6	Cascode amplifier - Design for a specific voltage gain and plot frequency response characteristics
7	Feedback amplifiers (current series & voltage series) - Design for a specific voltage gain and plot frequency response characteristics
8	RC oscillators – RC phase shift or wien bridge oscillator
9	Power amplifiers (Transformer less) – Class B & Class AB
10	Transistor series voltage regulator – Design for a specific output voltage with & without short circuit protection (plot load & line regulation characteristics).

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Design and demonstrate the functioning of basic analog circuits using discrete components.	**K3**
CO2	Design and simulate the functioning of basic analog circuits using simulation tools	**K3**
CO3	Conduct troubleshooting of a given circuit and to analyze it	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Devices and Circuits	David A Bell	Oxford University Press, 2008	5th edition
2	Electronic Circuits Analysis and Design 1	D. Meganathan	Yes Dee Publishing, 2023	1st edition

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**

    - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
    - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (7 Marks)**

    - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
    - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
    - Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**

    - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
    - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**

    - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

3. **Viva Voce (10 Marks)**

    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

4. **Record (5 Marks)**

    - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S3
LOGIC CIRCUIT DESIGN LABORATORY

Course Code	**PCECL308**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Lab

Course Objectives:

1. Familiarise the students with the Digital Logic Design through the implementation of Logic Circuits.
2. Familiarise the students with the HDL based Digital Design and FPGA boards

Expt. No.	**Experiments**
Part A – List of Experiments using digital components (Any *Six* experiments mandatory)	
1	Realization of functions using basic and universal gates (SOP and POS forms).
2	Design and Realization of half/full adder and subtractor using basic gates and universal gates.
3	4 bit adder/subtractor and BCD adder using 7483
4	Study of Flip Flops : S-R, D, T, JK and Master slave JK FF using NAND gates
5	Asynchronous Counter : 3 bit up/down counter, Realization of Mod N Counter
6	Synchronous Counter: Realization of 4-bit up/down counter, Realization of Mod-N counters
7	Ring counter and Johnson Counter.
8	Realization of counters using IC's (7490, 7492, 7493).
9	Realization of combinational circuits using MUX & DEMUX, using ICs (74150, 74154)
10	Sequence Generator / Detector
Part B – Simulation Experiments (Any *Six* experiments mandatory) The experiments shall be conducted using Verilog and implementation using small FPGA	
1	Experiment 1: Realization of Logic Gates and Familiarization of FPGAs

	(a) Familiarization of a small FPGA board and its ports and interface. (b) Create the .pcf files for your FPGA board. (c) Familiarization of the basic syntax of verilog Development of verilog modules for basic gates, synthesis and implementation in the above FPGA to verify the truth tables. (e) Verify the universality and non associativity of NAND and NOR gates by uploading the corresponding verilog files to the FPGA boards.
2	Experiment 2: Adders in Verilog (a) Development of verilog modules for half adder in any of the 3 modeling styles (b) Development of verilog modules for full adder in structural modeling using half adder.
3	Experiment 3: Mux and Demux in Verilog (a) Development of verilog modules for a 4x1 MUX. (b) Development of verilog modules for a 1x4 DEMUX.
4	Experiment 4: Flipflops and counters (a) Development of verilog modules for SR, JK and D flipflops. (b) Development of verilog modules for a binary decade/Johnson/Ring counters
5	Experiment 5. Multiplexer and Logic Implementation in FPGA (a) Make a gate level design of an 8 : 1 multiplexer, write to FPGA and test its functionality. (b) Use the above module to realize any logic function
6	Experiment 6. Flip-Flops and their Conversion in FPGA (a) Make gate level designs of J-K, J-K master-slave, T and D flip-flops, implement and test them on the FPGA board. (b) Implement and test the conversions such as T to D, D to T, J-K to T and J-K to D
7	Experiment 7: Asynchronous and Synchronous Counters in FPGA (a) Make a design of a 4-bit up down ripple counter using T-flip-flops in the previous experiment, implement and test them on the FPGA board. (b) Make a design of a 4-bit up down synchronous counter using T-flip-lops in the previous experiment, implement and test them on the FPGA board.
8	Experiment 8: Universal Shift Register in FPGA (a) Make a design of a 4-bit universal shift register using D-flip-flops in the previous experiment, implement and test them on the FPGA board. (b) Implement ring and Johnson counters with it.
9	Experiment 9. BCD to Seven Segment Decoder in FPGA (a) Make a gate level design of a seven segment decoder, write to FPGA and test its functionality. (b) Test it with switches and seven segment display. Use ouput ports for connection to the display.

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Design and demonstrate the functioning of various combinational and sequential circuits using ICs	**K3**
CO2	Apply an industry compatible hardware description language to implement digital circuits	**K3**
CO3	Implement digital circuits on FPGA boards and connect external hardware to the boards	**K3**
CO4	Function effectively as an individual and in a team to accomplish the given task.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Verilog HDL Synthesis: A Practical Primer	J. Bhasker	B. S. Publications,	2001
2	Fundamentals of Logic Design	Roth C.H	Jaico Publishers. V Ed., 2009	5th Edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Verilog HDL :A guide to digital design and synthesis	Palnitkar S.	Prentice Hall; 2003.	2nd Edn.,

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

- Completeness, clarity, and accuracy of the lab record submitted.

SEMESTER 4

ELECTRONICS & COMMUNICATION ENGINEERING

SEMESTER S4

MATHEMATICS FOR ELECTRICAL SCIENCE – 4

Course Code	**GBMAT401**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Basic calculus	**Course Type**	Theory

Course Objectives:

1. To familiarize students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.
2. To expose the students to the basics of random processes essential for their subsequent study of analog and digital communication

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Random variables, Discrete random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Binomial distribution, Poisson distribution, Poisson distribution as a limit of the binomial distribution, Joint pmf of two discrete random variables, Marginal pmf, Independent random variables, Expected value of a function of two discrete variables. **[Text 1: Relevant topics from sections 3.1 to 3.4, 3.6, 5.1, 5.2]**	**9**
2	Continuous random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Uniform, Normal and Exponential distributions, Joint pdf of two Continuous random variables, Marginal pdf, Independent random variables, Expectation value of a function of two continuous variables. **[Text 1: Relevant topics from sections 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2]**	**9**
3	Confidence Intervals, Confidence Level, Confidence Intervals and One-side confidence intervals for a Population Mean for large and	**9**

	small samples (normal distribution and *t*-distribution), Hypotheses and Test Procedures, Type I and Type II error, *z* Tests for Hypotheses about a Population Mean (for large sample), *t* Test for Hypotheses about a Population Mean (for small sample), Tests concerning a population proportion for large and small samples. **[Text 1: Relevant topics from 7.1, 7.2, 7.3, 8.1, 8.2, 8.3, 8.4]**	
4	Random process concept, classification of process, Methods of Description of Random process, Special classes, Average Values of Random Process, Stationarity- SSS, WSS, Autocorrelation functions and its properties, Ergodicity, Mean-Ergodic Process, Mean-Ergodic Theorem, Correlation Ergodic Process, Distribution Ergodic Process. **[Text 2: Relevant topics from Chapter 6]**	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the concept, properties and important models of discrete random variables and to apply in suitable random phenomena.	**K3**
CO2	Describe the concept, properties and important models of continuous random variables and to apply in suitable random phenomena.	**K3**
CO3	Estimate population parameters, assess their certainty with confidence intervals, and test hypotheses about population means and proportions using *z*-tests and the one-sample *t*-test.	**K3**
CO4	Analyze random processes by classifying them, describing their properties, utilizing autocorrelation functions, and understanding their applications in areas like signal processing and communication systems.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probability and Statistics for Engineering and the Sciences	Devore J. L	Cengage Learning	9th edition, 2016
2	Probability, Statistics and Random Processes	T Veerarajan	The McGraw-Hill	3rd edition, 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probability, Random Variables and Stochastic Processes,	Papoulis, A. & Pillai, S.U.,	McGraw Hill.	4th edition, 2002
2	Introduction to Probability and Statistics for Engineers and Scientists	Ross, S. M.	Academic Press	6th edition, 2020
3	Probability and Random Processes	Palaniammal, S.	PHI Learning Private Limited	3rd edition, 2015
4	Introduction to Probability	David F. Anderson, Timo, Benedek	Cambridge	1st edition, 2017

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/105/117105085/
2	https://archive.nptel.ac.in/courses/117/105/117105085/
3	https://archive.nptel.ac.in/courses/117/105/117105085/
4	https://archive.nptel.ac.in/courses/117/105/117105085/

SEMESTER S4

SIGNALS AND SYSTEMS

Course Code	PCECT402	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Mathematics for Electrical and Physical Sciences (GYMAT101, GYMAT201)	Course Type	Theory

Course Objectives:

1. To provide sufficient understanding of different types of signals and systems in time and frequency domain.
2. Analyze LTI systems in time and frequency domain using different transforms

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to signals and systems:** Continuous time and discrete time signals - Elementary signals, Classification of signals, Basic signal operations. Continuous time and discrete time systems – Representation and Classification (memory, causal, stable, linear, time-invariant, invertible) Convolution integral and convolution sum operations. Continuous time and discrete time LTI systems-Stability and causality of LTI systems.	11
2	**Frequency domain representation of continuous time signals:** Continuous time Fourier series - Exponential Fourier series representation of periodic signals. Continuous time Fourier transform - Convergence and Gibbs phenomenon, Continuous time Fourier transform of standard signals, Properties of Continuous time Fourier transform, Inverse Transform. Bilateral Laplace Transform, Concept of ROC, Relation of Laplace transform to Fourier Transform.	11

3	**Sampling of continuous time signals to discrete signals and frequency domain representation of discrete time signals:** Conversion of continuous time signal to discrete time signal, Sampling theorem for low pass signals, Nyquist criteria, Aliasing. Discrete time Fourier series for discrete periodic signals. Discrete time Fourier transform (DTFT)-Convergence condition, DTFT of standard signals, Properties of DTFT, Inverse transform. Z transform- ROC, Properties (Proof not needed), Inverse transform, Relation between DTFT and Z-Transform.	**11**
4	**Analysis of LTI systems using Transforms** Concept of transfer function-Frequency response, Magnitude response and phase response. Analysis of Continuous time LTI systems using Laplace and Fourier transforms. Analysis of discrete time LTI systems using DTFT and Z transforms, Stability and causality using Z transform.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Classify continuous and discrete time signals and systems based on their properties and perform basic operations on signals.	**K2**
CO2	Determine the stability and causality of LTI systems using convolution operations.	**K3**
CO3	Analyze signals in frequency domain using various transforms and examine their properties.	**K3**
CO4	Interpret the use of various transforms to analyze continuous and discrete time LTI systems.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Signals and Systems	Alan V. Oppenheim and Alan Willsky	Pearson	2/e, 2015
2	Signals and Systems	Simon Haykin	John Wiley	2/e, 2021

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Signals and Systems	Anand Kumar	PHI	3/e, 2013
2	Principles of Signal Processing & Linear systems	B P. Lathi	Oxford University Press	2/e, 2009
3	Signals & Systems - Continuous and Discrete	Rodger E. Ziemer	Pearson	4/e, 2013
4	Analog and Digital Signal Processing	Ashok Ambardar	Brooks/Cole Publishing Company	2/e, 2013
5	Signals and systems - Principles and Applications	Shaila Dinkar Apte	Cambridge University Press	1/e, 2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117101055 https://nptel.ac.in/courses/117104074 https://nptel.ac.in/courses/108104100
2	Same as above
3	Same as above
4	Same as above

SEMESTER S4

LINEAR INTEGRATED CIRCUITS

Course Code	**PCECT403**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Analog Circuits (PCECT303)	**Course Type**	Theory

Course Objectives:

1. To develop skills to design and analyze circuits using operational amplifiers for various applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Differential Amplifiers:** Differential amplifier configurations using BJT, DC Analysis - transfer characteristics; AC analysis - differential and common mode gains, CMRR, input and output resistance, voltage gain, constant current bias, constant current source. **Concept of current mirror**: two-transistor current mirror, Wilson and Widlar current mirrors. **Operational amplifiers (Op Amps):** The 741 Op Amp, Block diagram, Ideal Op Amp parameters, typical parameter values for 741, equivalent circuit, open loop configurations, voltage transfer curve, frequency response curve.	**11**
2	**Op Amp with negative feedback:** General concept of Voltage Series, Voltage Shunt, Current Series and Current Shunt negative feedback, Op Amp circuits with Voltage Series and Voltage Shunt feedback, Virtual ground concept. Analysis of inverting and non-inverting amplifier for closed loop gain, Input Resistance and Output Resistance. **Op Amp applications:** Summer, Voltage Follower, Differential and Instrumentation Amplifiers, Voltage to Current and Current to Voltage converters, Integrator, Differentiator, Precision Rectifiers, Comparators, Schmitt Triggers, Log and Antilog amplifiers.	**11**

3	**Oscillators and Multivibrators:** Phase Shift and Wien-bridge Oscillators, Triangular and Sawtooth waveform generators, Astable and Monostable multivibrators. **Active filters:** Comparison with passive filters, First and Second order Low pass, High pass, Band pass and Band Reject active filters, State Variable filters. **Voltage Regulators:** Fixed and Adjustable voltage regulators, IC 723 – Low voltage and High voltage configurations, Current boosting, Current limiting, Short circuit and Fold-back protection.	**11**
4	**Timer and VCO:** Timer IC 555 - Functional diagram, Astable and monostable operations, Basic concepts of Voltage Controlled Oscillator and application of VCO IC LM566. **Phase Locked Loop**: Basic building block, Operation, Closed loop analysis, Lock and capture range, Applications of PLL, PLL IC565. **Data Converters:** Digital to Analog converters, Specifications, Weighted resistor type and R-2R Ladder type. Analog to Digital Converters: Specifications, Flash type and Successive approximation type.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarize the concepts of operational amplifiers and differential amplifier configurations	**K2**
CO2	Design operational amplifier circuits for various applications.	**K3**
CO3	Choose integrated circuit chips for various linear circuit applications.	**K2**
CO4	Implement various applications using specific integrated circuit chips	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Linear Integrated Circuits	Roy D. C. and S. B. Jain	New Age International	5/e, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Design with Operational Amplifiers and Analog Integrated Circuits	Sergio Franco	Tata McGraw Hill	3/e, 2017
2	Op-Amps and Linear Integrated Circuits	Gayakwad R. A.	Prentice Hall	4/e, 2015
3	Integrated Circuits	Botkar K. R.	Khanna Publishers	10/e, 2013
4	Operational Amplifiers	C.G. Clayton	Butterworth & Company Publ. Ltd. Elsevier	5/e, 2005
5	Operational Amplifiers & Linear Integrated Circuits	R.F. Coughlin & Fredrick Driscoll	PHI	6/e, 2000
6	Operational Amplifiers & Linear ICs	David A. Bell	Oxford University Press	3/e, 2011
7	Microelectronic Circuits	Sedra A. S. and K. C. Smith	Oxford University Press	6/e, 2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117101106
2	https://nptel.ac.in/courses/117101106
3	https://nptel.ac.in/courses/117101106
4	https://nptel.ac.in/courses/117101106

SEMESTER S4

MICROCONTROLLERS

Course Code	PBECT404	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PBECT304-Logic Circuit Design	Course Type	Theory

Course Objectives:

1. To learn Microcontroller architecture and its programming
2. To learn embedded system design to develop a product.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Microcontroller Architecture – General internal architecture, Address bus, Data bus, control bus. The Microcontroller 8051: Features of 8051 microcontroller, Block diagram of 8051- program status word (PSW), accumulator, program counter. Memory organization – RAM & ROM, register banks and stack, Special Function Registers (SFRs), I/O port organization, Interrupts.	9
2	Instruction Set of 8051 & Addressing modes: Classification of instruction set - Data transfer group, arithmetic group, logical group, branching group. Addressing modes - Types. Accessing the data from internal and external memory.	9
3	Programming 8051 Using Assembly Language: Introduction to 8051 assembly language programming. Data types & directives, Concept of subroutine. Software delay programming. Programming 8051 Using Embedded C Language: Introduction to embedded C – advantages.	9
4	Timer / Counter in 8051: Timer registers - Timer0, Timer1. Configuration of timer registers. Timer mode programming. Counter mode.	9

	Serial Communication in 8051: Serial communication – modes and protocols, RS-232 pin configuration and connection. Serial port programming – transmitting and receiving. Programming the interrupts: Use external, timer and serial port interrupts. Interrupt priority settings.	

Suggestion on Project Topics

1. Interface any known ADC chip to 8051 uC. Read the variation in voltage from a potentiometer and display it on an LCD module.
2. Interface any known DAC chip to 8051 uC. Generate a Sine waveform of 1KHz at any port pin.
3. DC motor interface for speed and direction control.
4. Stepper motor interface - Unit step control, Rotation angle control, Speed control, Direction control
5. Read the Temperature sensor and display it on LCD.

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Outline Architecture of Microcontroller	**K2**
CO2	Develop Microcontroller programs	**K5**
CO3	Design various interfaces to Microcontroller	**K5**
CO4	Design and implement an Embedded System	**K6**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The 8051 Microcontroller and Embedded Systems Using Assembly and C	Muhammad Ali Mazidi Janice Gillispie Mazidi Rolin D. McKinlay	Prentice Hall -Inc	Second, 2007
2	The 8051 Microcontroller Architecture, Programming and Applications	Kenneth J Ayala Dhananjay V Gadre	Cengage Learning	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	8051 hardware Description	Datasheet	Intel Corporation	1992
2	Microprocessors and Microcontrollers	Lyla B. Das	Pearson Education	2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Microprocessors and Microcontrollers - https://nptel.ac.in/courses/106108100
2	Microcontrollers and Applications - https://nptel.ac.in/courses/117104072

PBL Course Elements

L: Lecture (3 Hrs.)	**R: Project (1 Hr.), 2 Faculty Members**		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	**Evaluation for**	**Allotted Marks**
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**
    - Clarity and feasibility of the project plan
    - Research and background understanding
    - Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**
    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**
    - Active participation and individual contribution
    - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**
    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result

5. **Final Presentation (5 Marks)**
    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions

6. **Project Quality, Innovation, and Creativity (3 Marks)**
    - Overall quality and technical excellence of the project
    - Innovation and originality in the project
    - Creativity in solutions and approaches

SEMESTER S4

INSTRUMENTATION

Course Code	**PEECT 411**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	**Course Type**	Theory

Course Objectives:

1. This course aims to introduce the basic concepts of electronic measuring instruments.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to measuring instruments** Generalized Configurations and Functional elements of Instrumentation systems, Need for Measurement Systems, Classification of Types of Measuring instruments. Static and Dynamic characteristics of measuring instruments.	9
2	**Sensors and Transducers** Classification and selection criteria of Transducers Principles of operation, construction, theory, advantages and disadvantages, applications of **Resistive Transducers:** Potentiometers, strain gauges, (metallic and semi-conductor type), Resistance Thermometer, Thermistors. **Inductive Transducers:** LVDT (Linear variable differential transformer). **Capacitive Transducers:** various capacitive transducers based upon familiar equation of capacitance (capacitive microphone)	9
3	**Electronic Measuring Instruments** Digital storage oscilloscope, Working principle and applications of waveform analyser, digital frequency meter, harmonic distortion meter, harmonic analyser, spectrum analyser and logic state analyser IEEE -	9

	488 General Purpose Interface Bus (GPIB) Instruments with application. EMI, Grounding and Shielding	
4	**PLC Programming** Basic PLC Programming: Programming ON/OFF Inputs, Creating Ladder diagrams, Register Basics, PLC Timers and Counters, PLC Arithmetic functions, Number comparison functions, Data handling Functions: Skip function and applications; master control relay function and applications; jump with non-return and return; data table, register and other move functions, PLC functions with BITS.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Interpret the basic concepts of measuring instruments, its classification, and selection criteria.	**K2**
CO2	Outline the principle, construction and working of transducers for measuring physical variables.	**K2**
CO3	Comprehend the principle, construction and working of various electronic measuring instruments.	**K2**
CO4	Apply PLC programming for selected industrial processes.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Doebelin's Measurement Systems	Ernest Doebelin, Dhanesh N. Manik	Tata McGraw Hill	6/e, 2011
2	Electronic Instrumentation	Kalsi H S	Tata McGraw Hill	4/e, 2019
3	Programmable Logic controllers Programming Methods and Applications	John R Hackworth, Frederick D Hackworth	Pearson Education	3/e, 2022

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	"Electrical and Electronics Measurements and Instrumentation,"	Sawhney AK,	Dhanpat Rai and Sons	2023
2	"Programmable Logic Controllers- Principles and applications	John W Webb, Ronald A. Reis,	Pearson	5/e, 2015

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/105/108105064/
2	https://archive.nptel.ac.in/courses/108/105/108105153/

SEMESTER S4

POWER ELECTRONICS

Course Code	**PEECT 412**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Analog Circuits (PCECT303)	**Course Type**	Theory

Course Objectives:

1. To study the characteristics of power electronic devices.
2. To study different power converter circuits.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** Scope and applications of Power Electronics, Properties of ideal switch. **Structure and static characteristics:** Power diodes, Power BJT, Power MOSFET & IGBT – comparison. Basic principles of wide band gap devices – SiC & GaN. **Safe Operating Area:** Power BJT, Power MOSFET & IGBT. **Drive Circuits:** Power BJT and Power MOSFET (any two example circuits – no analysis).	9
2	**SCR:** Structure, two transistor analogy, static characteristics. **Rectifiers:** Three phase diode bridge rectifiers, Single phase half-controlled rectifier with R load – Single phase fully controlled bridge rectifier (continuous conduction) – output voltage equation. Principle of three phase half wave controlled rectifier– (average output voltage equation for continuous load current) – related simple problems (1-phase & 3-phase).	9
3	**DC – DC Switch Mode Converters:** Buck, Boost and Buck-boost DC-DC converters. Waveforms and expression of DC-DC converters for output voltage, voltage and current ripple under continuous conduction mode.	9

	Isolated converters: Flyback, Forward, Push Pull, Half bridge and Full bridge converters – Waveforms and governing equations.	
4	**DC-AC Switch Mode Inverters:** Inverter topologies, Driven Inverters: Push-Pull, Half bridge and Full bridge configurations, Single phase PWM inverters (Single pulse width and sinusoidal pulse width modulation) – rms output voltage equation and output voltage waveforms.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Outline the operation of power semiconductor devices and its characteristics.	**K2**
CO2	Design and analyze various rectifier circuits for power devices	**K3**
CO3	Analyze different power converter circuits	**K3**
CO4	Illustrate different types of inverter circuits	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Power Electronics Essentials & Applications	L Umanand	Wiley India	Reprint Edition 2014
2	Power Electronics Circuits, Devices, and Applications	Muhammad H Rashid	Pearson India	Third Edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Power Electronics Converters, Applications, and Design	Ned Mohan, Tore M Undeland, William P. Robbins	Wiley India	Third Edition
2	Power Electronics Principles and Applications	Joseph Vithayathil	Tata McGraw-HILL	Second Reprint 2010
3	Power Electronics	Daniel W Hart	McGraw-HILL	2011
4	SiC and GaN Wide Bandgap Device Technology Overview,	Milligan, J. W., Sheppard, S., Pribble, W., Wu, Y.-F., Muller, G., &Palmour, J. W	2007 IEEE Radar Conference.	doi:10.1109/radar.2007.374395.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	
2	https://www.youtube.com/watch?v=fOZ8bUrFJGk
3	https://archive.nptel.ac.in/courses/117/108/117108124/
4	https://www.youtube.com/watch?v=Dg5AIy0bY1A

SEMESTER S4

MACHINE LEARNING

Course Code	PEECT413	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3-0-0--0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	NONE	Course Type	Theory

Course Objectives:

1. To provide a comprehensive understanding of machine learning principles and techniques.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Review**: supervised, unsupervised machine learning techniques, dimensionality reduction techniques-PCA, SVD Instance-Based vs Model-Based Learning, Machine Learning models, Hyper parameters, regularization, Training - Batch and Online Learning, Challenges of Machine Learning: Data Issues-Quality, Relevancy, Over fitting, under fitting. Bias, variance, Performance metrics: Accuracy Recall, Precision, ROC curve	9
2	Regression: linear regression, logistic regression error functions in regression, MSE, L1, L2, Cross entropy multivariate regression. Classification: Naive Bayes classifier, Support Vector machines, Decision trees -random forests, Ensemble methods: boosting, bagging.	9
3	Unsupervised learning: Clustering-K-means, High, Hierarchical clustering, criterion functions for clustering, proximity measures, *Euclidean, Manhattan, Minkowski Distances, Cosine Similarity.* Reinforcement Learning: Agent based learning, Q-learning, Introduction to HMM models	7

4	Introduction to Artificial Neural Networks: Biological Neuron, Perceptron, Training, limitations, XOR problem, Multilayer perceptron, Gradient based learning, stochastic gradient descent, Activation Functions-Sigmoid, ReLU, tanh. Back propagation- Chain rule, Regularization- L1, L2,	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyze and apply supervised and unsupervised machine learning techniques to solve various data-driven problems.	**K4**
CO2	Develop, train, and optimize regression and classification models	**K3**
CO3	Design and execute clustering techniques, and assess their effectiveness using various proximity measures.	**K3**
CO4	Apply unsupervised learning techniques and understand reinforcement learning for complex problem-solving.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Hands-on Machine learning with Sc-kit Learn Keras and Tensorflow (module 1)	Aurelien Geron	Oreilly	Second edition 2019
2	Machine learning for absolute beginners	Oliver Theobald		Second edition
3	Learning Deep Learning (for module 4)	Magnus Ekman	Addison -Wesley	2022
4	Introduction to Machine learning with Python	Andreas C. Müller & Sarah Guido	O'Reilly	2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	"Pattern Recognition and Machine Learning"	. Bishop, C. M.	Springer, New York,	2006.
2	"Pattern Recognition".	Theodoridis, S. and Koutroumbas, K.	Academic Press, San Diego,.	2003
3	Artificial Intelligence : a Modern Approach.	Russell, Stuart J.	:Prentice Hall,	2010.
4	CS229 Lecture Notes	Andrew Ng and Tengyu Ma	https://cs229.stanford.edu/main_notes.pdf	2023

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc23_cs18/preview (For modules 1,2 and 3)
2	https://see.stanford.edu/Course/CS229
3	https://onlinecourses.nptel.ac.in/noc23_cs18/preview
4	https://www.3blue1brown.com/topics/neural-networks

SEMESTER S4

OBJECT ORIENTED PROGRAMMING

Course Code	**PEECT414**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PROGRAMMING IN C	**Course Type**	Theory

Course Objectives:

1. To introduce the basic concepts of object-oriented design techniques.
2. To give a thorough understanding of the basics of Java programming

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** **Approaches to Software Design** - Functional Oriented Design, Object Oriented Design, Case Study of Automated Fire Alarm System. **Introduction to Java** - Java Buzzwords, Java program structure, Java compiler, Bytecode, Java Virtual Machine (JVM), Comments, Lexical Issues.	7
2	**Core Java Fundamentals:** **Primitive Data types** - Integers, Floating Point Types, Characters, Boolean. Literals, Variables, Type Conversion and Casting, Arrays, Strings- String Handling functions. **Operators** - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence. **Control Statements** - Selection Statements, Iteration Statements and Jump Statements.	9
	Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Object Reference, Access Control, Introduction to	

	Methods, Constructors, this Keyword, Method Overloading. Inheritance - Super Class, Sub Class, The Keyword super, protected Members, Method Overriding.	
3	**More features of Java:** **Packages** - Defining Package, CLASSPATH, Importing Packages. **Exception Handling** - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw, throws and finally. **Input/output** - I/O Basics, Reading Console Input, Writing Console Output, Print Writer Class, Working with Files.	**10**
4	**Advanced features of Java:** **Swings fundamentals** - Swing Key Features, Model View Controller (MVC), Swing Controls, Components and Containers, Swing Packages, Event Handling in Swings, Swing Layout Managers, Exploring Swings –JFrame, JLabel, The Swing Buttons, JtextField.. **Java DataBase Connectivity (JDBC)** - JDBC overview, Creating and Executing Queries – create table, delete, insert, select.	**10**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Summarize the object-oriented concepts - classes, objects, constructors, data hiding, inheritance and polymorphism and to illustrate it using UML diagrams.	**K2**
CO2	Utilise datatypes, operators, control statements, object oriented class, object concepts in Java to develop programs.	**K3**
CO3	Illustrate how robust programs can be written in Java using packages, exception handling mechanism and Input/ Output Streams with Files.	**K3**
CO4	Identify and utilize various Swing controls, components, and containers.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Java: The Complete Reference	Herbert Schildt	Tata McGraw Hill	8/e, 2011.
2	Fundamentals of Software Engineering,	Rajib Mall	PHI	4th edition, 2014.
3	Java How to Program, Early Objects	Paul Deitel, Harvey Deitel,	Pearson,	11th Edition, 2018.

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Programming JAVA a Primer	Balagurusamy E	McGraw Hill	5/e, 2014.
2	Object Oriented Systems Development using the Unified Modeling Language	Ali Bahrami	McGraw-Hill Int.	2017
3	Introduction to Java Programming	Y. Daniel Liang	Pearson	7/e, 2013.
4	Core Java: An Integrated Approach	Nageswararao R.	Dreamtech Press	2008
5	Java in A Nutshell	Flanagan D	O'Reilly	5/e, 2005.
6	Object Oriented Design with UML and Java	Barclay K.J. Savage,	Elsevier	2004
7	Head First Java	Sierra K.	O'Reilly	2/e, 2005.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc20_cs08/preview

SEMESTER S4
DIGITAL SYSTEM DESIGN

Course Code	**PEECT416**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PBECT304: Logic Circuit Design	**Course Type**	Theory

Course Objectives:

1. To acquire knowledge about Asynchronous and clocked Synchronous sequential circuit design.
2. To detect the faults and hazards in digital circuit design
3. To design and implement digital circuits using VHDL.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Clocked Synchronous Networks, Analysis of Clocked Synchronous Sequential Networks (CSSN), Modeling of CSSN, State assignment and reduction, Design of CSSN.	**10**
2	ASM Chart and its realization. Asynchronous Sequential Circuits, Analysis of Asynchronous Sequential Circuits (ASC), Flow table reduction, Races in ASC, State assignment problem and the transition table.	**10**
3	Hazards – static and dynamic hazards in combinational networks, Essential Hazards, Design of Hazard free circuits, Data synchronizers, Mixed operating mode asynchronous circuits, Practical issues- clock skew and jitter, Synchronous and asynchronous inputs. Faults: Fault table method – path sensitization method – Boolean difference method.	**8**
4	VLSI Design flow: Design entry: Schematic, Data types and objects, different modelling styles in VHDL - Dataflow, Behavioural and Structural Modelling. VHDL constructs and codes for combinational and sequential circuits.	**8**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyze asynchronous and clocked synchronous sequential circuits	**K3**
CO2	Design hazard-free digital circuits	**K3**
CO3	Identify faults in digital circuits	**K3**
CO4	Apply VHDL programming in digital system design	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Principles & Design	Donald G Givone	Tata McGraw Hill	1/e 2002
2	Digital Design with an introduction to HDL, VHDL and Verilog	M.Morris Mano and Michel.D.Ciletti	Pearson education	6/e, 2018
3	Digital Design	John F Wakerly	Pearson Education	4/e 2008
4	Digital Logic Applications and Design	John M Yarbrough	Cengage India	1/e 2006

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Systems Testing and Testable Design	Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman	John Wiley & Sons Inc	1994
2	Logic Design Theory	N. N. Biswas	PHI	1992
3	Introduction to Digital Design Using Digilent FPGA Boards	Richard E. Haskell, Darrin M. Hanna	LBE Books- LLC	2009
4	Digital Circuits and Logic Design	Samuel C. Lee	PHI	1980
5	Digital System Design Using VHDL	R. Anand	Khanna Book Publishing Company	FIRST,2013
6	Digital System Design using VHDL	Charles Roth	PWS PUBLISHING	1997
7	Digital System Design Using VHDL	Lizy Kurian John, Charles H. Roth	Cengage	1st, 2012

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/106/117106086/
2	https://archive.nptel.ac.in/courses/117/106/117106086/
3	https://archive.nptel.ac.in/courses/108/105/108105132/ Lecture 15
4	https://nptel.ac.in/courses/108106177

SEMESTER S4

DIGITAL SYSTEMS AND VLSI DESIGN

Course Code	**PEECT415**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	**ESE Marks**	60
Credits	5/3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PBECT304 Logic Circuit Design	**Course Type**	Theory

Course Objectives:

1. To equip students with comprehensive knowledge and skills in designing, analysing, modelling, and optimizing clocked synchronous sequential networks (CSSNs).
2. To provide a thorough understanding of the designing, analyzing, and optimizing techniques of asynchronous sequential circuits (ASCs).
3. To equip students with the knowledge and skills to identify and mitigate static and dynamic hazards and to understand fault detection and testing methods.
4. To provide students with a comprehensive understanding of the VLSI design flow and the application of VHDL constructs and coding for combinational and sequential circuits.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Clocked Synchronous Networks, Analysis of Clocked Synchronous Sequential Networks (CSSN), Mealy machine, Moore machine, Modelling of CSSN, State assignment and reduction, Design of CSSN, ASM Chart and its realization.	**9**
2	Asynchronous Sequential Circuits, Analysis of Asynchronous Sequential Circuits (ASC), Flow table reduction, Races in ASC, State assignment problem and the transition table, Design of Asynchronous Sequential Circuits, Design of ALU.	**9**

3	Hazards – static and dynamic hazards in combinational networks, Essential Hazards, Design of Hazard free circuits, Data synchronizers, Mixed operating mode asynchronous circuits, Practical issues- clock skew and jitter, Synchronous and asynchronous inputs, Flip-Flops and Simple Flip-Flop Applications, switch debouncer. Faults, Fault table method – path sensitization method – Boolean difference method, Kohavi algorithm, Automatic test pattern generation – Built in Self-Test (BIST)	**9**
4	VLSI Design flow: Design entry: Schematic, FSM & HDL, VHDL Hardware Description Language, VHDL Modules, VHDL Processes, Different modeling styles in VHDL, Data types and operators, Objects, Dataflow, Behavioral and Structural Modeling, Synthesis, Simulation. VHDL constructs and codes for combinational and sequential circuits.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	*Internal Ex*	*Evaluate*	*Analyse*	*Total*
5	**15**	**10**	**10**	**40**

Criteria for Evaluation (Evaluate and Analyse): 20 marks

Evaluation Methods:

1. Experiments Using Design and Analysis Tools: (10 marks)

Students can perform specific experiments using tools like GHDL, iVerilog, ModelSim, Xilinx ISE, Vivado etc.

Each experiment can focus on designing and simulating different types of circuits (synchronous, asynchronous, combinational, sequential).

2. Course Project:

Comprehensive project involving design, modeling, and analysis of a digital system. (10 marks)

Project phases: Proposal, Design, Implementation, Testing, Final Report.

Presentations and Viva Voce:

Students present their projects and experiments, explaining design choices, methodologies, and results.

Viva voce to assess understanding and ability to answer related questions.

Sample Experiments:

Experiment 1: Basic Mealy/Moore Machine Design

- **Objective:** Design a simple Mealy/Moore machine to detect a specific sequence of bits (e.g., "101").
- **Tools:** VHDL/Verilog, GHDL, iVerilog, ModelSim/Xilinx ISE, Vivado.
- **Steps:**
    1. Draw the state diagram for the sequence detector.
    2. Write the VHDL or Verilog code for the Mealy machine.
    3. Simulate the design to verify its functionality.

Experiment 2: Basic Flow Table Reduction

- **Objective:** Reduce the flow table for a simple asynchronous sequential circuit.
- **Tools:** Manual calculation, VHDL/Verilog for verification.
- **Steps:**
    1. Given a flow table, perform flow table reduction.
    2. Assign binary codes to the reduced states.
    3. Implement the reduced state machine in VHDL or Verilog and simulate it.

Experiment 3: Identifying and Eliminating Static Hazards

- **Objective:** Identify and eliminate static hazards in a simple combinational circuit.
- **Tools:** VHDL/Verilog, GHDL, iVerilog, ModelSim/Xilinx ISE, Vivado.
- **Steps:**
    1. Design a combinational circuit with a known static hazard.
    2. Identify the static hazard in the circuit.
    3. Modify the design to eliminate the static hazard and simulate it.

Experiment 4: Fault Detection Using Path Sensitization

- **Objective:** Use the path sensitization method to detect faults in a simple digital circuit.
- **Tools:** VHDL/Verilog, GHDL, iVerilog, ModelSim/Xilinx ISE, Vivado.
- **Steps:**

1. Design a simple digital circuit.
2. Apply the path sensitization method to detect faults.
3. Implement and simulate the circuit in VHDL or Verilog to verify fault detection.

Sample Project Topics:

1. Design and Analysis of a Traffic Light Controller Using Mealy and Moore Machines
2. State Reduction and Assignment for a Sequence Detector
3. Design and Analysis of an Asynchronous Sequence Detector
4. Designing a Simple Arithmetic Logic Unit (ALU) with Flow Table Reduction and Hazard Handling
5. Design of a Hazard-Free Circuit for a Critical Application
6. Implementing Data Synchronizers for Mixed Operating Mode Asynchronous Circuits
7. Comprehensive VLSI Design Project Using VHDL (e.g., Digital Clock, ALU, Traffic Light Controller)
8. Synthesis and Simulation of Complex Sequential Circuits Using Different VHDL Modeling Styles

Criteria for Evaluation: Lab Experiments (10 marks)

1. **Understanding of Concepts (3 marks)**
    - Demonstrates a clear understanding of the theoretical concepts related to the experiment.
    - Correctly explains the purpose and expected outcomes of the experiment.
2. **Implementation and Accuracy (3 marks)**
    - Correctly implements the design using appropriate tools.
    - The design functions as expected without errors.
3. **Analysis and Problem-Solving (2 marks)**
    - Effectively analyse the design to identify and resolve issues.
    - Demonstrates problem-solving skills in addressing any encountered challenges.
4. **Documentation and Reporting (1 mark)**
    - Provides clear and concise documentation of the steps and processes followed.
    - The report includes diagrams, code snippets, and simulation results.

5. **Presentation and Communication (1 mark)**
    - Clearly presents the experiment and its results.
    - Able to answer questions and explain the design choices.

Criteria for Evaluation: Course Project (10 marks)

1. **Project Proposal and Planning (2 marks)**
    - Submits a well-defined project proposal outlining objectives, methodology, and expected outcomes.
    - Demonstrates thorough planning and a clear timeline for the project.
2. **Design and Implementation (3 marks)**
    - Implements the project design accurately using appropriate tools and techniques.
    - The design is functional and meets the project objectives.
3. **Innovation and Creativity (2 marks)**
    - Introduces innovative ideas or unique approaches in the design and implementation.
    - Demonstrates creativity in solving problems or optimizing designs.
4. **Analysis and Testing (2 marks)**
    - Effectively analyzes the project design to identify and address any issues.
    - Conducts thorough testing to verify the functionality and performance of the design.
5. **Final Report and Presentation (1 mark)**
    - Submits a comprehensive final report detailing the project, including objectives, design, methodology, analysis, and results.
    - Clearly presents the project and its outcomes, and effectively communicates the key points.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. • Each question carries 9 marks. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Design, analyze, and model clocked synchronous sequential networks (CSSNs), optimize state assignment and reduction, and effectively utilize ASM charts for the realization of complex digital systems.	**K3**
CO2	Design and analyze asynchronous sequential circuits (ASCs), perform flow table reduction, address race conditions and state assignment problems, and design both ASCs and Arithmetic Logic Units (ALUs).	**K3**
CO3	Identify and mitigate static and dynamic hazards in combinational networks, design hazard-free circuits, address practical issues in digital systems and apply fault detection and testing methods.	**K2**
CO4	Explain the VLSI design flow, utilize various design entry methods, apply different VHDL modeling styles, and develop and simulate VHDL constructs for combinational and sequential circuits.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Principles & Design	Donald G Givone	McGraw Hill Education	2017
2	Digital Design: Principles and Practices	John F Wakerly	Pearson India	4th, 2008
3	Digital Logic Applications and Design	John M Yarbrough	Cengage Learning India	1st, 2006
4	Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog	M.Morris Mano and Michel.D.Ciletti,	Pearson	6th, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Systems Testing and Testable Design	Melvin A. Breuer, Miron Abramovici, Arthur D. Friedman	Wiley-IEEE Press	1st, 1994
2	Logic Design Theory	Nripendra N. Biswas	Prentice Hall	1993
3	Introduction to Digital Design Using Digilent FPGA Boards: Block Diagram / VHDL Examples	Richard E. Haskell Darrin M. Hanna	LBE Books- LLC	2019
4	Digital Circuits and Logic Design	Samuel C. Lee	Prentice Hall India Learning Private Limited	1980
5	Switching and Finite Automata Theory	Zvi Kohavi, Niraj K. Jha	CAMBRIDGE UNIVERSITY PRESS	3rd 2009
6	Digital System Design Using VHDL	Rishabh Anand	Khanna Publishing	1st, 2013
7	Digital System Design Using VHDL	Lizy Kurian John, Charles H. Roth	Cengage	1st, 2012

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/106/117106086/
2	https://archive.nptel.ac.in/courses/117/106/117106086/
3	https://archive.nptel.ac.in/courses/108/105/108105132/ Lecture 15
4	https://nptel.ac.in/courses/108106177

SEMESTER S4

ECONOMICS FOR ENGINEERS

(Common to All Branches)

Course Code	**UCHUT346**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2.30
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Understanding of finance and costing for engineering operation, budgetary planning and control
2. Provide fundamental concept of micro and macroeconomics related to engineering industry
3. Deliver the basic concepts of Value Engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	6
2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	6

3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators- SENSEX and NIFTY	**6**
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	**6**

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case study/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	**15**	**12.5**	**12.5**	**50**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• Minimum 1 and Maximum 2 Questions from each module. • Total of 6 Questions, each carrying 3 marks **(6x3 =18marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 sub divisions. • Each question carries 8 marks. **(4x8 = 32 marks)**	**50**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	**K2**
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	**K3**
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	**K2**
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	**UCHUT347**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of ethics** - Personal vs. professional ethics, Civic Virtue, Respect for others, **Profession and Professionalism,** Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, **Technology and digital revolution**-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, **High technologies: connecting people and places**-accessibility and social impacts, **Managing conflict**, Collective bargaining, **Confidentiality**, Role of confidentiality in moral integrity, **Codes of Ethics**. **Basic concepts in Gender Studies** - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, **Gender disparity and discrimination in education**, employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations**, Ethical values and practices in connection with gender** - equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	**6**
2	**Introduction to Environmental Ethics:** Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). **Sustainable Engineering Principles:** Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics.	**6**

	Ecosystems and Biodiversity: Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. **Landscape and Urban Ecology:** Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	
3	**Hydrology and Water Management:** Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. **Zero Waste Concepts and Practices:** Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. **Circular Economy and Degrowth:** Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. **Mobility and Sustainable Transportation:** Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	**6**
4	**Renewable Energy and Sustainable Technologies:** Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. **Climate Change and Engineering Solutions:** Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. **Environmental Policies and Regulations:** Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. **Case Studies and Future Directions:** Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	**6**

Course Assessment Method
(CIE: 50 marks , ESE: 50)

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis**: Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts**: Ability to apply course concepts to real-world problems and local contexts.
- **Creativity**: Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills**: Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	**K3**
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	**K4**
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	**K5**
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	**K4**
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessmen	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).

- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S4

LINEAR INTEGRATED CIRCUITS LAB

Course Code	**PCECL407**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCECT303	**Course Type**	Lab

Course Objectives:

1. To study the design and implementation of various Linear Integrated Circuits.
2. To familiarize the simulation of basic Linear Integrated Circuits.

Details of Experiment

Expt. No.	**Part A – List of Experiments using Op Amps (Minimum seven experiments mandatory)**
1	Familiarization of Operational amplifiers - Inverting and Non inverting amplifiers, Integrator, Differentiator - frequency response, Adder, Comparators
2	Measurement of Op-Amp parameters
3	Difference Amplifier and Instrumentation amplifier
4	Schmitt trigger circuit
5	Astable and Monostable multivibrators
6	Waveform generators using Op Amps - Triangular and Sawtooth
7	Wien bridge oscillator - without & with amplitude stabilization
8	RC Phase shift Oscillator
9	Active first and second order filters (LPF, HPF, BPF and BRF)
10	Active Notch filter to eliminate the 50Hz power line frequency
11	Precision rectifiers
Expt. No	**Part B – Application circuits using ICs [Minimum three experiments are to be done]**
1	Astable and Monostable multivibrator using Timer IC NE555
2	DC power supply using IC 723: Low voltage and high voltage configurations, Short circuit and Fold-back protection.
3	A/D converters- counter ramp and flash type.
4	D/A Converters - R-2R ladder circuit
5	Study of PLL IC: free running, frequency lock range and capture range

Expt No.	**Part C – Simulation experiments** **[**The experiments shall be conducted using open tools such as QUCS, KiCad or variants of SPICE] **]**
1	Simulation of any three circuits from experiments 3, 5, 6, 7, 8, 9, 10 and 11 of section I
2	Simulation of experiments 3 or 4 from section II

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Design and implement basic linear integrated circuits using Op Amps.	**K4**
CO2	Design and implement basic linear integrated circuits using linear ICs.	**K4**
CO3	Design and simulate the functioning of basic linear integrated circuits and linear ICs. using simulation tools.	**K4**
CO4	Effectively troubleshoot a given circuit and analyze it	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Linear Integrated Circuits	D. Roy Choudhary and Shail B Jain	New Age International Private Limited	6th edition, 2021
2	Introduction to Pspice Using Orcad for Circuits and Electronics	M. H. Rashid	Pearson	3rd edition, 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Op-Amps And Linear Integrated Circuits: Business Management	Gayakwad	PHI	2002
2	Linear Integrated Circuits	D Roy Choudhury, Shail Bala Jain	New Age International	(2018)

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_ee73/preview
2	https://archive.nptel.ac.in/courses/108/108/108108111/

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**

    - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**

    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**

    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**

    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**

    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

    - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S4

MICROCONTROLLER LAB

Course Code	**PCECL408**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCECL307-Logic Circuit Design and Simulation Lab	**Course Type**	Lab

Course Objectives:

1. To learn Microcontroller Programming using Assembly and C language
2. To learn Microcontroller interfaces to various modules
3. To learn any advanced microcontrollers like ARM or higher.
4. To learn Embedded System Design

Details of Experiment

Expt. No.	Experiments
	PART A – Data manipulation experiments using Assembly language(Min 4 has to be completed)
1	Multiplication of two 16-bit numbers.
2	Largest/smallest from a series.
3	Sorting (Ascending/Descending) of data.
4	Matrix addition.
5	LCM and HCF of two 8-bit numbers.
6	Code conversion – Hex to Decimal/ASCII to Decimal and vice versa.
	PART B - Interface to Microcontroller Assembly/C language (Min 3 has to be completed)
1	Time delay generation and relay interface.
2	Display (LED/Seven segments/LCD) and keyboard interface.
3	ADC interface.
4	DAC interface with waveform generation.
5	Stepper motor and DC motor interface.

	PART C - Interface with Advanced Microcontroller using C language (Min 3 has to be completed)
1	PWM generation for DC motor control.
2	Object/Visitor Counter.
3	UART interface to Bluetooth.
4	SPI/I2C interface to display.
5	Real-time clock.

* A minimum of 12 experiments is to be completed.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop 8051 Microcontroller programs	**K4**
CO2	Design and implement various interfaces to the 8051 Microcontroller	**K4**
CO3	Design and implement an Embedded System using a 8051 microcontroller	**K4**
CO4	Design and implement an Embedded System using an ARM processor	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

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

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The 8051 Microcontroller and Embedded Systems Using Assembly and C	Muhammad Ali Mazidi Janice Gillispie Mazidi Rolin D. McKinlay	Printice Hall -Inc	Second, 2007
2	The 8051 Microcontroller Architecture, Programming and Applications	Kenneth J Ayala Dhananjay V Gadre	Cengage Learning	2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	8051 Hardware Description	Datasheet	Intel Corporation	1992
2	Microprocessors and Microcontrollers	Lyla B. Das	Pearson Education	2011
3	ARM System-on-Chip Architecture	Steve Furber	Addison-Wesley Educational Publishers Inc	2000
4	System-on-Chip Design with Arm(R) Cortex(R)-M Processors	Joseph Yiu	ARM Education Media	2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Microprocessors and Microcontrollers - https://nptel.ac.in/courses/106108100
2	Microcontrollers and Applications - https://nptel.ac.in/courses/117104072
3	Embedded System Design With ARM - https://onlinecourses.nptel.ac.in/noc22_cs93

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**
   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.
2. **Conduct of Experiments (7 Marks)**
   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.
3. **Lab Reports and Record Keeping (6 Marks)**
   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.

- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**
    - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
    - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
    - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**
    - Accuracy of Results: Precision and correctness of the obtained results.
    - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**
    - Ability to explain the experiment, procedure results and answer related questions
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 5

ELECTRONICS & COMMUNICATION ENGINEERING

SEMESTER S5

ELECTROMAGNETICS

Course Code	PCECT501	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2Hrs. 30 Min.
Prerequisites (if any)	Physics for Electrical sciences (GBPHT121)	Course Type	Theory

Course Objectives:

1. To impart knowledge on the basic concepts of electric and magnetic fields and its applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Review of coordinate system-Rectangular, cylindrical and spherical coordinate systems. Review of vector calculus- curl, divergence gradient. Review of Coulomb's law, Gauss's law and Ampere's current law. Derivation of capacitance and inductance of two wire transmission line and coaxial cable. Magnetic scalar and vector potential. Poisson and Laplace equations, Determination of voltage and electric field using Laplace and Poisson's equation.	12
2	Maxwell's equation from fundamental laws. Boundary condition of electric field and magnetic field from Maxwell's equations. Solution to wave equation Propagation of plane EM wave in perfect dielectric, lossy medium, good conductor, skin depth. Polarization of waves.	10
3	Reflection and refraction of plane electromagnetic waves at boundaries for normal & oblique incidence (parallel and perpendicular polarization), Snell's law of refraction, Brewster angle. Power density of EM wave, Poynting	10

	vector theorem.	
4	Transmission line as circuit elements (L and C). Transmission line equations and characteristic impedance. Reflection coefficient and VSWR. Derivation of input impedance of transmission line. Calculation of line impedance and VSWR using smith chart. The hollow rectangular waveguide –TE and TM wave-dominant mode, group velocity and phase velocity –derivation and simple problems only.	**12**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarize the basic mathematical concepts related to electromagnetic vector fields.	**K2**
CO2	Apply Maxwell's equations in different forms to diverse electromagnetic problems.	**K3**
CO3	Analyze reflection, refraction and power density of electromagnetic waves.	**K3**
CO4	Analyse the propagation of EM waves in transmission lines and wave guides.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Elements of Electromagnetics	Matthew N. O. Sadiku	Oxford University Press	7th edition, 2018
2	Engineering Electromagnetics	William Hayt and John Buck	McGraw-Hill Higher Education	9th edition, 2019
3	Electromagnetic Waves and Transmission Lines	Y Mallikarjuna Reddy	The Orient Blackswan	1st edition 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Schaum's Outline of Elctromagnetics	Mahmood Nahvi; Joseph Edminister	McGraw-Hill	5th edition, 2019
2	Engineering Electromagnetics Essentials	B N Basu	The Orient Blackswan	1st edition 2015

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_ee83/preview
2	https://onlinecourses.nptel.ac.in/noc21_ee83/preview
3	https://nptel.ac.in/courses/115101005
4	https://archive.nptel.ac.in/courses/117/101/117101056/#

SEMESTER S5

ANALOG AND DIGITAL COMMUNICATION

Course Code	PCECT502	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3-1-0-0	ESE Marks	60
Credits	4	Exam Hours	2Hrs. 30 Min.
Prerequisites (if any)	PCECT402 Signals and Systems GBMAT401 Probability, Random Process and Numerical Methods	Course Type	Theory

Course Objectives:

1. To analyse different analog and digital communication systems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Block diagram of a communication system. Need for modulation. Amplitude modulation, Equation and spectrum of AM signal, DSB-SC, SSB -pilot carrier and Vestigial sideband systems. Angle modulation: Narrow and wide band FM and their spectra, relationship between FM and PM, Carson's rule, pre-emphasis and de-emphasis filtering. Comparison of AM and FM, Block diagram of FM receiver. Superheterodyne receivers- Characteristics of receivers –image frequency. Noise: external, internal, White noise.	12
2	Sampling and Quantization, SQNR for uniform quantization, Companding Pulse code modulation, Transmitter and receiver. DPCM transmitter and receiver. Delta modulation, Slope overload, Line codes.	10
3	Baseband data transmission of digital data through AWGN channel, Mathematical model of ISI, Nyquist criterion for zero ISI, Signal modelling for ISI, Raised cosine spectrum, Equalization,Zero forcing Equaliser. Geometric representation of Signals-Gram-Schmitt procedure, Signal space. Vector model of AWGN channel. Matched filter and correlation receivers, MAP receiver, Maximum likelihood	12

	receiver.	
4	Digital band pass modulation schemes-BPSK system and signal constellation. BPSK transmitter and receiver. QPSK system and Signal constellations. BER analysis of BPSK and QPSK in erfc. Plots of BER Vs SNR. QPSK transmitter and receiver. Quadrature amplitude modulation and signal constellation.	**10**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the principles of analog communication systems	**K2**
CO2	Explain the basic concepts of digital communication	**K2**
CO3	Analyse the baseband transmission of digital data through AWGN channel	**K3**
CO4	Apply various digital modulation techniques in the design of digital communication systems	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Communication Systems	Simon Haykin and Michael Moher	Wiley	5th Edition, 2020
2	Modern Digital and Analog Communication Systems	B.P. Lathi and Zhi Ding	Oxford University Press	5th Edition, 2018
3	Introduction to Analog and Digital Communication, An Indian adaptation	Simon Haykin and Michael Moher	Wiley	2nd Edition, 2022

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Communication Systems	Herbert Taub and Donald L. Schilling	McGraw-Hill Education	4th Edition, 2013
2	Digital Communications	John G. Proakis and Masoud Salehi	McGraw-Hill Education	6th Edition, 2020
3	Communication Systems Engineering	John G. Proakis and Masoud Salehi	Pearson	2nd Edition, 2001
4	Digital Communications Systems, An Indian Adaptation	Simon Haykin	John Wiley& Sons	4th Edition, 2021
5	Electronic communication systems	George Kennedy	McGraw Hill	6th Edition, 2017
6	Introduction to Digital Communications	Wayne Stark	Cambridge University Press	1st edition 2023

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/hTAlcrqjNps?si=okoRHdUegx9pbOz3
2	https://youtu.be/s_vmLqT_6NQ?si=MF2OW6AaICiYKTfj

SEMESTER S5

CONTROL SYSTEMS

Course Code	PCECT503	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	ESE Marks	60
Credits	3	Exam Hours	2Hr. 30 Min.
Prerequisites (if any)	GBMAT301 Mathematics for Electrical Science -3	Course Type	Theory

Course Objectives:

1. To study the elements of control system, modelling and perform stability analysis of systems.
2. To design control systems with compensating techniques.
3. To understand the state variable analysis method.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** Basic Components of Control Systems, Open-Loop and Closed-Loop Control Systems with examples. **Mathematical modelling of control systems**: Electrical Systems and Mechanical translational systems. **Transfer Function:** Block diagram reduction techniques, Signal flow graph, Mason's gain formula.	8
2	**Time Domain Analysis of Control Systems:** Standard Test signals, Time response of first order systems (unit impulse, step and ramp inputs) and second order systems (step input only). Time response of undamped, under damped, critically damped second order system to unit step signal, Time domain specifications for a second order underdamped system, Steady state error and static error coefficients.	8
3	**Stability of linear control systems**: Concept of BIBO stability, absolute stability, Routh Hurwitz Criterion. **Root Locus Techniques**: Introduction, properties and its construction.	12

	Frequency domain analysis: Frequency domain specifications **Relative stability**: gain margin and phase margin. Stability analysis using Bode plot and Nyquist stability criterion. **P, PI & PID controllers**: Introduction. **Design of Compensators**: Need for compensators, lag and lead compensators using Bode plots(only design steps)	
4	**State Variable Analysis of Linear Systems:** State variables, state equations, state variable representation of electrical systems. Transfer function from State equation, Solutions of the state equations, state transition matrix, Controllability and observability - Kalman's Test.	**8**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyze the systems using transfer function approach	**K3**
CO2	Perform time domain analysis and steady state analysis of systems	**K2**
CO3	Determine the absolute stability and relative stability of a system using Routh Hurwitz Criterion and root locus	**K3**
CO4	Apply frequency domain techniques to assess the system stability and to design different compensation techniques	**K3**
CO5	Analyse system Controllability and Observability using state space representation	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	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	3		2							2
CO4	3	3	3		2							2
CO5	3	3	3		2							2

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Control Systems Engineering	I.J. Nagarath, M. Gopal	New Age International Publishers	7th Edition 2022
2	Automatic Control Systems	Benjamin C. Kuo, Farid Golnaraghi,	Wiley	10th Edition 2017
3	Modern Control Engineering	Katsuhiko Ogata	Pearson	Fifth Edition 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Feedback and Control Systems	Joseph DiStefano, Allen R. Stubberud, and Ivan J. Williams	McGraw Hill	Third Edition 2013
2	Control systems	Ashok Kumar	Tata McGraw-Hill	Second Edition 2010
3	Control Systems: Principles and Design	M Gopal	McGraw Hill Education	Fourth Edition 2012
4	Nise's Control Systems Engineering	Norman S. Nise	Wiley India	8th Edition 2017

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/Cl23xQrvFhk?feature=shared https://youtu.be/fsxSst10_cE?feature=shared
2	https://youtu.be/cLyT6OWcmyU?feature=shared
3	https://youtu.be/CZL7_Z0i1KQ?feature=shared
4	https://youtu.be/CrXOMBlYFp0?feature=shared

SEMESTER S5

DIGITAL SIGNAL PROCESSING

Course Code	PBECT504	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Signals & Systems PCECT402	Course Type	Theory

Course Objectives:

1. To describe signals mathematically and understand how to perform mathematical operations on signals
2. To gain knowledge of Digital filters

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Review of sampling, Z-Transform and DTFT The Discrete Fourier Transform: DFT as a linear transformation (Matrix Relation), IDFT, Properties of DFT and examples (proof not necessary). Circular convolution, linear convolution using circular convolution, Filtering of long data sequences, overlap save and overlap add methods. Frequency Analysis of Signals using the DFT (concept only required)	9
2	Design of FIR Filters - Symmetric and Anti-symmetric FIR Filters, Design of linear phase FIR filters using Window methods, (rectangular, Hamming and Hanning). Design of IIR Digital Filters from Analog Filters (Butterworth), IIR Filter Design by Impulse Invariance, and Bilinear Transformation, Frequency Transformations in the Analog Domain.	9
3	Structures for the realization of Discrete-Time Systems - Block diagram and signal flow graph representations of filters. FIR Filter Structures: Linear structures, Direct Form. IIR Filter Structures: Direct Form, Transposed Form, Cascade Form and Parallel Form. Multi-rate Digital Signal Processing:	9

	Decimation and Interpolation (Time domain and Frequency Domain Interpretation), Anti- aliasing and anti-imaging filter.	
4	Efficient Computation of DFT: Fast Fourier Transform and computational advantage over DFT, Radix-2 Decimation in Time FFT Algorithm. Computer architecture for signal processing: Harvard Architecture, pipelining, MAC, Introduction to TMS320C67xx digital signal processor, Functional Block Diagram. Finite word length effects in DSP systems: Introduction, fixed-point and floating-point DSP arithmetic, ADC quantization noise.	**9**

Suggestion on Project Topics

Projects can include but not limited to, analysing various signals/finding their transforms and designing filters for extracting different frequency components. Projects can be simulated or implemented in hardware.

Course Assessment Method

(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	**30**	**12.5**	**12.5**	**60**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate fundamental properties and relations relevant to DFT and solve basic problems involving DFT-based filtering methods.	**K2**
CO2	Design linear phase FIR filters and IIR filters of different specifications.	**K3**
CO3	Realise the various FIR and IIR filter structures for a given system function.	**K3**
CO4	Compute DFT efficiently using FFT method and to explain the architecture of a DSP processor.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Signal Processing using Matlab	Vinay K. Ingle, John G. Proakis	Cengage Learning	3rd Ed., 2011
2	Think DSP: Digital Signal Processing using Python	Allen B. Downey	Green Tea Press	2nd Ed., 2012
3	Discrete-Time Signal Processing	Alan V Oppenheim, Ronald W. Schafer	Pearson Education	3rd Ed., 2014

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Signal Processing	Shaila D. Apte	Wiley	2nd Ed, 2019
2	Digital Signal Processing: A Computer based Approach	Mitra S. K.	McGraw Hill	4th Ed., 2014
3	Digital Signal Processing: A Practical Approach	Ifeachor E. C., Jervis B. W.	Pearson Education	2nd Ed., 2009
4	Digital Signal Processing	Salivahanan S.	McGraw Hill	4th Ed., 2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117102060 https://nptel.ac.in/courses/108105055
2	same as above
3	same as above
4	same as above

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**

    - Clarity and feasibility of the project plan
    - Research and background understanding
    - Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**

    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**

    - Active participation and individual contribution
    - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**

    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result

5. **Final Presentation (5 Marks)**

    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions

6. **Project Quality, Innovation, and Creativity (3 Marks)**

    - Overall quality and technical excellence of the project
    - Innovation and originality in the project
    - Creativity in solutions and approaches

SEMESTER S5

BIOMEDICAL ENGINEERING

Course Code	PEECT521	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3-0-0-0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. This course will introduce the various aspects of biomedical engineering and its applications described using engineering principles
2. The student will be able to understand the techniques and uses of modern diagnostic and therapeutic equipment.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to bio-medical engineering, Sources of bio-electric potential: Resting and action potential, propagation of action potentials. Various bioelectric potentials (ECG, EEG, EMG, ERG, EOG, EGG concept only.) Electrode theory: Nernst equation, Electrode skin interface Bio-potential electrodes: Microelectrodes, skin surface electrodes, needle electrodes Bio-potential amplifiers: instrumentation amplifiers, carrier amplifiers, isolation amplifiers, chopper amplifiers	9
2	Heart and cardiovascular system: electro conduction system of the heart, ECG lead configurations, Einthoven triangle, Electrocardiography, ECG machine - block diagram, ECG recording system. The human nervous system: Neurons, action potential of brain, brain waves, placement of electrodes, EEG recording, evoked potential,	9

	Electrical activity of muscles: EMG signal acquisition and analysis. Myoelectric control system. Electrical stimulation of the muscle and nerve, Applications of EMG	
3	Instruments for clinical laboratory: Oxymeters, blood cell counter, flame photometer, Spectrophotometer Therapeutic Equipments: Principles, block schematic diagram, working and applications of pacemakers, cardiac defibrillators, heart–lung machine, dialyzers, surgical diathermy equipment, ventilators Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, single channel telemetry system for ECG.	**9**
4	Medical Imaging systems (Basic Principle only): X-ray imaging - X-ray machine, applications of X-rays in medicine. Computed Tomograpy: Principle, image reconstruction, scanning system and applications Ultrasonic imaging systems: Basic pulse echo system, Different types of Ultrasonics systems:, A-Scan, B-Scan, M-Scan, applications, real-time ultrasonic imaging systems and probes. Magnetic Resonance Imaging – Basic NMR components, Biological effects and advantages of NMR imaging	**9**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (K)
CO1	Outline the basic bioelectric potentials and their implications in diagnostics	**K2**
CO2	Summarize the principles used for diagnosis of abnormalities in the cardiovascular system	**K2**
CO3	Identify the techniques used for diagnosis and therapy in the neuromuscular and myoelectric systems.	**K2**
CO4	Illustrate the principle and working of different types of bio medical equipment/devices	**K2**
CO5	State various diagnostic medical imaging techniques.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Handbook of Biomedical Instrumentation	R. S. Khandpur	Tata Mc Graw Hill	Third edition
2	Biomedical Instrumentation and Measurement	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer,	PHI	2nd Edition, 2004

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Medical Instrumentation application and design	John G Webster	John Wiley	5th edition 2020
2	Introduction to Biomedical Equipment Technology	J. J. Carr	Pearson Education	4th edition 2020
3	Principle of Biomedical Instrumentation and Measurement	Richard Aston	Merrill Education/Prentice Hall	1st edition 2007
4	Introduction to Biomedical Instrumentation	Barbara Christe	Cambridge University Press,	2nd edition 2017

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=_fD9gOqiBVE
2	http://www.digimat.in/nptel/courses/video/127106134/L16.html

SEMESTER S5

DATA STRUCTURES

Course Code	PEECT522	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hr. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To familiarise with different data structures and the techniques involved.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Concepts of Data Structures: Algorithms, Performance Analysis, Space Complexity, Time Complexity, Asymptotic Notations Arrays: Linear Search and Binary Search, Stacks, Queues-Circular Queues, Priority Queues, Double Ended Queues, Evaluation of Expressions	9
2	Linked List: Self-Referential Structures, Dynamic Memory Allocation, Singly Linked List- Operations on Linked List. Doubly Linked List, Circular Linked List, Stacks and Queues using Linked List, Polynomial representation using Linked List	9
3	Trees and Graphs: Trees, Binary Trees-Tree Operations, Binary Tree Representation, Tree Traversals, Binary Search Trees- Binary Search Tree Operations Graphs, Representation of Graphs, Depth First Search and Breadth First Search on Graphs, Applications of Graphs	9
4	Sorting and Hashing: Sorting Techniques – Selection Sort, Insertion Sort, Quick Sort, Merge Sort and Heap Sort Hashing- Hashing Techniques, Collision Resolution, Overflow handling, Hashing functions – Mid square, Division, Folding, Digit Analysis	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Compare performance of algorithms using asymptotic notations	**K2**
CO2	Solve real world problems efficiently using appropriate data structures like arrays, linked list, stacks and queues.	**K3**
CO3	Make use of nonlinear data structures like trees and graphs to design algorithms for various applications.	**K3**
CO4	Apply and compare various techniques for searching and sorting.	**K3**
CO5	Apply appropriate hash function to store and access a given dataset	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Data Structures in C	Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed	Universities Press	2/e, 2008
2	Classic Data Structures	Samanta D	Prentice Hall India	2/e, 2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Structures: A Pseudocode Approach with C	Richard F. Gilberg, Behrouz A. Forouzan	Cengage Learning	2/e, 2005
2	Data Structures and Algorithms	Aho A. V., J. E. Hopcroft and J. D. Ullman	Pearson Publication	1/e. 1983
3	Introduction to Data Structures with Applications	Tremblay J. P. and P. G. Sorenson	Tata McGraw Hill	2/e, 1995
4	Advanced Data Structures	Peter Brass	Cambridge University Press	2/e, 2018
5	Theory and Problems of Data Structures	Lipschuts S.	Schaum's Series	2/e, 2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106102064 https://youtu.be/zWg7U0OEAoE https://youtu.be/g1USSZVWDsY https://youtu.be/PGWZUgzDMYI
2	https://nptel.ac.in/courses/106102064 https://youtu.be/PGWZUgzDMYI
3	https://nptel.ac.in/courses/106102064 https://youtu.be/tORLeHHtazM https://youtu.be/eWeqqVpgNPg https://youtu.be/9zpSs845wf8
4	https://youtu.be/KW0UvOW0XIo https://youtu.be/gtWw_8VvHjk

SEMESTER S5

SENSORS AND ACTUATORS

Course Code	PEECT 523	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. The course on Sensors and Actuators typically aims to provide students with comprehensive knowledge in the principles, design, and application of various sensors and actuators used in real-world applications

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Sensors and actuators**: Block diagram of a closed loop control System, Sensors and Transducers, Sensors Classification, Sensor Characteristics - Transfer Function, Calibration, Span (Full Scale Input), Full-Scale Output, Accuracy, Precision, Hysteresis, Nonlinearity, Saturation, Repeatability, Dead Band, Sensitivity, Resolution.	9
2	Position and Displacement Sensors - Potentiometric Sensors, Capacitive Sensors, LVDT, Hall Effect Sensors Pressure Sensors -Mercury Pressure Sensor, Bellows, Membranes, and Thin plates, Piezoresistive Sensors, Capacitive Sensors. Force, Strain, and Tactile Sensors - Strain Gauges, Tactile Sensors - Switch Sensors, Piezoelectric Sensors, Piezoresistive Sensors, Capacitive Touch Sensors, Acoustic Touch Sensors, Optical Touch Sensors, Piezoelectric Force Sensors.	9
3	Flow Sensors - Ultrasonic Flow Sensors, Electromagnetic Flow Sensors. Temperature Sensors - Resistance Temperature Detectors, Thermistors, Thermocouple.	9

	Proximity Sensors - PIR sensors. Ultrasonic proximity sensors. Smart Sensors - Block Diagram, Difference between Normal Sensor & Smart Sensor, Advantages, Disadvantages and Applications.	
4	**Actuators**: - Definition- classification-Electric, Hydraulic, Pneumatic actuators. Hydraulic System - Physical Components and typical circuit. Hydraulic actuators - Linear actuators, Rotary actuators - Gear motor, vane motor. Pneumatic System - Components and typical circuit. Pneumatic Actuators - Bellows actuator, Flapper-nozzle, Diaphragm actuators for industrial control valves. Electric actuators- Solenoids, Stepper motors, DC motors, DC servo motors. Electro-Pneumatic actuator; rotary output actuators, Linear output actuators.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe Sensor Fundamentals	**K2**
CO2	Explain the basic principles and concepts of commonly used different types of sensors, including their purpose, how they work, and the various types of sensors available.	**K2**
CO3	Illustrate the working principles of smart sensors	**K2**
CO4	Explain the working principle of different types of actuators.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Handbook of Modern Sensors	Jacob Fraden	Springer	Fourth Edition, 2010
2	Hydraulics and Pneumatics	Andrew Parr	Elsevier Science	Second edition, 1999
3	Process Control	K. Krishnaswamy	New Age International	Second edition, 2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Sensors and Actuators in Mechatronics, Design and Applications	Andrzej M. Pawlak	Taylor & Francis Group	1/e, 2016
2	Mechatronic systems, Sensors and Actuators Fundamentals and Modelling	Robert H. Bishop	Taylor & Francis Group	3/e, 2022
3	Process Control Instrumentation Technology	Curtis D. Johnson	Pearson/Prentice Hall	8/e, 2019
4	Sensors and Transducers	D. Patranabis	PHI Learning	4/e, 2021

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_ee32/preview
2	https://onlinecourses.nptel.ac.in/noc21_ee32/preview
3	https://onlinecourses.nptel.ac.in/noc21_ee32/preview
4	https://onlinecourses.nptel.ac.in/noc21_ee32/preview

SEMESTER S5

ARM ARCHITECTURE AND PROGRAMMING

Course Code	PEECT524	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Programming in C	Course Type	Theory

Course Objectives:

1. To introduce ARM Cortex M programming in assembly and C
2. To lay the foundation for practical embedded system design

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Embedded C: Fixed-width integer data types in C99, boolean type, mixing types, manipulating bits in memory and IO ports, accessing memory mapped IO using pointers, structures, packed structures, bit fields, casting address of an object, unions. [1] Ch. 4 Review of computer organization: Memory, CPU, IO, Introduction to Arm cortex M architecture: Internal organization-general purpose and special registers, instruction pipelining, memory model, bit banding, Arm assembly language instruction format and operands [1] Ch. 5	9
2	Arm assembly language programming: Loading constants into registers, loading memory data into registers, storing data from registers to memory, converting C assignment statements to assembly, memory address calculations, Memory addressing examples: translating C pointer expressions to assembly, translating C subscript expressions to assembly, translating structure references to assembly, Stack instructions, data processing instructions: updating flags in APSR, arithmetic instructions, bit	9

	manipulation instructions, shift instructions, bit field manipulation instructions [1] Ch. 6	
3	Control structures in assembly language: instruction sequencing, conditional branch instructions, translating if-then and if-then-else statements to assembly, compound conditionals, implementing loops, speeding up array access, Implementing functions: function call and return, register usage, parameter passing, return values, temporary variables, preserving registers [1] Ch. 7.	**9**
4	IO programming in assembly: Interrupts and exceptions, thread and handler modes, entering the exception handler, returning from exception handler, latency reduction techniques, priorities and nested exceptions, synchronization, transfer rate and latency, buffers and queues, double buffering, polled waiting loops, interrupt driven IO, DMA [1] Ch. 8. System initialization: Memory layout, cpu and vector table, C run-time environment, System Timer [1] Ch. 13	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Use the features of C that are frequently used in embedded systems	**K3**
CO2	Explain a programmer's view of processor architecture	**K2**
CO3	Choose between programming at the level of assembly or C as appropriate	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Embedded Software with the ARM Cortex M3	Daniel W Lewis	Pearson	2e, 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors	Joseph Yiu	Elsevier	3e, 2014
2	Embedded systems with ARM Cortex M Microcontrollers in Assembly and C	Yifeng Zhu	E-man Press	3e, 2018

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/106/117106111/
2	https://archive.nptel.ac.in/courses/106/105/106105193/
3	https://onlinecourses.nptel.ac.in/noc22_cs93/preview

SEMESTER S5

HIGH SPEED DIGITAL DESIGN

Course Code	PEECT526	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	BASIC ELECTRONICS	Course Type	Theory

Course Objectives:

1. To understand the fundamentals of the effects of passive circuit elements on signal propagation in high speed digital circuits
2. To understand the high speed properties of logic gates and the measurement techniques at high frequencies
3. To analyse the effects of wiring, source, and load on the signal propagation from one end of a circuit to the other end
4. To design the power supply and clock distribution circuits for high speed devices,

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**High Speed Digital Design:** Fundamentals: Frequency and time, Time and distance, Lumped versus distributed systems, four kinds of reactance-ordinary capacitance and inductance, mutual capacitance and inductance, Relation of mutual capacitance and mutual inductance to cross talk.	9
2	**High Speed properties of Logic gates**: Power, Quiescent vs active dissipation, Active power driving a capacitive load, Active power due to overlapping bias currents, Input power, Speed, Packaging (Power dissipation analysis of only CMOS logic gates are required) **Measurement Techniques:** Rise time and bandwidth of oscilloscope probes, self inductance of probe ground loop, spurious signal pick up from probe ground loops, special probing fixtures, Avoiding pickup from probe shield currents, slowing down of a system clock, observing metastable states.	9

3	**Transmission Lines:** Problems of point to point wiring, signal distortion, EMI, cross talk. Infinite Uniform transmission line; ideal distortion less lossless transmission line, RC transmission line, Skin effect, Proximity effect, Dielectric loss. Effects of source and load impedance. Termination: End terminator, Source terminators, middle terminators, AC biasing for end terminators, Resistor selection, Cross talk in terminators.	**9**
4	**Power system:** Stable voltage reference, Uniform voltage distribution, distribution problems, choosing a bypass capacitor. **Clock Distribution**: Timing margin, Clock skew, Using low impedance drivers, using low impedance distribution lines, delay adjustments, Differential distribution, Clock signal duty cycle, Decoupling clock receivers from the clock bus. Clock Oscillators, Canned clock oscillator, Clock Jitter.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the fundamentals of the effects of passive circuit elements on signal propagation in high speed digital circuits	**K2**
CO2	Describe the high speed properties of logic gates and the measurement techniques at high frequencies	**K2**
CO3	Analyze the effects of wiring, source, and load on the signal propagation from one end of a circuit to the other end	**K3**
CO4	Design the power supply and clock distribution circuits for high speed devices	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	High Speed Digital Design: A Handbook of Black Magic	Howard Johnson & Martin Graham	Prentice Hall PTR,	Second Edition, 2008
2	Noise Reduction Techniques in Electronic Systems	Henry W. Ott	John Wiley & Sons	Second Edition, 1988

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	High-Speed Digital System Design—A Handbook of Interconnect Theory and Design Practices	Stephen H. Hall Garrett W. Hall James A. McCall	John Wiley & Sons	First Edition, 2000
2	Digital Systems Engineering	William S. Dally & John W. Poulton	Cambridge University Press,	First Edition, 1998
3	High Speed Digital Circuits	Masakazu Shoji	Addison Wesley Publishing Company	First Edition, 1996
4	Digital Integrated Circuits: A Design perspective,	Jan M, Rabaey	Pearson	Second Edition, 2003

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/108105375
2	https://nptel.ac.in/courses/108105375
3	https://nptel.ac.in/courses/108105375, https://nptel.ac.in/courses/108106069
4	https://nptel.ac.in/courses/108105375

SEMESTER S5

ESTIMATION AND DETECTION

Course Code	PEECT527	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. This course aims to impart the fundamentals of statistical signal processing theory in engineering applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Statistical Estimation Theory I** Fundamentals of estimation theory, the mathematical estimation problem, Minimum variance unbiased estimation, basics of Cramer-Rao Lower Bound, linear models, best linear unbiased estimation, application examples.	9
2	**Statistical Estimation Theory II** Maximum likelihood estimation, least squares, Bayesian philosophy, minimum mean square error estimation, application examples.	9
3	**Statistical Detection Theory I** Fundamentals of detection theory, the mathematical detection problem, Hypothesis testing, classical approach, Neyman-Pearson theorem, likelihood ratio test, receiver operating characteristics, Bayesian approach, minimum probability of error, Bayes risk, multiple hypothesis testing.	10
4	**Statistical Detection Theory II** Detection of deterministic signals, matched filters, detection of random signals, estimator-correlator, linear model, application examples.	8

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarize the fundamentals of statistical estimation principles used in various engineering problems.	**K2**
CO2	Apply different types of estimation algorithms in engineering applications.	**K3**
CO3	Illustrate the fundamentals of statistical detection principles used in various engineering problems.	**K2**
CO4	Apply various types of statistical decision rules in engineering applications.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	"Fundamentals of Statistical Signal Processing" Vol I: Estimation Theory,	S.M. Kay,	Pearson,	3/e, 2010.
2	"Fundamentals of Statistical Signal Processing" Vol II: Detection Theory,	S.M. Kay,	Pearson,	3/e, 2010.

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Detection, Estimation, and Modulation Theory, Vol. I,	H. L. Van Trees	John Wiley & Sons	2/e, 2001
2	Statistical Digital Signal Processing and Modelling	Monson H. Hayes	John Wiley & Sons	2/e, 2018

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117103018
2	https://nptel.ac.in/courses/117103018
3	https://nptel.ac.in/courses/117103018
4	https://nptel.ac.in/courses/117103018

SEMESTER S5

ARM ARCHITECTURE, PROGRAMMING AND INTERFACING

Course Code	PEECT525	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs.30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce ARM Cortex M programming in assembly and C
2. To lay the foundation for practical embedded system design

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Embedded C: Fixed-width integer data types in C99, boolean type, mixing types, manipulating bits in memory and IO ports, accessing memory mapped IO using pointers, structures, packed structures, bit fields, casting address of an object, unions. [1] Ch. 4 Review of computer organization: Memory, CPU, IO, Introduction to Arm cortex M architecture: Internal organization-general purpose and special registers, instruction pipelining, memory model, bit banding, Arm assembly language instruction format and operands [1] Ch. 5	9
2	Arm assembly language programming: Loading constants into registers, loading memory data into registers, storing data from registers to memory, converting C assignment statements to assembly, memory address calculations, Memory addressing examples: translating C pointer expressions to assembly, translating C subscript expressions to assembly, translating structure references to assembly, Stack instructions, data processing	9

	instructions: updating flags in APSR, arithmetic instructions, bit manipulation instructions, shift instructions, bit field manipulation instructions [1] Ch. 6	
3	Control structures in assembly language: instruction sequencing, conditional branch instructions, translating if-then and if-then-else statements to assembly, compound conditionals, implementing loops, speeding up array access, Implementing functions: function call and return, register usage, parameter passing, return values, temporary variables, preserving registers [1] Ch. 7.	**9**
4	IO programming in assembly: Interrupts and exceptions, thread and handler modes, entering the exception handler, returning from exception handler, latency reduction techniques, priorities and nested exceptions, synchronization, transfer rate and latency, buffers and queues, double buffering, polled waiting loops, interrupt driven IO, DMA [1] Ch. 8. System initialization: Memory layout, cpu and vector table, C run-time environment, System Timer [1] Ch. 13	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	**15**	**10**	**10**	**40**

Criteria for Evaluation (Evaluate and Analyse): 20 marks

Interfacing experiments on Arm Microcontroller boards TM4C123G/ STM32 Nucleo

GPIO – push button, LED, keypad scan ([2] Ch. 14)

Toggling LED using timers ([2] Ch. 15)

Stepper motor control ([2] Ch. 16)

LCD interfacing ([2] Ch. 17)

ADC and DAC with DMA ([2] Ch. 19, 20, 21)

Serial Communication ([2] Ch. 22)

Course Project involving the design and implementation of an embedded system for a chosen application

Project phases: Proposal, Implementation, Testing, Final Report, Presentations and Viva Voce

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Use the features of C that are frequently used in embedded systems	**K3**
CO2	Explain a programmer's view of processor architecture	**K2**
CO3	Choose between programming at the level of assembly or C as appropriate	**K3**
CO4	Analyze the interfacing of peripherals	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Embedded Software with the ARM Cortex M3	Daniel W Lewis	Pearson	2e, 2015
2	Embedded systems with ARM Cortex M Microcontrollers in Assembly and C	Yifeng Zhu	E-man Press	3e, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors	Joseph Yiu	Elsevier	3e, 2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Modern Embedded Systems Programming Course Quantum Leaps, LLC https://youtube.com/playlist?list=PLPW8O6W-1chwyTzI3BHwBLbGQoPFxPAPM&si=vmU66G3vMmQihUPk
2	Modern Embedded Systems Programming Course Quantum Leaps, LLC https://youtube.com/playlist?list=PLPW8O6W-1chwyTzI3BHwBLbGQoPFxPAPM&si=vmU66G3vMmQihUPk
3	Modern Embedded Systems Programming Course Quantum Leaps, LLC https://youtube.com/playlist?list=PLPW8O6W-1chwyTzI3BHwBLbGQoPFxPAPM&si=vmU66G3vMmQihUPk
4	Modern Embedded Systems Programming Course Quantum Leaps, LLC https://youtube.com/playlist?list=PLPW8O6W-1chwyTzI3BHwBLbGQoPFxPAPM&si=vmU66G3vMmQihUPk

SEMESTER S5

DIGITAL SIGNAL PROCESSING LAB

Course Code	PBECL507	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Signals & Systems, DSP	Course Type	Lab

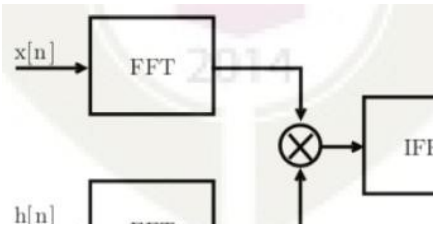
Course Objectives:

1. To realize the DFT, filtering techniques and familiarize DSP hardware
2. To implement Digital Filter.

Details of Experiment

Expt.	Experiment
1	**Simulation of Signals** Simulate the following signals using Python/ Scilab/MATLAB. 1. Unit impulse signal 2. Unit pulse signal 3. Unit ramp signal 4. Bipolar pulse 5. Triangular signal
2	**Verification of the Properties of DFT** 1. Generate a DFT matrix and apply it to an example sequence. 2. Write a function that returns the N point DFT matrix VN for a given N. 3. Plot its real and imaginary parts of VN as images using matshow or imshow commands (in Python) for N = 16, N = 64 and N = 1024 4. Compute the DFTs of 16 point, 64 point and 1024 point random sequences using the above matrices. 5. Observe the time of computations for N = 2σ for different values of σ. (You may use the time module in Python). 6. Use some iterations to plot the times of computation against x. Plot and understand this curve. Plot the computation times for the FFT function over this curve and observe the computational advantage of FFT. Circular Convolution. 1. Write a python function *circcon.py* that returns the circular convolution of an *N*1 point

	sequence and an $N2$ point sequence given at the input. The easiest way is to convert a linear convolution into circular convolution with $N = max(N1, N2)$. Parseval's Theorem Take two complex random sequences $x1[n]$ and $x2[n]$, and verify Parseval's Theorem.
3	**Familarization of DSP Hardware** 1. Familiarization of the code composer studio (in the case of TI hard- ware) or Visual DSP (in the case of Analog Devices hardware) or any equivalent cross-compiler for DSP programming. 2. Familiarization of the analog and digital input and output ports of the DSP board. 3. Generation and cross compilation and execution of the C code to connect the input digital switches to the output LEDs. 4. Generation and cross compilation and execution of the C code to connect the input analog port to the output. Connect a microphone, speak into it and observe the output electrical signal on a DSO and store it.
4	**Linear convolution** 1. Write a C function for the linear convolution of two arrays. 2. The arrays may be kept in different files and downloaded to the DSP hardware. 3. Store the result as a file and observe the output.
5	**FFT of signals** 1. Write a C function for N - point FFT. 2. Connect a precision signal generator and apply 1 mV , 1 kHz sinusoid at the analog port. 3. Apply the FFT on the input signal with appropriate window size and observe the result. 4. Connect microphone to the analog port and read in real time speech. 5. Observe and store the FFT values.
6	**IFFT with FFT** 1. Use the FFT function in the previous experiment to compute the IFFT of the input signal. 2. Apply IFFT on the stored FFT values from the previous experiments and observe the reconstruction.
7	**FIR low pass filter** 1. Use Python/scilab to implement the FIR filter response $h[n] = \omega c\ n)/\pi$ for a filter size $N = 50$, $\omega c = 0.1\pi$ and $\omega c = 0.3\pi$. 2. Realize the hamming (wH [n]) and kaiser ($wK[n]$) windows. 3. Compute $h[n]w[n]$ in both cases and store as file. 4. Observe the low pass response in the simulator. 5. Download the filter on to the DSP target board and test with 1 mV sinusoid from a signal generator connected to the analog port.

	6. Test the operation of the filters with speech signals.
8	**Overlap Save Block Convolution** 1. Use the file of filter coefficients from the previous experiment. 2. Realize the system shown below for the input speech signal $x[n]$.  3. Segment the signal values into blocks of length $N = 2000$. Pad the last block with zeros, if necessary. 4. Implement the *overlap save* block convolution method
9	**9. Overlap Add Block Convolution** 1. Use the file of filter coefficients from the previous experiment. 2. Realize the system shown in the previous experiment for the input speech signal $x[n]$. 3. Segment the signal values into blocks of length $N = 2000$. Pad the last block with zeros, if necessary. 4. Implement the *overlap add* block convolution method.

Course Assessment Method (CIE: 50 Marks, ESE 50 Marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record. (Continuous Assessment)	Internal Exam	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

Mandatory requirements for ESE:

- Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- Endorsement by External Examiner: The external examiner shall endorse the record.

Course Outcomes (COs)

At the end of the course the student will be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Generate basic signal waveforms	**K2**
CO2	Verify the properties of DFT	**K2**
CO3	Familiarize with DSP hardware and interface with Computer	**K2**
CO4	Implement LTI systems	**K3**
CO5	Design and Implement FIR low-pass filters	**K3**

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table

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

1: Slight (Low),2: Moderate (Medium),3: Substantial (High), : No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Signal Processing using Matlab	Vinay K. Ingle, John G. Proakis	Cengage Learning	3rd Ed., 2011
2	Think DSP: Digital Signal Processing using Python	Allen B. Downey	Green Tea Press	1st Ed. 2019
3	DSP applications using C and the TMS320C6x DSK	Chassaing, Rulph	Wiley & Sons	2/e. 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Discrete-Time Signal Processing	Alan V Oppenheim, Ronald W. Schafer	Pearson Education	4th Ed.,2018

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://www.youtube.com/watch?v=6dFnpz_AEyA
2	https://onlinecourses.nptel.ac.in/noc21_ee20/preview

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S5

COMMUNICATION LAB I

Course Code	PCECL508	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Analog circuits, Signals and systems, Digital Signal Processing	Course Type	Lab

Course Objectives:

1. Understanding and Implementing Modulation and Detection Techniques
2. Analyzing and Evaluating Communication System Performance.

Details of Experiment

Expt. No	Experiment
	PART A: Hardware Experiments
1	**Any one from the following Analog modulation schemes** ● AM modulation and detection using Transistors or ICS ● FM modulation and detection
2	**Hardware Experiment: Any one from the following Digital modulation & Waveform coding Schemes** ● Generation and Detection of PCM signals ● Generation and Detection of Delta modulated signals ● Generation and Detection of BPSK ● Generation and Detection of QPSK
	PART B: Simulation Experiments
1.	Performance of Waveform Coding Using PCM

2.	Pulse Shaping and Matched Filtering
3.	Eye diagram
4.	Error Performance of BPSK
5.	Error Performance of QPSK
	PART C: Software Defined Radio
1.	Familiarization with Software Defined Radio (Hardware and Control Software)
2.	FM reception or FM transmission using SDR

Experiment Details

PART A: Hardware Experiments

The students shall design and setup simple prototype circuits with the help of available ICs. They can observe waveforms produced by these circuits for standard ideal inputs

PART B: Simulation Experiments

The students shall write scripts to simulate components of communication systems for the following experiments.

Performance of Waveform Coding Using PCM

1. Generate a sinusoidal waveform with a DC offset so that it takes only
2. positive amplitude value.
3. Sample and quantize the signal using a uniform quantizer with number of
4. representation levels L. Vary L. Represent each value using decimal to
5. binary encoder.
6. Compute the signal-to-noise ratio in dB.
7. Plot the SNR versus number of bits per symbol. Observe that the SNR
8. increases linearly

Pulse Shaping and Matched Filtering

1. Generate a string of message bits.
2. Use Root Raised Cosine (RRC) pulse p(t) as the shaping pulse, and generate the

3. corresponding baseband signal with a fixed bit duration Tb. You may use roll-off factor as $\alpha = 0.4$. Vary the roll off rate and study.
4. Simulate transmission of baseband signal via an AWGN channel
5. Apply matched filter with frequency response Pr(f) =P*(f) to the received signal.
6. Sample the signal at mTb and compare it against the message sequence.

Eye diagram

1. Generate a string of message bits.
2. Use raised cosine pulse p(t) as the shaping pulse, and generate the corresponding baseband signal with a fixed bit duration Tb You may use roll-off factor as $\alpha = 0.4$
3. Use various roll off factors and plot the eye diagram in each case for the received signal. Make a comparison study among them.

Error Performance of BPSK

1. Generate a string of message bits.
2. Encode using BPSK with energy per bit Eb and represent it using points in a signal-space.
3. Simulate transmission of the BPSK modulated signal via an AWGN channel with variance No/2.
4. Detect using an ML, decoder and plot the probability of error as a function of SNR per bit Eb/No.

Error Performance of QPSK

1. Generate a string of message bits.
2. Encode using QPSK with energy per symbol E_b and represent it using points in a signal-space.
3. Simulate transmission of the QPSK modulated signal via an AWGN channel with variance No/2 in both I-channel and Q-channel.
4. Detect using an ML decoder and plot the probability of error as a function of SNR per bit E_b/N_0 where $E_s=2E_b$

PART C: Software Defined Radio

The students shall emulate communication systems with the help of software-defined-radio hardware and necessary control software. Use available blocks in GNU Radio (or similar software's like Simulink/ Lab- View) to implement all the signal processing.

Familiarization with Software Defined Radio (Hardware and Control Software)

1. Familiarize with an SDR hardware for reception and transmission of RF signal
2. Familiarize how it can be interfaced with computer
3. Familiarize with GNU Radio (or similar software's like Simulink/ Lab- View) that can be used to process the signals received through the SDR hardware.
4. Familiarize available blocks in GNU radio. Study how signals can be generated and spectrum (or power spectral density) of signals can be analyzed. Study how filtering can be performed.

FM reception using SDR

1. Receive digitized FM signal (for the clearest channel in the lab) using the SDR board.
2. Set up an LPF and FM receiver using GNU Radio.
3. Use appropriate sink in GNU Radio to display the spectrum of signal.
4. Resample the voice to make it suitable for playing on computer speaker. or playing on compute

FM transmission using SDR

1. Use a wave file source.
2. Set up an FM transmitter using GNU Radio.
3. Resample the voice source and transmit using the SDR.

Course Assessment Method (CIE: 50 Marks, ESE 50 Marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record. (Continuous Assessment)	Internal Exam	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

Mandatory requirements for ESE:

- Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- Endorsement by External Examiner: The external examiner shall endorse the record.

Course Outcomes (COs)

At the end of the course the student will be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Setup simple prototype circuits for waveform coding and digital modulation techniques working in a team.	K3
CO2	Simulate the error performance of a digital communication system using standard binary and M-ary modulation schemes.	K4
CO3	Develop hands-on skills to emulate a communication system with software-designed-radio working in a team.	K5

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table

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

1: Slight (Low),2: Moderate (Medium),3: Substantial (High), : No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Hobbyist's Guide to the RTL-SDR: Really Cheap Software Defined Radio	Carl Laufer	CreateSpace Independent Publishing Platform	2nd Edition, 2015
2	Principles of Communication Systems Simulation with Wireless Applications	WH Tranter, KS Shanmugan, TS Rappaport, KL Kosbar	Prentice Hall	2nd Edition, 2006
3	Digital Modulations using Python	Mathuranathan Viswanathan, "	Independently Published	1st Edition, 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Communication Systems	Simon Haykin and Michael Moher	Wiley	5th Edition, 2020
2	Modern Digital and Analog Communication Systems	B.P. Lathi and Zhi Ding	Oxford University Press	5th Edition, 2018
3	Introduction to Analog and Digital Communication	Simon Haykin and Michael Moher	Wiley	2nd Edition, 2006
4	Electronic communication systems	George Kennedy	McGraw Hil	6th Edition, 2017

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	Neel Pandeya, "Implementation of a Simple FM Receiver in GNU Ra- dio," https://kb.ettus.com/
2	Michael Ossmann, "Software Defined Radio with HackRF," YouTube Tutorial, https://www.youtube.com/watch?v=BeeSN14JUYU
3	Nptel videos on Software Defined radio, https://www.youtube.com/watch?v=0KQWPFwFByU
4	Experimenting with software defined radio, https://www.youtube.com/watch?v=tx5xofG2Fxg

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 6

ELECTRONICS & COMMUNICATION ENGINEERING

SEMESTER S6

ADVANCED COMMUNICATION THEORY

Course Code	PCECT 601	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	ADC (PCECT 502)	Course Type	Theory

Course Objectives:

1. To impart basics of information theory introducing both source coding and channel coding.
2. To impart the basic concepts of wireless communication system.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Entropy: Entropy, Properties of Entropy, Joint and Conditional Entropy, Mutual Information, Properties of Mutual Information Discrete memoryless sources, Source code, Average length of source code, Bounds on average length, uniquely decodable and prefix-free source codes. Kraft Inequality (with proof) Shannon's source coding theorem (both achievability and converse), Huffman code, operational meaning of entropy. Channel capacity, Capacity of discrete memoryless channels, Binary symmetric channels (BSC), Binary Erasure channels (BEC). Capacity of BSC and BEC, Shannon's channel coding theorem	11
2	Channel Capacity of AWGN Channel: Differential entropy, Differential Entropy of Gaussian random variable, Shannon-Hartley theorem (with proof), Shannon limit Block codes: Error detecting and correcting capability. Linear block codes. Generator and parity-check matrix. (Systematic form only). Encoding circuit, Maximum likelihood decoding of linear block codes.	11

	Bounded distance decoding. Syndrome, Standard array decoding. Convolutional Codes. State diagram. Trellis diagram. Maximum likelihood decoding. Viterbi algorithm.	
3	Introduction to Wireless Communication: - Introduction, Evolution, Paging. Wireless LAN, Bluetooth, Zig-Bee and Personal Area networks. Broadband Wireless Access-WiMax Technology. Wireless Spectrum allocation, Standards. Cellular System Design Fundamentals: Frequency Reuse, channel assignment strategies, Handoff strategies, Interference and system capacity, trunking and grade off service, improving coverage and capacity – cell splitting, sectoring, microcells Introduction to Multiple Access techniques: FDMA, TDMA, Code-Division Multiple Access (CDMA), Orthogonal Frequency-Division Multiple Access (OFDMA)	**11**
4	Path loss and shadowing: Free space path loss, Two-Ray model, Shadowing Statistical Multipath Channel Models: Time-varying channel impulse response (Analysis not required) , Narrowband fading, Wideband fading models, Delay spread and Coherence bandwidth, Doppler spread and Coherence time, Flat fading versus frequency selective fading, Slow fading versus fast fading Multi-carrier Modulation: Data transmission using multicarrier modulation for frequency-selective fading channels, overlapping subchannels, Mitigation of Subcarrier Fading, Discrete Implementation of multicarrier – OFDM Diversity: Receiver diversity – selection combining and maximal ratio combining. Transmitter diversity – Alamouti scheme for 2x2 MIMO. Equalization: Equalization – Linear and non-linear equalization, MMSE equalizers.	**11**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain information theory measures such as entropy, conditional entropy, mutual information	**K2**
CO2	Apply source coding theorem for data compression.	**K3**
CO3	Apply channel coding for error detection and correction	**K3**
CO4	Explain the basic Principle of wireless communication techniques	**K2**
CO5	Describe the wireless channel models and analyse the performance of the modulation techniques for flat fading channels	**K2**
CO6	Identify the advantages of various diversity and equalization techniques for improving the wireless receiver performance .	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
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
CO6	3	2	2									2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Wireless Communications	Andrea Goldsmith	Cambridge University Press	1/e, 2005
2	Wireless communication: Principles and Practice	Theodore S. Rappaport	Pearson Education	2/e, 2022
3	Elements of Information Theory	Joy A Thomas, Thomas M Cover	Wiley-Interscience	2/e 2006
4	Communication Systems	Simon Haykin	John Wiley and Sons Inc	4e, 2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Wireless Communication	David Tse and Pramod Viswanath	Cambridge University Press	1st Edition 2005
2	Mobile Communications	Jochen Schiller	Pearson	2nd Edition 2008
3	Wireless Communications	Andreas F Molish	Wiley India Publications	2nd Edition 2013
4	Principles of Mobile Communication	Gordon L. Stuber	Springer	4th Edition 2017
5	Error Control Coding : Fundamentals and Applications	Shu Lin & Daniel J. Costello. Jr.	Prentice Hall Inc	2nd Edition 2011
6	Digital Communication Systems, An Indian Adaptation	Simon Haykin	Wiley India	1/e. 2021

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117101053
2	https://nptel.ac.in/courses/117101053
3	https://onlinecourses.nptel.ac.in/noc21_ee66/preview
4	https://onlinecourses.nptel.ac.in/noc21_ee66/preview

SEMESTER S6

MICROWAVES & ANTENNAS

Course Code	**PCECT602**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Electromagnetics (PCECT501)	**Course Type**	Theory

Course Objectives:

1. To gain knowledge on the basic parameters, types and design of antennas
2. To gain an insight into the principles of operations of microwave sources, hybrid circuits and semiconductor devices.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Microwaves:** Electromagnetic spectrum, Frequency Bands, Features of microwaves, advantages & disadvantages, Applications, Atmospheric propagation effects. **Cavity Resonator**: TE and TM modes in waveguides (Review only)- Rectangular Cavity Resonator- Resonance frequency, Q factor, Excitation and Tuning, Re-entrant cavity. **Microwave Hybrid Circuits:** E plane Tee, H plane Tee, Hybrid Tee, Hybrid Ring, Two-hole directional coupler, Isolator, Circulator, Phase shifter, Attenuator **Scattering parameters**: Properties of S matrix, S matrix formulation of E plane Tee, H plane Tee, Magic Tee, Directional coupler. **Microwave Semiconductor Devices**: Principle of operation of Tunnel diode, Gunn diode- Different modes.	9
2	**Microwave tubes:** Types, Structure and Principles of operation of Two Cavity Klystron- Velocity Modulation, Bunching	9

	Reflex Klystron- Velocity Modulation, Power output and efficiency Traveling Wave Tube Amplifier- Slow wave structures, Helix TWT amplification process. Magnetron Oscillator- Cylindrical magnetron, Cyclotron angular frequency, **Microwave measurements:** Measurement of Power, VSWR, frequency, wavelength, insertion loss, impedance and attenuation; Basic concept of Network Analyzer and Anechoic chamber	
3	**Antennas**: Definition, Radiation mechanism, Polarisation, Types, Applications **Basic antenna parameters**: Radiation Pattern, Radiation Power Density, Radiation Intensity, Radiation resistance, Beamwidth, Directivity, Antenna Efficiency, Gain, Beam Efficiency, Bandwidth, Input Impedance, Antenna Radiation Efficiency, Effective aperture area, Effective height, Antenna noise temperature Reciprocity theorem, Helmholtz theorem, Duality Theorem (No proof required) Field, directivity and radiation resistance of a short dipole and half wave dipole (far field derivation).	**9**
4	**Antenna arrays**: Field of two isotropic point sources, Principle of pattern multiplication, Array factor, Linear arrays of 'n' isotropic point sources with equal amplitude, Grating lobes, Design of Broadside and End fire arrays, Phased array principle, Adaptive antenna array principle. **Broad band antennas**: Log periodic antenna array – Principle and design equations Helical antenna: Design equations, modes Micro strip Rectangular Patch Antennas -Design equations, important feeding methods. Horn antenna- Types, principles, expressions for E, H and gain (no derivation required) Parabolic dish antenna –Principle, Cassegrain feed, expression for E, H and Gain without derivation, Mobile phone antenna – Inverted F antenna.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basic mechanism of operation of cavity resonator and microwave sources	**K2**
CO2	Apply the S parameter theory to obtain the S matrices of various microwave hybrid circuits	**K3**
CO3	Illustrate the basic concepts of antenna radiation antenna parameters and their measurement techniques	**K2**
CO4	Design important broadband antennas and arrays	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Microwave Engineering,	Annapurna Das and Sisir K Das	McGraw Hill	4th edition
2	Microwave Devices & Circuits,	Samuel Y Liao,	Pearson Education	3rd edition
3	Antennas for all Applications,	John D. Krauss,Marhefka,Khan	Tata McGraw Hill	4th edition
4	Antennas and Wave Propagation	G S N Raju	Pearson Education	3rd edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electromagnetic Waves and Radiating Systems	Jordan and Balmain, E	Pearson Education	2nd edition
2	Concepts & Applications of Microwave Engineering	Sanjay Kumar Saurabh Shukla	PHI	2014
3	Microwave Engineering	R.S.Rao	PHI	2nd edition 2015
4	Antennas and Wave Propagation	R L yadava	PHI	2nd edition
5	Microwave Engineering: Fundamentals, Design and Applications	Subal Kar	Universities press	2022

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/I2OxOOmE0h8
2	https://youtu.be/NW1NXoM4q5c
3	https://youtu.be/h51mFbIgZRI
4	https://youtu.be/t-AP3ya8Pao

SEMESTER S6

COMPUTER NETWORKS

Course Code	**PEECT 631**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	**Course Type**	Theory

Course Objectives:

1. The course aims to expose students to computer networks taking a top-down approach of viewing from the layer of user applications and zooming into link layer protocols. The principles of various protocols used in every layer are studied in detail.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Computer Networks** Components of computer networks. Transmission modes in computer communication. Switching: circuit switching and packet switching. Performance analysis of packet switched network: Throughput analysis, Delay and loss in packet-switched networks, Types of delay, Packet loss. Introduction to Queueing models in computer networks. Littles theorem. Networks: Network criteria, physical structures, network models, categories of networks, Interconnection of Networks. Layered Architecture: Protocol layering, Internet protocol stack. TCP/IP protocol suite.	**9**
2	**Application Layer:** Communication between processes, Web application: HTTP, Message format, Email application: SMTP, Message format, MIME, POP3, Domain Name System (DNS).	**9**

	Transport Layer connectionless and connection-oriented protocols. UDP- Protocols for reliable data transfer: ARQ protocols, stop-and-wait protocol, alternating-bit protocol, Go-back- N, Selective Repeat. TCP Connection, segment structure, RTT estimate, Flow control. **Congestion Control** General approaches. TCP congestion control. Congestion control mechanisms and Quality of service.	
3	**Network Layer:** Datagram versus virtual-circuit network service, Router architecture, Routing and Forwarding, Static routing and Dynamic routing. Address Resolution protocols (ARP, RARP) Subnetting, Classless Routing(CIDR), ICMP. **IPv4:** Datagram format, Fragmentation and reassembly, addressing, address assignment – manual and DHCP. IPv6- Datagram format, Transitioning from IPv4 to IPv6, IP security. **Routing Algorithms** Link-State (Dijkstra's) Algorithm, Distance vector algorithm. Routing in Internet – RIP, OSPF, BGP.	**10**
4	**Link Layer** Services of link layer**,** Error detection and correction – checksum, CRC. Multiple access protocols – Channel partitioning, random access. ALOHA – pure and slotted, efficiency, CSMA, CSMA/CA, CSMA/CD. Link layer addressing: MAC address, Ethernet. Wireless Networks IEEE 802.11 wireless LAN. **Physical Layer**: Guided and unguided transmission media (Co-axial cable, UTP, STP, Fiber optic cable)	**8**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarize the principles and components of computer networks, switching, basic concepts of delay analysis and the layered network architecture.	**K2**
CO2	Demonstrate protocols and the functions of different layers.	**K2**
CO3	Analyse the concept of routing and addressing protocols in the context of computer networking.	**K3**
CO4	Make use of different physical communication standards in computer networks.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Networking: A Top-Down Approach Featuring the Internet.	James F. Kurose, Keith W. Ross,	Pearson	Sixth Edition, 2017
2	Data Communications and Networking	Behrouz A Forouzan	Tata McGraw-Hill	Fourth Edition , 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Networks – A Systems Approach,	Larry L. Peterson, Bruce S. Davie,	Elsevier,	2012
2	Communication Networking – An Analytical Approach,	A. Kumar, D. Manjunath, J. Kuri,	Morgan Kauffman Series	2004
3	Computer Networks	A. S. Tanenbaum, D. J. Wetherall	Pearson	Fifth
4	Data Networks	D. Bertsekas, RG Gallager	Pearson	2nd

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_cs19/preview
2	https://archive.nptel.ac.in/courses/106/105/106105183/
3	https://onlinecourses.swayam2.ac.in/cec21_cs04/preview

SEMESTER S6

DIGITAL IMAGE PROCESSING

Course Code	PEECT 632	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To introduce the fundamental concepts of Digital Image Processing and study the various transforms required for image processing.
2. To study spatial and frequency domain image enhancement and image restoration methods.
3. To understand image compression and segmentation techniques.,

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Digital Image Fundamentals: Image representation, Types of images, Elements of DIP system, Basic relationship between pixels, Distance Measures, Simple image formation model. Brightness, contrast, hue, saturation, Mach band effect. Colour image fundamentals-RGB, CMY, HIS models, 2D sampling and quantization.	9
2	2D Image transforms: DFT, Properties, Walsh transform, Hadamard transform, Haar transform, DCT, KL transform and Singular Value Decomposition. Image Compression: Image compression model, Lossy, lossless compression, Concept of transform coding, JPEG Image compression standard.	9
3	Image Enhancement: Spatial domain methods: Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing spatial Filters, Sharpening spatial Filters.	9

	Frequency domain methods: low pass filtering, high pass filtering, homomorphic filtering.	
4	Image Restoration: Degradation model, Inverse filtering- removal of blur caused by uniform linear motion, Minimum Mean Square Error (Wiener) Filtering. Image segmentation: Region based approach, clustering , Segmentation based on thresholding, edge based segmentation, Hough Transform.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain different components of image processing system	**K2**
CO2	Analyse the various concepts and mathematical transforms necessary for image processing	**K3**
CO3	Illustrate the various schemes of image compression	**K3**
CO4	Analyze the filtering and restoration of images	**K3**
CO5	Describe the basic image segmentation techniques	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Image Processing	Gonzalez Rafel C	PEARSON	4TH
2	Digital Image Processing	S Jayaraman, S Esakkirajan, T Veerakumar	McGraw Hill	Ist

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Image Processing	Kenneth R Castleman	Pearson Education	2/e,2003
2	Fundamentals of digital image processing	Anil K Jain	PHI	1988
3	Digital Image Processing	Pratt William K	John Wiley	4/e,2007

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_ee133/preview
2	https://nptel.ac.in/courses/117105135
3	https://www.youtube.com/watch?v=KiJo4-IijL4
4	https://archive.nptel.ac.in/courses/117/105/117105135/

SEMESTER S6

SECURE COMMUNICATION

Course Code	PEECT 633	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hr. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Understand and discuss the fundamental concepts of encryption
2. Provide insight into different types of encryption standards
3. Understand basic concepts of Cryptography

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction and Classic Encryption Techniques:-OSI security architecture, Security attacks – Passive attacks, Active attacks, Security services- Authentication, Access Control, Data Confidentiality, Data integrity, Nonrepudiation, Availability service. Model for network security. Symmetric cipher model, Cryptography, Substitution techniques- Hill Cipher, Transposition Techniques. Finite Fields: -Groups, Rings and Fields, Modular arithmetic, Euclidian algorithm, Finite Fields of the form GF(p), Polynomial arithmetic	9
2	Block Ciphers: - Data Encryption Standard, Block Cipher Principles – Stream Ciphers and Block Ciphers, Feistel Cipher, Feistel Decryption algorithm, The Data encryption standard, DES Decryption, The AES Cipher, substitute bytes transformation, Shift row transformation, Mix Column transformation.	9
3	Public Key Cryptography: -RSA and Key Management, Principles of public key cryptosystems-Public key cryptosystems, Application for Public key cryptosystem requirements, Fermat's theorem, Euler's Totient Function,	

	Euler's theorem, RSA algorithm, Key management, Distribution of public keys, Publicly available directory, Public key authority, public key certificates, Distribution of secret keys using public key cryptography.	**9**
4	Message Authentication and Hash Function: - Authentication requirements, Authentication functions- Message Encryption, Public Key Encryption, Message Authentication Code, Hash function	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain network security services and mechanisms and the types of attacks they are designed for and apply the concepts of modular arithmetic, Euclidean algorithm, polynomial arithmetic.	**K3**
CO2	Illustrate the principles of modern symmetric ciphers like Data Encryption Standard and Advanced Encryption Standard.	**K3**
CO3	Outline the concepts of public key cryptography, RSA algorithm, key distribution, and management for public key systems.	**K2**
CO4	Explain the requirements for authentication and the types of functions used to produce an authenticator	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Cryptography and Network security: principles and practice	William Stallings	Prentice Hall of India	4th Edition, 2006

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Cryptography and Network security	Behrouz A. Forouzan	Tata McGraw-Hill	2008
2	Abstract Algebra	David S. Dummit & Richard M Foote	Wiley India Pvt. Ltd	2nd Edition, 2008.
3	Cryptography, Theory and Practice	Douglas A. Stinson,	Chapman & Hall CRC Press Company	2nd Edition, 2005.
4	Elliptic Curves: Theory and Cryptography	Lawrence C. Washington	Chapman & Hall, CRCPress Company, Washington	2008
5	A course in Number theory and Cryptography	N. Koeblitz		2008
6	Elementary Number Theory with Applications	Thomas Koshy	Academic Press	2nd Edition, 2007
7	Cryptography and network security	Tyagi and Yadav	Dhanpat Rai & Co	2012

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_cs91/preview
2	https://nptel.ac.in/courses/108102117
3	https://onlinecourses.nptel.ac.in/noc22_cs90/preview

SEMESTER S6

NANOELECTRONICS

Course Code	PEECT634	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To understand the challenges of scaling of devices to Nano-meter scales
2. To design novel transistor devices to reduce the short channel effects and to improve the performance
3. To understand the Nano-scale quantum transport in Nano electronic devices from atom to transistor
4. To apply quantum mechanics in materials and quantum devices

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Nano electronics-Review of MOSFETs**- Band diagram-operation-threshold voltage- current-MOSFET parameters. **Challenges going to sub-100 nm MOSFETs**- Technological and physical limits of Nano electronic systems, characteristic lengths **Scaling and short channel effects**-Channel length, Oxide layer thickness, tunneling, power density, non-uniform dopant concentration, threshold voltage scaling, hot electron effects, sub threshold current, velocity saturation, DIBL, channel length modulation. **High-K gate dielectrics**- Effective oxide thickness, Effects of high-K gate dielectrics on MOSFET performance (Text books 1,2,3)	9
2	**Novel MOS Devices and Performance Optimization** **Silicon-on-insulator devices**--FD SOI, PD SOI	

	Multiple gate MOSFETs--Double gate MOSFETs, FinFETs, Nanowires-Multi gate MOSFET physics-natural length and short channel effects. **Multi Gate MOSFET performance optimization**: Fins, Fin Width, Fin Height and Fin Pitch, Fin Surface Crystal Orientation, Fins on Bulk Silicon, Nano-wires. Gate Stack, Gate Patterning, Threshold Voltage and Gate Work function requirements, Poly silicon Gate, Metal Gate, Tunable Work function metal gate, Mobility and Strain Engineering, Nitride Stress Liners, Embedded SiGe and SiC Source and Drain, Local Strain from Gate Electrode, Substrate Strain, Strained Silicon on Insulator. (Text books 1,4)	**9**
3	**Quantum Transport** **Atomistic view of electrical Resistance**-Energy level diagram- What makes electrons flow- The quantum of conductance - Potential profile- Coulomb blockade - Towards Ohm's law **Schrodinger equation**- Method of finite differences – Examples (particle in a box only) **Band structure**- 1-D examples- General result with basis- 2-D example **Sub bands**- Quantum wells, wires, dots, graphene and "carbon nanotubes" --Density of states-Minimum resistance of a wire **Ballistic to Diffusive Transport**-Landauer formula, Landauer-Buttiker formula. Ballistic and Diffusive transport – transmission. (Text books 3,5,6. Use MATLAB codes in the text book "Quantum transport atom to transistor" to illustrate the concepts)	**9**
4	**Applications of Quantum mechanics and Quantum devices** **Tunneling and applications of quantum mechanics**- solution of Schrodinger equation: Free space, Potential well, tunneling through a potential barrier. Potential energy profiles for material interfaces, Applications of tunneling. **Hetero junctions** -Modulation-doped hetero junctions- SiGe strained hetero structures- MODFET- Resonant tunnelling-Resonant tunnelling transistor **Single electron devices** –Coulomb blockade in a Nano capacitor, tunnel junctions, Double tunnel junction--Coulomb staircase, Single electron transistor. **Spintronics**-Transport of spin, GMR-TMR,applications, Spin Transistor (Text books 3,6)	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the challenges of scaling of electron devices to Nano meter scales	**K2**
CO2	Design novel transistor devices to reduce the short channel effects and improve performance	**K3**
CO3	Outline the Nano scale quantum transport in Nano electronic devices from atom to transistor	**K2**
CO4	Apply quantum mechanics in materials and quantum devices	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Modern VLSI Devices	Yuan Taur, Tak H Ning	Cambridge University Press,	Second edition 2009
2	Nanoelectronics and Nanosystems	Karl Goser· Peter GlÖsekötter· Jan Dienstuhl	Springer-Verlag Berlin Heide1berg	First Edition, 2004
3	Nanotechnology for microelectronics and optoelectronics,	J M Martinez Duart, R J Martin Palma, F Agullo Rueda	Elsevier,	First Edition, 2006
4	FinFETs and Other multigate Transistors	J-P Colinge	Springer	First Edition, 2008
5	Quantum Transport Atom to Transistor	Supriyo Datta	Cambridge University Press	First Edition, 2005
6	Fundamentals of nano electronics,	George W.Hanson,	Pearson Education.	First Edition 2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Carrier Transport	Mark Lundstrom	Cambridge University Press	Second Edition, 2000
2	High Dielectric Constant materials VLSI MOSFET Applications,	H R Huff, D C Gilmer,	Springer	First Edition, 2004
3	Nanoelectronics and nanosystems From Transistors to Molecular and Quantum Devices	Karl Goser· Peter GlÖsekötter· Jan Dienstuhl	Springer	First Edition, 2004
4	NANOSCALE TRANSISTORS Device Physics, Modeling and Simulation	Mark S. Lundstrom, Jing Guo	Springer	First Edition, 2006
5	Fundamentals of Ultra-Thin-Body MOSFETs and FinFETs	Jerry G. Fossum, Vishal P. Trivedi	Cambridge University Press	First Edition, 2013
6	Introduction to Nanotechnology	Charles P Poole jr. Frank J Owens	John Wiley and Sons	First Edition, 2003
7	Introduction to Quantum Mechanics	David J Griffiths, Darrel F schroetter	Cambridge University Press	Third Edition, 2018

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117108047, https://nanohub.org/resources/5328
2	https://nptel.ac.in/courses/117108047
3	https://nptel.ac.in/courses/117107149, https://nanohub.org/resources/8086,, https://nanohub.org/courses/FON1, https://nanohub.org/resources/5306
4	https://nptel.ac.in/courses/117107149, https://nanohub.org/resources/8086

SEMESTER S6

OPTICAL COMMUNICATION

Course Code	PEECT636	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PHYSICS	Course Type	Theory

Course Objectives:

1. To introduce the concepts of light transmission through optical fibers
2. To introduce the working of optical components and its usage in optical communication systems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Optical fiber Communications:** Structure of Optical fiber**,** materials, General block diagram of optical communication system, Advantages. **Optical fiber waveguides:** Principle of light guidance, Numerical Aperture, V number, Step and Graded index fibers, Single and Multi mode fibers. **Transmission Characteristics:** Attenuation, Absorption losses, Linear and Non linear scattering losses, bend losses. Dispersion- Intermodal dispersion, Chromatic dispersion, Dispersion modified fibers, Photonic crystal fibers, Polarization mode dispersion, Nonlinear effects, Solitons.	9
2	**Optical fibers and Cables** – Fabrication Techniques- Double crucible method, Outside Vapour phase oxidation, Modified Chemical Vapour Deposition. Optical Fiber Cables- Single and Multi fiber cables. **Optical Fiber Connections:** splices, connectors & couplers. **Optical Fiber Measurements:-** Attenuation and dispersion measurements**,** MZ interferometer, Optical Time Domain Reflectometer – Applications	9
3	**Optical sources:** LEDs and LDs, general structures, characteristics**,** modulators using LEDs and LDs. coupling with fibres, **Optical detectors:** Quantum efficiency and Responsivity, Structure and	9

	working of PIN and APD **Optical Receivers: -** Direct detection- noise in detectors, SNR, BER analysis Coherent detection principles. **Optical Amplifiers:** EDFA - Principle, structure and working, Raman amplifiers	
4	**Multiplexing Strategies:** OTDM, SCM, OFDM, WDM and Optical CDMA: concepts, components - couplers, splitters, Add/ Drop multiplexers, Fiber grating filters, tunable filters. **Optical networks** – General description of SONET/SDH **Free space optics:** Principle of LiFi technology. Visible Light Communication **Other applications of optical fibers**: Entertainment, Sensors – Types & principles	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the structure, fabrication, principle of operation and classifications of optical fibers	**K2**
CO2	Describe the transmission characteristics and evaluate losses in optical fiber	**K2**
CO3	Illustrate the working of sources, detectors and optical amplifiers used in optical communication system	**K2**
CO4	Explainthe concepts of Multiplexing, Optical Networks and Free Space Communication	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Optical Fiber Communications	Gerd Keiser	McGraw Hill	5th/e, 2021
2	Optical Fiber Communication: Principles and Practice	John M Senior	Pearson Education	3rd/e, 2014
3	Fibre Optic Communications	Joseph C. Palais	Pearson Education	5th/e, 2013
4	Fibre optic Communication: Systems and Components	Mishra and Ugale,	Wiley	2019
5	Fibre Optic Communications Systems	G P Agrawal	WILEY	4th Ed

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fibre Optic Communication: Optical Waveguides, Devices and Applications	Sanjeev Kumar Raghuwanshi	University Press	2015
2	Optical Communication	M Mukunda Rao	University Press	2000

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=ougKUUM3hJA
2	https://www.digimat.in/nptel/courses/video/117104127/L01.html
3	https://www.youtube.com/watch?v=seHmi6AMWy4
4	https://www.youtube.com/watch?v=4W7hieXDAmc

SEMESTER S6

OPTIMIZATION TECHNIQUES

Course Code	PEECT637	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Enable the learner to formulate engineering minima/maxima problems as optimization problems
2. Enable the learner to deploy various constrained and unconstrained optimization algorithms to obtain the minima/maxima of engineering problems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Engineering application of Optimization – Statement of an Optimization problem–Classification, Review of basic calculus concepts –Stationary points; Functions of single and two variables; Convexity and concavity of functions –Definition of Global and Local optima – Optimality criteria, Linear programming methods for optimum design – Standard form of linear programming (LP) problem; Canonical form of LP problem; Simplex Method, Duality, Application of LPP models in engineering	9
2	Optimization algorithms for solving unconstrained nonlinear optimization problems – Search based techniques: Direct search: Fibonacci and golden section search , Hookes and Jeeves , Gradient based method: Newton's method	9
3	Optimization algorithms for solving constrained optimization problems– direct methods – penalty function methods, barrier method -Optimization of function of multiple variables subject to equality constraints; Lagrangian function– Inequality constrained techniques-KKT conditions-constrained	9

	steepest descent method	
4	Modern methods of Optimization– Metaheuristic techniques: Genetic Algorithms – Simulated Annealing – Particle Swarm optimization –Ant colony optimization– : Use of Matlab/Scilab to solve optimization problem	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Formulate an optimization problem to optimize an engineering application using the principles of basic calculus.	**K2**
CO2	Apply the Simplex method to solve a linear programming problem	**K3**
CO3	Solve the unconstrained optimization problems using gradient based method.	**K3**
CO4	Apply the various optimization techniques to solve a constrained optimization problem	**K3**
CO5	Use metaheuristic algorithms to solve constrained and unconstrained optimization problems	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Optimization, Theory and Practice	S.S RAO	New Age International Publishers	4th Edition ,2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Optimization Techniques and Applications with Examples	Xin-She Yang	John Wiley & Sons	2018
2	Optimization for Engineering Design Algorithms and Examples	Deb K	Prentice Hall India	2000
3	Introduction to Optimization Design	Arora J	Elsevier Academic Press, New Delhi	2004
4	Linear Programming	Hardley G	Narosa Book Distributors Private Ltd	2002
5	Genetic Algorithms and engineering optimization	Mitsuo Gen, Runwei Cheng	John Wiley & Sons	2002
6	An introduction to optimization	Edwin KP Chong, Stanislaw, H Hak	John Wiley & Sons	Fourth Edition, 2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	NPTEL https://www.youtube.com/watch?v=a2QgdDk4Xjw
2	NPTEL https://www.youtube.com/watch?v=dPQKltPBLfc
3	NPTEL https://www.youtube.com/watch?v=qY-gKL7GxYk
4	NPTEL https://www.youtube.com/watch?v=Z_8MpZeMdD4 https://www.youtube.com/watch?v=FKBgCpJlX48

SEMESTER S6

IMAGE PROCESSING APPLICATIONS

Course Code	PEECT 635	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2Hrs. 30 Min.
Prerequisites (if any)	PBECT504 Digital Signal Processing	Course Type	Theory

Course Objectives:

1. To introduce the fundamental concepts of Digital Image Processing and study the various transforms required for image processing.
2. To study spatial and frequency domain image enhancement and image restoration methods.
3. To understand image compression and segmentation techniques.
4. To apply the principles of image processing techniques in real life images.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Digital Image Fundamentals: Image representation, Types of images, Elements of DIP system, Basic relationship between pixels, Distance Measures, Simple image formation model. Brightness, contrast, hue, saturation, Mach band effect. Colour image fundamentals-RGB, CMY, HIS models, 2D sampling and quantization.	9
2	2D Image transforms: DFT, Properties, Walsh transform, Hadamard transform, Haar transform, DCT, KL transform and Singular Value Decomposition. Image Compression: Image compression model, Lossy, lossless compression, Concept of transform coding, JPEG Image compression standard.	9

3	Image Enhancement: Spatial domain methods: Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing spatial Filters, Sharpening spatial Filters. Frequency domain methods: low pass filtering, high pass filtering, homomorphic filtering.	**9**
4	Image Restoration: Degradation model, Inverse filtering- removal of blur caused by uniform linear motion, Minimum Mean Square Error (Wiener) Filtering. Constrained Least square filtering, geometric mean filtering. Image segmentation: Region based approach, clustering, Segmentation based on thresholding, edge based segmentation, Hough Transform.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	**Internal Ex**	**Evaluate**	**Analyse**	**Total**
5	**15**	**10**	**10**	**40**

Criteria for Evaluation (Evaluate and Analyse): 20 marks

Students should analyze real world image processing problems and implement using Matlab or any other programming language.

Evaluation Methods:

1. Experiments using software tools: (10 marks)

2. Course Project applying the principles of image processing techniques:(10 marks)

Project phases: Proposal, Implementation, Testing, Final Report, Presentations and Viva Voce:

The following topics may be identified for project.

1. Illustration of different colour image models and its application.

2. Implementation of image transforms and compression algorithms

3. Examine different spatial and frequency domain filtering techniques on real world example images.

4. Implement image restoration techniques, adjust parameters, and evaluate results qualitatively and quantitatively

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Compare different colour model representations of image processing system	**K4**
CO2	Analyse the various concepts and mathematical transforms and compression schemes necessary for image processing	**K4**
CO3	Illustrate the various schemes of image filtering	**K5**
CO4	Determine the techniques for restoration of images	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Image Processing	Gonzalez Rafel C	Pearson Education	2009
2	Digital Image Processing	S Jayaraman, S Esakkirajan, T Veerakumar	Tata Mc Graw Hill	2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Image Processing	Kenneth R Castleman	Pearson Education	2/e,2003
2	Fundamentals of digital image processing	Anil K Jain	PHI	1988
3	Digital Image Processing	Pratt William K	John Wiley	4/e,2007

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117105079 https://nptel.ac.in/courses/117104069
2	same as above
3	same as above
4	same as above

SEMESTER S6

VLSI CIRCUIT DESIGN

Course Code	PBECT604	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCECT302 Solid State Devices, PCECT303 Analog Circuits, PBECT304 Logic Circuit Design	Course Type	Theory

Course Objectives:

1. To provide a comprehensive understanding of VLSI design methodologies, including ASIC types, SoCs and FPGA devices, design flows, methodologies.
2. To provide a comprehensive understanding of VLSI fabrication techniques.
3. To provide a solid foundation in static CMOS logic design and analysis, layout design and the application of design rules in layout design.
4. To cover dynamic logic design principles and the design and operation of storage cells.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**VLSI Design Methodologies**: Introduction, Moore's law, ASIC design, Full custom ASICs, Standard cell based ASICs, Gate array based ASICs, SoCs, FPGA devices, ASIC and FPGA Design flows, Top-Down and Bottom-Up design methodologies, Logical and Physical design.	6
2	**Fabrication techniques:** Material Preparation Purification and Crystal growth (CZ process), Wafer preparation, Epitaxy - molecular beam epitaxy, Thermal Oxidation- Dry and Wet oxidation, Diffusion and ion implantation techniques, Lithography- Photo lithographic sequence, Electron Beam Lithography, Etching, Chemical Vapor Deposition and Physical Vapor Deposition. **MOSFET Fabrication techniques**: Twin-Tub fabrication sequence, Fabrication process flow.	8

3	**Static CMOS Logic Design**: MOSFET Logic Design - NMOS Inverter (Static analysis only), basic logic gates, CMOS logic, Static and transient analysis of CMOS inverter, Static and dynamic power dissipation (detailed analysis not required), Propagation delays. Realization of logic functions with static CMOS logic. **Layout Design and Design rules:** Stick Diagram and Design rules-micron rules and Lambda rules. (definitions only). Layout of CMOS Inverter, two input NAND and NOR gates.	**11**
4	**Pass transistors and Transmission gate logic:** Basic concepts, Realisation of logic gates using pass transistors and complementary pass transistors. **Dynamic logic Design:** Pre charge, Logic evaluation, Issues in dynamic logic, Domino Logic, NP domino logic, Realisation of logic gates circuits using dynamic logic (NAND and NOR). **Sequential Logic and Memory design:** Behaviour of bistable elements, CMOS D latch and edge triggered flip flop, Read Only Memory- 4x4 MOS ROM Cell Arrays (NOR, NAND), Random Access Memory- SRAM-Six transistor CMOS SRAM cell, DRAM-Three transistor and One transistor Dynamic Memory Cell.	**11**

Suggestion on Project Topics

Sample Projects:

1.Create a standard cell library including basic logic gates, flip-flops, and multiplexers.

Tasks:

- Design cells using schematic capture.
- Perform logic synthesis to verify functionality.
- Simulate the cells using Verilog testbenches.

2. Design and implement a simple RISC processor on an FPGA.

Tasks:

- Design the processor architecture using Verilog.
- Implement and synthesize the design using FPGA tools (e.g., Xilinx Vivado).
- Verify functionality through simulation and hardware testing.

3. Simulate the fabrication process of a MOSFET using TCAD tools.

Tasks:

- Model the different stages of MOSFET fabrication (e.g., oxidation, lithography, doping).
- Analyze the effects of various parameters on device characteristics.

4. Create the layout of CMOS logic gates and perform design rule checking.

Tasks:

- Draw the stick diagrams for a CMOS inverter and two-input NAND/NOR gates.
- Create the corresponding layout using layout tools.
- Verify the layout against micron and lambda design rules.

5. Design and simulate basic memory cells including SRAM and DRAM.

Tasks:

- Design a 4x4 MOS ROM cell array and SRAM/DRAM cells using Verilog.
- Simulate the memory cells to verify their read and write operations.
- Analyze the performance and area of different memory cell designs**.**

Course Assessment Method

(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks **(8x2 =16 marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain VLSI design methodologies including ASIC types, SoC and FPGA devices, design flows, methodologies.	**K2**
CO2	Describe VLSI fabrication techniques.	**K2**
CO3	Design, analyse and create the layout of static CMOS logic circuits adhering to design rules and specifications.	**K3**
CO4	Design and analysis of dynamic logic circuits and the implementation of basic storage cells.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	CMOS Digital Integrated Circuits- Analysis & Design	Sung-Mo Kang, Yusuf Leblebici, Chulwoo Kim	Mc Graw Hill	4/e, Indian Edition, 2016
2	VLSI Technology	S.M. SZE	Mc Graw Hill	2/e, Indian Edition, 2017
3	Modern VLSI Design	Wayne Wolf	Prentice Hall; 4th edition	4/e, 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Application Specific Integrated Circuits	Michael John Sebastian Smith	Pearson	1/e, 2002
2	Principles of CMOS VLSI Design -A Systems Perspective	Neil H. E. Weste, Kamran Eshraghian	Pearson	2/e, 2007
3	Digital Integrated Circuits	Jan M. Rabaey	Pearson	2/e, 2016
4	Design of Analog CMOS Integrated Circuits	Behzad Razavi	McGraw Hill Education	2/e, 2017

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117106092 https://nptel.ac.in/courses/106103116
2	https://nptel.ac.in/courses/108101089
3	https://nptel.ac.in/courses/108107129 https://nptel.ac.in/courses/117101105 Lecture 26 - Layout of Analog Circuit
4	https://nptel.ac.in/courses/108107129

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**

    - Clarity and feasibility of the project plan
    - Research and background understanding
    - Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**

    - Individual contribution to the presentation
    - Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**

    - Active participation and individual contribution
    - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**

    - Adherence to the project timeline and milestones
    - Application of theoretical knowledge and problem-solving
    - Final Result

5. **Final Presentation (5 Marks)**

    - Quality and clarity of the overall presentation
    - Individual contribution to the presentation
    - Effectiveness in answering questions

6. **Project Quality, Innovation, and Creativity (3 Marks)**

    - Overall quality and technical excellence of the project
    - Innovation and originality in the project

Creativity in solutions and approaches

SEMESTER S6

ENTERTAINMENT ELECTRONICS

Course Code	OEECT611	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To provide broad knowledge on various industry standards, algorithms and technologies used to carry out digital audio and video broadcasting in infotainment industry.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Review of Analog Television: Scanning, Horizontal and Vertical Synchronization, Color information, Transmission methods. NTSC and PAL standards. Digital media streaming: Packetized elementary stream of audio-video data, MPEG data stream, MPEG-2 transport stream packet, Accessing a program, scrambled programs, program synchronization. PSI, Additional (Network information and service description) information in data streams for set-top boxes.	9
2	Digital Video Broadcasting (DVB): Satellite TV broadcasting – DVB-S Parameters, DVB-S Modulator, DVB-S set-top box, DVB-S2. Cable TV broadcasting – DVB-C Standard, DVB-C Modulator, DVB- C set-top box. Terrestrial TV broadcasting – DVB-T Standard, DVB-T Modulator, DVB-T Carriers and System Parameters, DVB-T receiver. Broadcasting for Handheld devices – DVB-H Standard DVB tele-text, DVB subtitling system. Digital Audio Broadcasting (DAB): Comparison of DAB with DVB. Physical layer of DAB. DAB Modulator, DAB Data Structure, DAB single frequency networks, Data broad casting using DAB.	9
3	High Definition Video and Audio: Pixel resolution, Comparison with	9

	Standard Definition TV, Review of Discrete Cosine Transforms (DCT), Video Compression - Quantization levels, Horizontal/Vertical blanking interval, Vertical Color resolution, DPCM of moving pictures, DCT, Run-length coding. MPEG-4 Video coding.	
4	Display Technology: Block diagram of video reproduction system in a TV, Cathode Ray tubes, Basic principle of Plasma displays, LC displays, Light-emitting diode displays, Field emission displays, Organic light emitting device displays. Television of future: Holographic TV, Virtual Reality, Augmented Reality.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain packetized streaming of digital media happens in the field of infotainment industry.	**K2**
CO2	Realise the critical aspects of DVB and DAB standards used for media broadcasting	**K2**
CO3	Apply video coding/compression algorithms are used to produce high-definition video in MPEG-4 standard	**K3**
CO4	Describe modern display technologies for video reproduction	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Video and Audio Broadcasting Technology: A Practical Engineering Guide (Signals and Communication Technology)	W. Fischer	Springer	2020
2	Understanding Digital Television An Introduction to DVB Systems with Satellite, Cable, Broadband and Terrestrial TV,.	Lars-Ingemar Lundström	Focal Press,Elsevier	2006
3	Newnes Guide to Televeision and Video Technology	K F Ibrahim	Newnes	2007
4	Introduction to Flat Panel Displays	Jiun-Haw Lee, David N. Liu, Shin-Tson Wu	Wiley	2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Video and HD Algorithms and Interfaces,"	C. Poynton	Morgan Kaufmann	2012.
2	Digital audio broadcasting: principles and applications of DAB, DAB+ and DMB	Wolfgang Hoeg, Thomas Lauterbach	Wiley	2009.
3	Introduction to Digital Audio	John Watkinson	Focal Press	1994.
4	Art of Digital Video,	John Watkinson	Focal Press	2008
5	Introduction to Digital Video,	John Watkinson	Focal Press	2001

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=M_nTmRtAD98
2	https://www.youtube.com/watch?v=aTDr79yvUus
3	https://www.youtube.com/watch?v=g_ysg46q-jQ
4	https://www.youtube.com/watch?v=4BaDaGTUgIY

SEMESTER S6

COMPUTER NETWORKS

Course Code	OEECT 612	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. The course aims to expose students to computer networks taking a top-down approach of viewing from the layer of user applications and zooming into link layer protocols. The principles of various protocols used in every layer are studied in detail,

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Computer Networks** Components of computer networks. Transmission modes - serial and parallel transmission, asynchronous, synchronous, simplex, half duplex, full duplex communication. Switching: circuit switching and packet switching. Networks: Network criteria, physical structures, network models, categories of networks, Interconnection of Networks. Delay and loss in packet-switched networks, Types of delay, Packet loss. Layered Architecture: OSI model	9
2	**TCP/IP protocol suite:** Introduction **Application Layer:** Communication between processes, Web application: HTTP, Message format, Email application: SMTP, Message format, MIME, POP3, Domain Name System (DNS). **Transport Layer** connectionless and connection-oriented protocols. UDP- Protocols for reliable data transfer: ARQ protocols, stop-and-wait protocol, alternating-bit protocol, Go-back- N,	9

	Selective Repeat. TCP Connection, segment structure, RTT estimate, Flow control. **Congestion Control** General approaches. TCP congestion control.	
3	**Network Layer:** Datagram versus virtual-circuit network service, Router architecture, Routing and Forwarding, Static routing and Dynamic routing. Address Resolution protocols (ARP, RARP) Subnetting, Classless Routing(CIDR), ICMP. **IPv4:** Datagram format, Fragmentation and reassembly, addressing, address assignment – manual and DHCP. IPv6- Datagram format, Transitioning from IPv4 to IPv6, IP security. **Routing Algorithms** Link-State (Dijkstra's) Algorithm, Distance vector algorithm. Routing in Internet – RIP, OSPF, BGP.	**10**
4	**Link Layer** Services of link layer**,** Error detection and correction – checksum, CRC. Multiple access protocols – Channel partitioning, random access. ALOHA – pure and slotted, efficiency, CSMA, CSMA/CA, CSMA/CD. Link layer addressing: MAC address, Ethernet. Wireless Networks IEEE 802.11 wireless LAN. **Physical Layer**: Guided and unguided transmission media (Co-axial cable, UTP,STP, Fiber optic cable)	**8**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarize the principles and components of computer networks, switching, basic concepts of delay analysis and the layered network architecture.	**K2**
CO2	Demonstrate protocols and the functions of different layers.	**K2**
CO3	Analyse the concept of routing and addressing protocols in the context of computer networking.	**K3**
CO4	Make use of different physical communication standards in computer networks.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Networking: A Top-Down Approach Featuring the Internet.	James F. Kurose, Keith W. Ross,	Pearson	Sixth Edition, 2017
2	Data Communications and Networking	Behrouz A Forouzan	Tata McGraw-Hill	Fourth Edition , 2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Networks – A Systems Approach,	Larry L. Peterson, Bruce S. Davie,	Morgan Kauffman	
2	Communication Networking – An Analytical Approach,	A. Kumar, D. Manjunath, J. Kuri,	Morgan Kauffman Series	
3	Computer Networks	A. S. Tanenbaum, D. J. Wetherall	Pearson	
4	Data Networks	D. Bertsekas, RG Gallager	Prentice Hall	

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_cs19/preview
2	https://archive.nptel.ac.in/courses/106/105/106105183/
3	https://onlinecourses.swayam2.ac.in/cec21_cs04/preview

SEMESTER S6

BIOMEDICAL ENGINEERING

Course Code	OEECT613	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3-0-0--0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. This course will introduce the various aspects of biomedical engineering and its applications escribed using engineering principles
2. The student will be able to understand the techniques and uses of modern diagnostic and therapeutic equipment**.**

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to bio-medical engineering, Sources of bio-electric potential: Resting and action potential, propagation of action potentials. Various bioelectric potentials (ECG, EEG, EMG, ERG, EOG, EGG concept only.) Electrode theory: Nernst equation, Electrode skin interface Bio-potential electrodes: Microelectrodes, skin surface electrodes, needle electrodes Bio-potential amplifiers: instrumentation amplifiers, carrier amplifiers, isolation amplifiers, chopper amplifiers	9

2	Heart and cardiovascular system: electro conduction system of the heart, ECG lead configurations, Einthoven triangle, Electrocardiography, ECG machine - block diagram, ECG recording system.. The human nervous system: Neurons, action potential of brain, brain waves, placement of electrodes, EEG recording, evoked potential, Electrical activity of muscles: EMG signal acquisition and analysis.Myoelectric control system. Electrical stimulation of the muscle and nerve, Applications of EMG	**9**
3	Instruments for clinical laboratory: Oxymeters, blood cell counter, flame photometer, Spectrophotometer Therapeutic Equipments: Principles, block schematic diagram, working and applications of pacemakers, cardiac defibrillators, heart–lung machine, dialyzers, surgical diathermy equipment, ventilators Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, single channel telemetry system for ECG.	**9**
4	Medical Imaging systems (Basic Principle only): X-ray imaging - X-ray machine, applications of X-rays in medicine. Computed Tomograpy: Principle, image reconstruction, scanning system and applications Ultrasonic imaging systems: Basic pulse echo system, Different types of Ultrasonics systems:, A-Scan, B-Scan, M-Scan, applications, real-time ultrasonic imaging systems and probes. Magnetic Resonance Imaging – Basic NMR components, Biological effects and advantages of NMR imaging	**9**

Course Assessment Method

(CIE: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Outline the basic bioelectric potentials and their implications in diagnostics	**KL2**
CO2	Summarize the principles used for diagnosis of abnormalities in the cardiovascular system	**KL2**
CO3	Identify the techniques used for diagnosis and therapy in the neuromuscular and myoelectric systems.	**KL2**
CO4	Illustrate the principle and working of different types of bio medical equipment/devices	**KL2**
CO5	State various diagnostic medical imaging techniques.	**KL2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	, Handbook of Biomedical Instrumentation	R. S. Khandpur	Tata Mc Graw Hill	Third edition
2	Biomedical Instrumentation and Measurement	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer,	, PHI	2nd Edition, 2004

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	"Medical Instrumentation application and design",	John G Webster,	John Wiley	3rd edition
2	Introduction to Biomedical Equipment Technology	J. J. Carr,	Pearson Education	4th edition
3	Principle of Biomedical Instrumentation and Measurement	Richard Aston,	Merrill Education/Prentice Hall	
4	Introduction to Biomedical Instrumentation	Barbara Christe	Cambridge University Press,	2008

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=_fD9gOqiBVE
2	http://www.digimat.in/nptel/courses/video/127106134/L16.html

SEMESTER S6

COMMUNICATION LAB II

Course Code	PCECL607	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0-0-3-0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Develop practical skills in microwave and optical communication systems through hands-on experiments involving microwave sources, fiber optics, and optoelectronic components.
2. Enhance understanding and application of antenna and waveguide theories by designing, simulating, and measuring various antenna types and waveguide characteristics.

Details of Experiment

Expt. No	Experiment
	MICROWAVE EXPERIMENTS (Minimum four experiments are mandatory)
1	Reflex Klystron Mode Characteristics.
2	GUNN diode characteristics.
3	VSWR and Frequency measurement.
4	Verify the relation between Guide wave length, free space wave length and cut off wave length for rectangular wave guide.
5	Unknown load impedance measurement using smith chart and verification using transmission line equation.
6	Measurement of Magic Tee characteristics.
7	Directional Coupler Characteristics.
	OPTICAL EXPERIMENTS (Minimum three experiments are mandatory)
1	Setting up of Fiber optic Digital link.
2	Measurement of Numerical Aperture of an Optical fiber

3	Study of losses in Optical fiber
4	Voltage vs. Current (V-I) characteristics of Laser Diode.
5	Voltage vs. Current (V-I) characteristics of LED.
6	Characteristics of Photodiode
	ANTENNA EXPERIMENTS (Minimum three experiments are mandatory)
1	Familiarization of any antenna simulation software
2	Simulation of Dipole Antenna
3	Simulation of Patch Antenna
4	Simulation of Antenna Array.
5	Study of Vector Network Analyzer.
6	Antenna Pattern Measurement

Course Assessment Method (CIE: 50 Marks, ESE 50 Marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record. (Continuous Assessment)	Internal Exam	Total
5	**25**	**20**	**50**

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	**15**	**10**	**10**	**5**	**50**

Mandatory requirements for ESE:

- Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- Endorsement by External Examiner: The external examiner shall endorse the record.

Course Outcomes (COs)

At the end of the course the student will be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Familiarize the basic Microwave components and to analyse a few microwave measurements and its parameters.	**K4**
CO2	Describe the principles of fiber-optic communications and the different kinds of losses, signal distortion and other signal degradation factors.	**K2**
CO3	Design and simulate basic antenna experiments with simulation tools.	**K6**

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table

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

1: Slight (Low),2: Moderate (Medium),3: Substantial (High), : No Correlation

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Microwave Devices and Circuits	Samuel Y. Liao	Prentice-Hall Of India Pvt. Limited	3rd Edition, 2008
2	Optical Fiber Communication	Gred Keiser	Mc Graw Hill	5th Edition, 2013
3	Antenna Theory and Design	Constantine A. Balanis Balanis	Wiley Publications	4th Edition, 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Antennas for all Applications	John D. Krauss	McGraw-Hill	4th Edition, 2010
2	Modern Antenna Design	Thomas A. Milligan	Wiley-IEEE Press	2nd Edition, 2005
3	Principles of Electromagnetics	N.O. Sadiku and S.V. Kulkarni	Oxford University Press, India	6th Edition, 2015

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://youtu.be/F07ApLj12sE?si=wN5Al8ERbd52xJ6h
2	https://youtu.be/h51mFbIgZRI?si=GsXQ2sQmaq1HlYui
3	https://www.youtube.com/live/G4DCS2T-hqs?si=3sTAjLEfGR11fNVd

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**

   - Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (7 Marks)**

   - Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - Teamwork: Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**

   - Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**

   - Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
   - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
   - Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
   - Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
   - Creativity and logic in algorithm or experimental design.
2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
   - Setup and Execution: Proper setup and accurate execution of the experiment or programming task.
3. **Result with Valid Inference/Quality of Output (10 Marks)**
   - Accuracy of Results: Precision and correctness of the obtained results.
   - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.
4. **Viva Voce (10 Marks)**
   - Ability to explain the experiment, procedure results and answer related questions
   - Proficiency in answering questions related to theoretical and practical aspects of the subject.
5. **Record (5 Marks)**
   - Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 7

ELECTRONICS & COMMUNICATION ENGINEERING

SEMESTER S7

ADVANCED MOBILE COMMUNICATION

Course Code	PEECT741	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand basics of 5G
2. To analyze 5G networks for future challenges

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Evolution from 1G to 5G. Analog voice systems in 1G; digital radio systems in 2G, voice and messaging services, TDMA based GSM, CDMA, 2.5G (GPRS), 2.75G (EDGE); IMT2000: 3G UMTS, W-CDMA, HSPA, HSPA+, 3G services and data rates; IMT Advanced: 4G, LTE, VoLTE, OFDM, MIMO, LTE Advanced Pro (3GPP Release 13+); IMT2020: 5G, enhancements in comparison to IMT Advanced. Evolution of LTE Technology to 5G Roadmap.	9
2	Basics of 5G. 5G potential and applications; Usage scenarios: enhanced mobile broadband (eMBB), ultra reliable low latency communications (URLLC), massive machine type communications (MMTC), D2D communications, V2X communications; Spectrum for 5G, spectrum access/sharing; millimeter Wave communication, channels and signals/waveforms in 5G, carrier aggregation, small cells, dual connectivity.	9
3	5G Network. New Radio (NR), Standalone and non-standalone mode; non-orthogonal multiple access (NOMA); massive MIMO, beam formation, FAPI: PHY API Specification, flexible frame structure, Service Data	9

	Adaptation Protocol (SDAP); centralized RAN, open RAN; multi-access edge computing (MEC); software defined networking (SDN), network function virtualization (NFV); network slicing; restful API for service-based interface; private networks.	
4	Current state and Challenges ahead. 5G penetration in developed countries; deployment challenges in low-middle income countries, stronger backhaul requirements, dynamic spectrum access and usage of unlicensed spectrum, contrasting radio resource requirements; large cell usage: LMLC; possible solutions for connectivity in rural areas (BharatNet, TVWS, Long-range WiFi, FSO); non-terrestrial fronthaul/backhaul solutions: LEOs, HAP/UAV.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the evolution from 1G to 5G	**K2**
CO2	Explain the basics of 5G	**K2**
CO3	Illustrate 5G network	**K2**
CO4	Describe the current state and challenges ahead in 5G	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	4G, LTE-Advanced Pro and The Road to 5G	Erik Dahlman, Johan Skold, and Stefan Parkvall	Academic Press	3rd Edition, 2016
2	5G NR: Architecture, Technology, Implementation, and Operation of 3GPP New Radio Standards	Dr. Sassan Ahmadi	Academic Press	2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	An Introduction to 5G: The New Radio, 5G Network and Beyond	Christopher Cox	Wiley	1st Edition, 2020
2	5G New Radio Non-Orthogonal Multiple Access	Yifei Yuan, Zhifeng Yuan	CRC Press	2022
	5G Outlook – Innovations and Applications	Ramjee Prasad	River Publishers	1st Edition, 2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_ee56/preview

SEMESTER S7

DEEP LEARNING

Course Code	PEECT742	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Understand the theoretical basics of neural networks and deep learning

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Review of ANN: Perceptrons Convolutional Neural Networks: Convolution operation , CNN Architecture kernels, padding- Convolutional layers-, Pooling Layers, fully connected layers. Feature and weight visualization, t-SNE	7
2	Loss functions-Mean Squared Error, Cross Entropy Activation functions, Sigmoid Relu , Softmax Training CNNs:-Initialization Back-propagation Optimization algorithms:-SGD, Momentum, Adagrad, RMS Prop, Adam, Hyper parameter optimization-Learning rate Regularization methods: L1, L2 regularizaton dropout, Data Augmentation, Early stopping batch normalization Introduction to Transfer learning, feature extraction , fine tuning. Case study: CNN architectures*: AlexNet, VGG, ResNet,Google net *(Case study only for practical assignments/microprojects)	11
3	Sequence models, Recurrent Neural Networks (RNN): cell structure and architecture, Training RNN, back propagation through time. Vanishing and exploding gradients. Long Short-Term Memory (LSTM), architecture and training.	11

	Gated Recurrent Units (GRU), architectture and training.	
4	Introduction to Generative models: parameter estimation, Maximum Likelyhood Estimation Auto encoders, latent space variational auto encoders. GANs : adversarial training. Discriminator , Generator, up sampling, Transformer models, architecture Word embedding, position encoding , attention , training transformer models Large language models BERT,GPT (Detailed mathematical treatment not required for this module)	**11**

Note:- Assignments/ Micro project should be given for modules 2 ,3 and 4 using standard machine learning frameworks such as tensorflow/keras/ pytorch. They may also be introduced to GPUs and standard data sets on hugging face/kaggle

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basic concepts of neural networks	**K2**
CO2	Solve real world problems usig CNN	**K2**
CO3	Solve real world problems using RNN	**K2**
CO4	Describe the concepts of GAN	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Learning Deep Learning	Magnus Ekman	Addison -Wesley	2022
2	Hands-on Machine learning with Sc-kit Learn Keras and Tensorflow	Aurelien Geron	Oreilly	Second edition 2019
3	Dive deep into machine learning	Astan Zhang and Zachary and Alexander semola	Cambridge university press https://d2l.ai/	2019
4	Neural Networks for deep learning	Michael Nielsen	http://neuralnetworksanddeeplearning.com/	2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Deep Learning.	Ian Goodfellow. Yoshua Bengio and Aaron Courville.	MIT Press	2016.
2	Neural Networks and Deep Learning: A Textbook..	Charu C. Aggarwal.	Springer	. 2019
3	Generative Deep Learning	David Foster	OReilly	2022
4	Build a Large Language Model	Sebastian Raschka	Manning	2023

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.cse.iitm.ac.in/~miteshk/CS6910.html
2	https://wiki.pathmind.com/lstm
3	http://colah.github.io/posts/2015-08-Understanding-LSTMs/
4	https://jalammar.github.io/illustrated-transformer/ Jay Almar

SEMESTER S7

ROBOTICS AND AUTOMATION

Course Code	**PEECT 743**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs .30 Min.
Prerequisites (if any)	None/ (Course code)	**Course Type**	Theory

Course Objectives:

1. Introduce the Fundamental concepts and terminology in Robotics and automation

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of Robotics** **Automation and Robotics**: Definition and history of robotics. Differences between automation and robotics. Applications of robotics in industry and service sectors. **Robot Anatomy**: Basic components: Links, joints, and end effectors. Structural configurations: Cartesian, cylindrical, spherical, SCARA, articulated. Degrees of Freedom (DOF) and their significance. **Configurations of Robots:** Cartesian, Cylindrical, Spherical, Articulated, SCARA. Work Volume and Workspace Analysis: Definition and importance. Factors affecting workspace. **Manipulator Kinematics:** Position representation. Introduction to forward and inverse kinematics. Homogeneous transformations and their application in robot kinematics. **D-H Notations:** Formulating and solving kinematic equations.	**9**

2	**Control Systems for Robots** **Basic Control System Models:** Open-loop and closed-loop control. Block diagrams and transfer functions. **Robot Motions:** Types of motions: Slew motion, joint-interpolated motion, and straight-line motion. Path planning and trajectory generation. **Controllers:** On/off control. Proportional (P) control. Integral (I) control. Proportional plus integral (PI) control. Proportional plus derivative (PD) control. Proportional plus integral plus derivative (PID) control.	**9**
3	**Actuation and Feedback Mechanisms** **Sensors:** Types of sensors: Position and velocity sensors. Working principles of encoders and resolvers. Potentiometers and tachometers. **Actuators:** Electric actuators: DC motors, stepper motors, and servomotors. Hydraulic actuators. Pneumatic actuators. Power Transmission Devices: Gears, belts, chains. Leadscrews and ball screws. **End Effectors:** Types of grippers: Mechanical, vacuum, magnetic. Design considerations for grippers. Methods of Power and Control Signal Transmission: Electrical, hydraulic, pneumatic transmission.	**9**
4	**Industrial Applications and Work Cell Design** **Material Handling:** General considerations for material handling with robots, Material transfer applications.	**9**

	Pick and Place Operations: Techniques and applications, Integration with production lines. Palletizing and Related Operations: Methods and case studies. **Manufacturing Processes:** Die casting, plastic molding, forging. Machining operations, stamping press operations. Role of robots in automation of these processes. **Robot Cell Layouts:** Design considerations for multiple robots and machine interfaces. Examples of typical robot cell layouts. **Work Cell Control:** Interlocks and safety mechanisms. Error detection and recovery strategies. **Work Cell Controllers:** Types and functions of work cell controllers. Integration with other control systems. **Cycle Time Analysis:** Techniques for analyzing and optimizing robot cycle times. Factors affecting cycle time and productivity.	

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the basic components, structural configurations, and degrees of freedom (DOF) of robots.	**K2**
CO2	Apply forward and inverse kinematics for different types of robotic manipulators.	**K3**
CO3	Implement various types of controllers and explain their impact on robot motion control	**K2**
CO4	Identify and compare different types of sensors and actuators used in robotic systems	**K2**
CO5	Describe the basics of robot cell layouts considering multiple robots and machine interfaces.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	"Introduction to Robotics: Mechanics and Control"	John J. Craig	PHI	FIRST
2	Robot Modeling and Control	Mark W. Spong, Seth Hutchinson, and M. Vidyasagar	WILEY	FIRST
3	Industrial Robotics	Groover MP	Mc Graw Hill	1987

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Robotics fundamental concepts & analysis	Ashitava Ghoshal	Oxford university press	2006
2	Introduction to Robotics	John G Craig	PHI	2005

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_me76/preview
2	https://nptel.ac.in/courses/107106090

SEMESTER S7

CODING THEORY

Course Code	PEECT744	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCECT 601 Advanced Communication Theory	Course Type	Theory

Course Objectives:

1. To impart the knowledge of current error control coding techniques used in digital communication networks.
2. To impart the knowledge of encoding and decoding of various error control codes

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Algebra-Overview of Groups, Rings , Finite Fields -Binary field arithmetic, Primitive elements (3hrs) Irreducible and Primitive Polynomials, Conjugate elements and Minimal Polynomials- Field extension-Construction of Finite Fields from Polynomial rings (3hrs) Vector spaces – Subspace and Dual spaces-matrices(3hrs)	9
2	Error Control Coding – Relevance of error control codes in Communication System, concepts of Code rate, Hamming Distance, Minimum Distance, Error detecting and correcting capability. (3hrs) Review on LBC-Generator matrix, Parity Check Matrix. Maximum Likelihood Decoding-syndrome decoding (3hrs) Simple bounds on block codes - Singleton bound, Hamming Bound, Gilbert-Varshamov bound. Maximum-distance-separable (MDS) codes. (3hrs)	9
3	Basic concepts of cyclic codes – Polynomial and matrix description. Interrelation between polynomial and matrix view point (2 hrs) Encoding: Non-systematic and systematic encoding, syndrome decoding-complete decoding of cyclic codes(4hrs) Hamming Codes-properties-Examples (1 hr)	9

	BCH codes, Reed-Solomon Codes (Properties and encoding only) (2hrs)	
4	Review on Convolution Codes- Systematic Encoders, Decoding of Convolution Codes –Viterbi algorithm, Turbo Codes, Encoding parallel concatenated codes. (3hrs) Low Density Parity Codes, Construction, Tanner Graphs, Message passing decoding. Example of message passing decoding over binary erasure channels. Message passing of LLR and decoding over AWGN channels. (3hrs) Polar Codes – Introduction, polarization of BEC channels, Polar transform and frozen bits. LDPC and Polar codes in 5G. (3hrs)	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain various algebraic structures used in coding theory	**K2**
CO2	Explain the error detection and correction capabilities of linear codes	**K2**
CO3	Apply linear block codes to detect and correct errors.	**K3**
CO4	Use algebraic techniques to construct efficient codes with reduced structural complexity	**K3**
CO5	Apply convolutional code for error detection correction	**K3**
CO6	Illustrate modern error correcting codes like Turbo codes, LDOC code and polar codes	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Error Control Coding : Fundamentals and Applications	Shu Lin & Daniel J. Costello. Jr.	Prentice Hall Inc	2nd Edition
2	Communication Systems	Simon Haykin	John Wiley and Sons Inc	4e
3	Modern Coding Theory	T. Richardson, R. Urbanke	Cambridge University Press	

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of digital communication	RG Gallager	Cambridge University Press	
2	Introduction to Coding Theory	Ron M Roth	Cambrdige University Press	
3	A Brief Introduction to Polar Codes	H. Pfister	Lec. Notes	
4	Polar Codes: A Non-Trivial Approach to Channel Coding	O. Gazi	Springer	2018
5	LDPC and Polar Codes in 5G Standard, NPTEL Course	A. Thangaraj		

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117101053
2	https://www.youtube.com/watch?v=f8RvFlr5wRk
3	https://onlinecourses.nptel.ac.in/noc22_ee49/preview
4	https://www.digimat.in/nptel/courses/video/108102117/L01.html

SEMESTER S7

ADVANCED DIGITAL SIGNAL PROCESSING

Course Code	**PEECT746**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Digital Signal Processing	**Course Type**	Theory

Course Objectives:

1. To gain an in-depth knowledge of processing of digital signals and their application to modern world problems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Multi-rate system and filter banks :** Basic multi-rate operations: up sampling and down sampling , time domain and frequency domain analysis, Need for anti aliasing and anti imaging filters. Noble identities. Type 1 and Type 2 polyphase decomposition, Efficient structures for decimation and interpolation filters. Uniform filter banks and its implementation using polyphase decomposition. QMF Filter Bank-conditions for perfect reconstruction, polyphase implementation. Design of perfect reconstruction M- channel Filter Banks. Applications of multirate systems.	**9**
2	**Wavelet transform:** Time Frequency Trade off in signal analysis, Heisenberg's uncertainty principle. Short Time Fourier transform-Filter Bank representation. Continuous Wavelet Transform- Admissibility condition. Time-frequency diagrams for the STFT and the wavelet transform Discrete Wavelet Transform- Haar Scaling and Wavelet Functions, Haar analysis of signals, concept of nested space. Orthonormal Wavelet Analysis-Filter bank interpretation. Applications of wavelet transform.	**9**

3	**Power spectrum estimation**- Rational power spectra representation, Relationships Between the Filter Parameters and the Autocorrelation Sequence, Parametric method of power spectrum estimation-Yule Walker equations, Non parametric method of power spectrum estimation-Periodogram, Averaging periodogram.	**9**
4	**Linear prediction filters**- Forward and backward predictors, lattice filter structure, relationship between linear filter coefficients and reflection coefficients, Normal equations for optimum filter design. Adaptive filters-Weiner filter design, Adaptive filters for adaptive channel equalization, adaptive noise cancellation and Linear Predictive Coding of Speech Signals, Steepest descent algorithm, LMS algorithm.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Classify continuous and discrete time signals and systems based on their properties and perform basic operations on signals.	**K2**
CO2	Determine the stability and causality of LTI systems using convolution operations.	**K3**
CO3	Analyze signals in frequency domain using Laplace, Fourier and z-transforms and examine the properties of transforms.	**K3**
CO4	Interpret the use of various transforms to analyze continuous and discrete time LTI systems.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Signals and Systems	Alan V. Oppenheim and Alan Willsky	Pearson Education	2/e, 2015
2	Signals and Systems	Simon Haykin	John Wiley	2/e, 2021

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Signals and Systems	Anand Kumar	PHI	3/e, 2013
2	Principles of Signal Processing & Linear systems	B P. Lathi	Oxford University Press	2/e, 2009
3	Signals & Systems - Continuous and Discrete	Rodger E. Ziemer	Pearson	4/e, 2013
4	Analog and Digital Signal Processing	Ashok Ambardar	Brooks/Cole Publishing Company	2/e, 2013
5	Signals and systems - Principles and Applications	Shaila Dinkar Apte	Cambridge University Press	1/e, 2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117101055 https://nptel.ac.in/courses/117104074 https://nptel.ac.in/courses/108104100
2	https://nptel.ac.in/courses/117101055 https://nptel.ac.in/courses/117104074 https://nptel.ac.in/courses/108104100
3	https://nptel.ac.in/courses/117101055 https://nptel.ac.in/courses/117104074 https://nptel.ac.in/courses/108104100
4	https://nptel.ac.in/courses/117101055 https://nptel.ac.in/courses/117104074 https://nptel.ac.in/courses/108104100

SEMESTER S7

CRYPTOGRAPHY

Course Code	PEECT 747	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To introduce fundamental concepts of symmetric and asymmetric cipher models.
2. To understand the basics of authentication.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to cryptology**: Stream and block ciphers- secret and public key cryptography. **Introduction to Complexity of Algorithm**- P, NP, NP-Complete classes. **Number theory:** Primes, divisibility, linear diaphantine equations, congruences, system of linear congruences, Wilson theorem, Fermat's little theorem, Euler's theorem. Multiplicative functions, Primitive roots, Quadratic congruences- quadratic residues, Legrende symbol.	10
2	**Review of algebraic structures:** groups, rings, finite fields, polynomial rings over finite field. **Symmetric Ciphers:** Affine cipher, Hill cipher, Enciphering matrices. Data Encryption standard (DES), Advanced Encryption standard (AES).	8
3	**Public key cryptography:** One-way functions, RSA, Discrete Log, Diffie-Helman Key Exchange system, Digital signature standards. Knapsack Crypto system, Zero-knowledge protocols. Elliptic curves and elliptic curve cryptosystems	9
4	**Cryptanalysis:** Primality testing- pseudo primes- the rho method. **Cryptanalysis methods**: linear, differential, higher order differential, quadratic. Factoring Algorithms- Trial Division, Dixon's Algorithm, Quadratic Sieve.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the principles of number theory and abstract algebra in cryptology.	**K3**
CO2	Design and analyze various symmetric ciphers	**K3**
CO3	Design and analyze various asymmetric ciphers	**K3**
CO4	Apply the mathematical techniques for the cryptanalysis of symmetric and asymmetric ciphers.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

	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**							**2**
CO4	**3**	**3**	**3**	**3**	**2**							**2**

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	A Course in Number Theory and Cryptography	Neal Koblitz:	Springer	2/e, 2012
2	Elementary Number Theory with Applications	Thomas Koshy	Elsevier India	2/e, 2007
3	Handbook of Applied Cryptography	Menezes, Paul C. V, Scott A. Vanstone	CRC Press	5/e, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Number Theory in Science and Communication	MR Schroeder	Springer	5th Edition, 2009
2	Cryptography: Theory and Practice	Douglas R. Stinson	Chapman and Hall/CRC	3rd Edition, 2006
3	Guide to Elliptic Curve Cryptography	Hankerson, D.J., Menezes, A., Vanstone, S.A.	Springer	2004
4	Advanced Engineering Mathematics	Merle C. Potter, David C. Wiggert	Wiley	10th Edition, 2012

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106105162
2	https://nptel.ac.in/courses/106105162
3	https://nptel.ac.in/courses/106105162
4	https://nptel.ac.in/courses/106105162

SEMESTER S7

DEEP LEARNING TECHNIQUES

Course Code	PEECT 745	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide foundational knowledge of advanced neural network architectures like CNNs, RNNs, and generative models, with practical insights into their training, optimization, and applications in transfer learning and sequence modeling.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Review of ANN: Perceptrons Convolutional Neural Networks: Convolution operation , CNN Architecture kernels, padding- Convolutional layers-, Pooling Layers, fully connected layers. Feature and weight visualization, t-SNE	7
2	Loss functions-Mean Squared Error, Cross Entropy Activation functions, Sigmoid Relu , Softmax Training CNNs:-Initialization Back-propagation Optimization algorithms:-SGD, Momentum, Adagrad, RMS Prop, Adam, Hyper parameter optimization-Learning rate Regularization methods: L1, L2 regularizaton dropout, Data Augmentation, Early stopping batch normalization Introduction to Transfer learning, feature extraction , fine tuning. Case study: CNN architectures*: AlexNet, VGG, ResNet,Google net *(Case study only for practical assignments/microprojects)	10
3	Sequence models, Recurrent Neural Networks (RNN): cell structure and architecture, Training RNN, back propagation through time. Vanishing	9

	and exploding gradients. Long Short-Term Memory (LSTM), architecture and training. Gated Recurrent Units (GRU), architectture and training.	
4	Introduction to Generative models: parameter estimation, Maximum Likelyhood Estimation Auto encoders, latent space variational auto encoders. GANs : adversarial training. Discriminator , Generator, up sampling, Transformer models, architecture Word embedding, position encoding , attention , training transformer models Large language models BERT,GPT (Detailed mathematical treatment not required for this module)	**10**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	**15**	**10**	**10**	**40**

Criteria for Evaluation (Evaluate and Analyse): 20 marks

Evaluation Methods:

1: Practical Experiments Using Design and Analysis Tools (10 marks)

Students will perform specific experiments using tools like TensorFlow, PyTorch, or Keras. Each experiment will focus on implementing and analyzing different types of neural network architectures and techniques.

2: Course Project (10 marks)

Comprehensive project involving design, implementation, and analysis of neural network models. Project phases: Proposal, Design, Implementation, Testing, Final Report, Presentation, and Viva Voce.

Sample Experiments:

Experiment 1: Building a Convolutional Neural Network (CNN)

- ***Objective****:* Design and train a CNN for image classification.
- ***Tools****:* TensorFlow/Keras or PyTorch.
- ***Steps****:*
  - Implement a CNN with convolutional layers, pooling layers, and fully connected layers.
  - Train the model on a dataset like CIFAR-10.
  - Analyze the model's performance using evaluation metrics like accuracy and loss curves.

Experiment 2: Visualizing Feature Maps and Weight Distributions

- ***Objective****:* Visualize the internal workings of a neural network.
- ***Tools****:* TensorFlow/Keras or PyTorch, Matplotlib.
- ***Steps:***
  - Train a CNN on a simple dataset.
  - Visualize the feature maps after each convolutional layer.
  - Use t-SNE for feature visualization and analyze the distribution of weights.

Experiment 3: Transfer Learning and Fine-Tuning

- ***Objective****:* Use a pre-trained model for a new task.
- ***Tools****:* TensorFlow/Keras or PyTorch.
- ***Steps:***
  - Use a pre-trained model like VGG or ResNet.
  - Fine-tune the model on a new dataset.
  - Analyze the performance improvement compared to training from scratch.

Experiment 4: Exploring Recurrent Neural Networks

- ***Objective****:*Implement an RNN to predict time-series data(eg. Word prediction).
- ***Tools****:* TensorFlow/Keras or PyTorch.

- ***Steps:***
  - Build an RNN model with LSTM or GRU cells..
  - Train the model on a time-series dataset
  - Visualize and interpret the model's predictions.

Sample Project Topics:

1. Designing a Real-Time Object Detection System Using YOLO
2. Development of a Neural Network for Sentiment Analysis on Social Media
3. Implementing a GAN for Image-to-Image Translation
4. Building a Speech Recognition System Using RNNs and LSTMs
5. Creating a Transfer Learning Model for Medical Image Classification

Criteria for Evaluation: Lab Experiments (10 marks)

Understanding of Concepts (3 marks)

- Demonstrates a thorough understanding of the theoretical concepts related to the experiments.
- Correctly explains the purpose and expected outcomes.

Implementation and Accuracy (3 marks)

- Correctly implements the neural network models using appropriate tools.
- Ensures the design functions as expected with minimal errors.

Analysis and Problem-Solving (2 marks)

- Effectively analyzes the model performance and identifies issues.
- Demonstrates problem-solving skills in addressing challenges encountered during experiments.

Documentation and Reporting (1 mark)

- Provides detailed documentation of the experimental setup, process, and outcomes.
- Includes visualizations, code snippets, and analysis of results.

Presentation and Communication (1 mark)

- Clearly presents the experiments and their results.
- Able to answer questions and explain design choices.

Course Project (10 marks)

Project Proposal and Planning (2 marks)

- Submits a well-defined project proposal outlining objectives, methodology, and expected outcomes.
- Demonstrates thorough planning and a clear timeline for the project.

Design and Implementation (3 marks)

- Implements the project design accurately using appropriate tools and techniques.
- The design is functional and meets the project objectives.

Innovation and Creativity (2 marks)

- Introduces innovative ideas or unique approaches in the design and implementation.
- Demonstrates creativity in solving problems or optimizing designs.

Analysis and Testing (2 marks)

- Effectively analyzes the project design to identify and address any issues.
- Conducts thorough testing to verify the functionality and performance of the model.

Final Report and Presentation (1 mark)

- Submits a comprehensive final report detailing the project, including objectives, design, methodology, analysis, and results.
- Clearly presents the project and its outcomes, and effectively communicates the key points.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Analyze and differentiate between various neural network components.	**K3**
CO2	Develop and implement strategies for training neural networks	**K4**
CO3	Apply and Integrate Sequence and Generative Models	**K3**
CO4	Evaluate the effectiveness of transformer models, including BERT and GPT, and assess the impact of transfer learning techniquess	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Learning Deep Learning	Magnus Ekman	Addison -Wesley	2022
2	Hands-on Machine learning with Sc-kit Learn Keras and Tensorflow	Aurelien Geron	Oreilly	Second edition 2019
3	Dive deep into machine learning	Astan Zhang and Zachary and Alexander semola	Cambridge university press https://d2l.ai/	2019
4	Neural Networks for deep learning	Michael Nielsen	http://neuralnetworksanddeeplearning.com/	2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Deep Learning.	Ian Goodfellow. Yoshua Bengio and Aaron Courville.	MIT Press	2016.
2	Neural Networks and Deep Learning: A Textbook..	Charu C. Aggarwal.	Springer	. 2019
3	Generative Deep Learning	David Foster	OReilly	2022
4	Build a Large Language Model	Sebastian Raschka	Manning	2023
5	Deep Learning with Python second Edition	Francois chollet	Manning	2021

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.cse.iitm.ac.in/~miteshk/CS6910.html
2	https://cs231n.github.io/
3	https://wiki.pathmind.com/lstm http://colah.github.io/posts/2015-08-Understanding-LSTMs/
4	https://jalammar.github.io/illustrated-transformer/ Jay Almar

SEMESTER S7

SATELLITE AND RADAR COMMUNICATION

Course Code	PCECT751	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To analyze operational principles of satellite communication systems
2. To apply radar techniques to detect and track targets

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Satellite orbit and orbital equations, Kepler‟s laws of planetary motion, locating satellite in the orbit, locating satellite with respect to earth, Look angle calculation, coverage angle and slant range, orbital perturbations, satellite launching, orbital effects in communication subsystem performance. Satellite subsystems, Attitude and orbit control system, Telemetry tracking command and monitoring, power system, communication subsystem, satellite antennas.	9
2	Satellite link design- Basic link analysis, Interference analysis, terrestrial interference, Intermodulation interference, inter-symbol interference and rain induced attenuation, uplink power control, system availability, system design for link without frequency reuse and system design for link with frequency reuse.	9
3	Basics of Radar: Introduction, Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation	9

4	CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Applications of CW radar. FM-CW Radar: FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar. MTI and Pulse Doppler Radar: Introduction, Principle. MTI versus Pulse Doppler Radar. Tracking Radar: various techniques of Tracking with Radar	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the principles of satellite communication	**K2**
CO2	Design and analysis of satellite link	**K3**
CO3	Illustrate Radar Fundamentals like Radar Equation and Applications.	**K2**
CO4	Compare various types of Radars and tracking techniques	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Satellite Communications	Timothy Pratt, Jeremy Allnutt	Wiley	3rd Edition, 2021
2	Introduction to Radar Systems	Merrill I. Skolnik	Tata McGraw-Hill	2nd Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Satellite Communications	Tri, T.Ha,	McGraw-Hill Education	2nd Edition, 2017
2	Satellite Communications Systems Engineering	Pritchard,	Pearson Education	2nd Edition, 2006
3	Radar: Principles, Technology, Applications	Byron Edde	Pearson	1st Edition, 2004
4	Understanding Radar Systems	Simon Kinsley and Shaun Quegan	John Wiley& Sons	1st Edition 1999

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/105/117105131/
2	Same as above
3	https://archive.nptel.ac.in/courses/108/105/108105154/
4	Same as above

SEMESTER S7

INTERNET OF THINGS

Course Code	PEECT 752	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. This course aims to introduce IoT fundamentals.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to IoT technology:** Definitions of IoT, Characteristics of IoT devices – power, computational constraints, IoT Architectural view – Middleware based architecture, Service oriented architecture, M2M Communication and IoT, Typical application areas of IoT technology (case studies of at least four domains) - Energy management and Smart grid, IoT for Home, Cities, Environment monitoring, Agriculture, Supply chain and customer monitoring	9
2	**Components of IoT technology:** Identification/Addressing - Electronic Product Codes, RFID, ubiquitous code, IPv4, IPv6. Sensors and Actuators*. IoT Hardware**, IoT Software – overview of Operating systems, Firmware, Middle ware, Application software used in IoT. Connectivity for IoT devices – characteristics.	9
3	**Communication technologies for IoT :** Zigbee - key features, architecture, limitations, Bluetooth technology - bluetooth stack, piconet, scatternet, limitations, Bluetooth Low Energy (key features, architecture, limitations), Wifi (IEEE 802.11) technology – key features, limitations, Cellular technology – GSM, 3G, 4GLTE (overview), features, limitations, LoRa	9

	technology – features, LoRaWAN architecture, 6LoWPAN – features, protocol stack, Narrow Band (NB- IoT) – features, applications, Sigfox – features, applications	
4	**IoT Data Management :** Storage technologies for IoT hardware – Volatile, Non-volatile, Embedded (MTP/OTP), external flash (NAND/NOR), DRAM, eflash, UFS, eMMC (overview of technologies). Cloud and IoT, Cloud computing – architecture, advantages of cloud computing, Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS). Case study of commercial cloud computing platforms like - Microsoft Azure IoT Suite, Google Cloud's IoT Platform, IBM Watson IoT Platform. IoT analytics	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain in a concise manner the architecture of IoT	**K2**
CO2	Identify various hardware and software components used in IoT	**K3**
CO3	Describe the various communication technologies and interfaces in IoT	**K2**
CO4	Describe the usage of modern technologies like cloud computing for data management in IoT	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Internet of Things : Architecture and Design Principles"	Rajkamal	McGraw Hill (India) Private Limited.	2nd edition,2022
2	"Internet of Things (A Hands-on- Approach)"	Vijay Madisetti and Arshdeep Bahga	Orient Blackswan Private Limited - New Delhi	1st Edition,2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	. Internet of things: A survey on enabling technologies, protocols, and applications	Al-Fuqaha	IEEE Communications Surveys & Tutorials	2015
2	The Internet of Things	Samuel Greengard	The MIT Press Essential Knowledge series Paperback	March 20, 2015
3	The Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems	Ovidu Vermesan and Peter Friess	River Publishers	1st Edition, 2013
4	. Internet of Things - From Research and Innovation to Market Deployment	Peter Friess, Ovidiu Vermesan	River Publishers	1st Edition,2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/WUYAjxnwjU4?si=s58W-NKMrEQMaJ8m https://youtu.be/BXDxYh1EV2w?si=8oFtQB9vycC_c-t2
2	https://youtu.be/z3VEZPwl5gA?si=tNuzG_By-KBU3ks_ https://youtu.be/SXz0XR68dwE?si=1tVN1g9FQcGp87li https://youtu.be/TvzgzO6xKrY?si=gYzJstW51MTNsgKj
3	https://youtu.be/qko-f1VDhCM?si=0tWM_OHS395ESV_w https://youtu.be/d9QfVpCG00Y?si=qeHk8tPg_torr2yX https://youtu.be/1zQ8wbBozqI?si=7vOSHMt8OT3nQINO
4	https://youtube.com/playlist?list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE&si=rr5Fpuew5q9_Y4qg

SEMESTER S7

REAL TIME OPERATING SYSTEM

Course Code	PEECT 753	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. Introduce Real Time Operating Systems, its basic structure, building blocks and various operations
2. Summarize the different scheduling algorithms used in RTOS.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Real-Time Systems** **Overview of Real-Time Systems:** Definition and types of real-time systems, Hard vs. soft real-time systems. **Basic Concepts:** Real-time tasks and their characteristics, Task scheduling, Timing constraints and requirements. **RTOS Architectures:** Monolithic kernels vs. microkernels. **RTOS examples:** commercial vs Open RTOS and their comparison, examples. **Inter-Process Communication (IPC):** Shared memory, Message passing. **RTOS Environment Setup:** Installation and setup of an RTOS on a microcontroller (e.g., ARM Cortex-M), **Task Creation and Management:** Writing simple tasks, Task states and transitions, **Scheduling and Context Switching:** Implementing basic scheduling algorithms, Demonstrating context switching with example tasks	**9**
2	**Real-Time Scheduling and Synchronization** **Real-Time Scheduling Algorithms:** Fixed-priority scheduling (Rate-	**9**

	Monotonic, Deadline-Monotonic), Dynamic priority scheduling (Earliest Deadline First), Priority based preemption, Round Robin, **Task Synchronization:** Mutual exclusion, Priority inversion and inheritance **Inter-Task Communication:** Semaphores, Mutexes, Event flags **Implementing Scheduling Algorithms:** Practical implementation of scheduling, **Synchronization Mechanisms:** Practical implementation of semaphores and mutexes in task synchronization, Demonstrating priority inversion and its mitigation: **Real-Time Task Communication:** Implementing inter-task communication using queues and mailboxes	
3	**Real-Time System Design and Analysis** **System Design Principles:** Modular design, Time-triggered vs. event-triggered systems, **Worst-Case Execution Time (WCET) Analysis:** Techniques for WCET estimation, Timing analysis, **Reliability and Fault Tolerance:** Redundancy, Error detection and recovery. **Designing a Real-Time System:** Case study: Designing a real-time control system, **WCET Analysis Tools:** Using tools for WCET analysis and timing verification, **Implementing Fault Tolerance:** Practical implementation of redundancy and error recovery mechanism	**9**
4	**Real-Time Operating System Services and Applications** **Real-Time Operating System Services:** Memory management, I/O management. **Real-Time Middleware:** Middleware services for real-time systems, **Case Studies and Applications:** Automotive systems, Aerospace and defense, Medical devices **Memory Management in RTOS:** Implementing dynamic memory allocation, **Real-Time Middleware Implementation:** Developing middleware components for a real-time application **Case Study Implementation:** Implementing a real-time system for a specific application (e.g., real-time data acquisition)	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamental concepts and characteristics of real-time systems.	**K1, K2**
CO2	Analyze and implement real-time scheduling algorithms and techniques.	**K4**
CO3	Conduct worst-case execution time (WCET) analysis for real-time tasks.	**K3, K4**
CO4	Utilize RTOS services and middleware for developing real-time applications	**K3,K4**
CO5	Develop practical real-time applications in various domains such as automotive, aerospace, and medical devices.	**K3, K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Real-Time Operating Systems Book 1: The Theory	Jim Cooling	CreateSpace Independent Publishing Platform	1st 2018
2	Real-Time Systems: Theory and Practice	Rajib Mall	Pearson Education	2007
3	Real-Time Systems: Design Principles for Distributed Embedded Applications	Hermann Kopetz	Springer	2nd 2011
4	Embedded Systems: Real-Time Operating Systems for Arm Cortex-M Microcontrollers	Jonathan W. Valvano	CreateSpace Independent Publishing Platform	3rd, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Real-Time Systems	C. M. Krishna, Kang G. Shin,	McGraw-Hill	2010
2	Real-Time Systems	Jane W. S. Liu	Pearson Education	2009
3	Real-Time Systems Design and Analysis	Philip A. Laplante, Seppo J. Ovaska,	Wiley	2012
4	Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C	Yifeng Zhu	E-Man Press LLC	3rd , 2017

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://elearn.nptel.ac.in/shop/iit-workshops/completed/lab-workshop-on-embedded-rtos/?v=c86ee0d9d7ed https://onlinecourses.nptel.ac.in/noc21_cs98/preview
2	https://elearn.nptel.ac.in/shop/iit-workshops/completed/lab-workshop-on-embedded-rtos/?v=c86ee0d9d7ed
3	https://elearn.nptel.ac.in/shop/nptel/real-time-operating-system/?v=c86ee0d9d7ed https://onlinecourses.nptel.ac.in/noc21_cs98/preview
4	https://elearn.nptel.ac.in/shop/iit-workshops/completed/lab-workshop-on-embedded-rtos/?v=c86ee0d9d7ed

SEMESTER S7

MIXED SIGNAL CIRCUITS

Course Code	PEECT754	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To gain knowledge about analysis and design of various analog and digital CMOS circuits

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**CMOS Amplifiers** **MOS small signal model:** **CMOS Amplifiers**: Common source amplifier with resistive and active loads, Common source amplifier with source degeneration, Common gate and Common drain amplifier (only voltage gain and input and output impedances of the circuits). **Cascode Amplifier:** Cascoded amplifier with cascade loads Folded cascode Amplifier.	9
2	**CMOS Differential Amplifiers** **MOS Current Mirror:** Basic circuit, PMOS and NMOS current mirrors Simple and Cascode current mirror circuits. **CMOS Differential Amplifier:** Differential Amplifier with resistive, current source and current mirror loads, MOS telescopic cascode amplifier (only voltage gain and input and output impedance of the circuits)	9
3	**CMOS Operational Amplifier** **Two Stage Operational Amplifiers** Frequency compensation of OPAMPS Miller compensation. **Band gap References-** Supply Independent Biasing, Temperature independent references –band gap reference	9

4	**Data Converters:** DAC specifications, ADC specifications **DAC Architecture -** Resistor String, R-2R Ladder Networks, Current Steering, Charge Scaling, cyclic and Pipeline types. **ADC Architecture-** Flash type, The Successive approximation type and oversampling ADCs.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain various Single stage Amplifiers with different types of loads	**K2**
CO2	Explain Differential Amplifiers & Current Mirrors	**K2**
CO3	Apply the knowledge of amplifiers in the design of two stage OPAMP	**K3**
CO4	Illustrate the concept of frequency compensation in OPAMP	**K2**
CO5	Describe the specifications and architectures of data converter circuits	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Design of Analog CMOS Integrated Circuits	Behzad Razavi	McGraw-Hill	2/e, 2002
2	CMOS: Circuits Design, Layout and Simulation,	Baker, Li, Boyce,	Prentice Hall India,	2000
3	Microelectronic Circuits	Sedra & Smith	Oxford University Press	6/e,2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	CMOS Analog Circuit Design,	Phillip E. Allen, Douglas R. Holbery	Oxford University Press	3/e
2	Fundamentals of Microelectronics	Behzad Razavi	Wiley student Edition	2014
3	Analysis and Design of Analog Integrated Circuits	Meyer Gray , Hurst, Lewis	Wiley	5/e, 2009

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
2	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
3	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
4	Switching Circuits and Logic Design by Prof. Indranil Sengupta Lectures 47-51

SEMESTER S7

SPEECH AND AUDIO PROCESSING

Course Code	PEECT 756	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To impart the basic concepts of speech signal processing
2. To familiarize the auditory mechanism and speech perception

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Speech Production: - Acoustic theory of speech production- -Source/Filter model - Pitch, Formant, Spectrogram-- Discrete model for speech production, Articulatory Phonetics -Acoustic Phonetics- Basic speech units and their classification.	9
2	Short-Time Speech Analysis, Windowing, STFT, spectra of windows- Wide and narrow band spectrogram -Time domain parameters (Short time energy, short time zero crossing Rate, ACF). Frequency domain parameters-Filter bank analysis. STFT Analysis. Prosody of speech. MFCC-computation, LPC Model, Pitch and Formant Estimation.	9
3	Speech Enhancement: Spectral subtraction and Filtering, Harmonic filtering, parametric resynthesis. Speaker Recognition: Speaker verification and speaker identification- log-likelihood. Machine learning models in Speaker Recognition. Language identification: implicit and explicit models.	9
4	Signal Processing models of audio perception: Basic anatomy of hearing System: Basilar membrane behaviour. Sound perception: Auditory Filter Banks, Critical Band Structure, Absolute Threshold of Hearing, Masking-Simultaneous Masking, Temporal Masking. Models of speech perception	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To describe the fundamental concepts, principles, and theories of speech production	**K1**
CO2	To analyse the speech signal in the time and frequency domain	**K2**
CO3	To apply speech processing concepts in real-world applications	**K3**
CO4	To describe the fundamental concepts, principles, and theories of hearing mechanism	**K1**
CO5	To develop applications by combining concepts of speech production and hearing mechanism	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Speech Communications: Human and Machine, 2nd Edition	Douglas O'Shaughnessy	Wiley-IEEE Press	2nd edition
2	Discrete-Time Speech Signal Processing: Principles and Practice	Thomas F. Quatieri	Prentice-Hall Signal Processing Series	2001

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Processing of Speech Signals	Rabinar	Pearson	2003

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Speech and Audio Processing 1: Introduction to Speech Processing - Professor E. Ambikairajah https://www.youtube.com/watch?v=Xjzm7S__kBU
2	Speech Analysis - Professor E. Ambikairajah https://www.youtube.com/watch?v=Y_mSQ7tTlvQ&t=38s
3	Speech and Audio Processing 1: Introduction to Speech Processing - Professor E. Ambikairajah https://www.youtube.com/watch?v=Xjzm7S__kBU
4	Video Links available on hearing anatomy

SEMESTER S7

MICROWAVE DEVICES & CIRCUITS

Course Code	PEECT 757	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Microwave & Antennas (Course code)	Course Type	Theory

Course Objectives:

1. To understand the principles of active and passive microwave semiconductor devices, components, microwave sources and amplifiers used in microwave communication systems, analysis of microwave networks and microwave integrated circuits.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Limitation of conventional solid state devices at Microwave. Microwave generation and amplification. Structure, Operation, Power output and efficiency of IMPATT and TRAPATT diodes Bipolar transistors – biasing, FET – biasing, MESFET – Structure, Operation. Microwave amplifiers and oscillators – Amplifiers – Gain and stability, Single stage transistor amplifier design. Oscillator design – One port negative resistance oscillators.	9
2	Microwave Network Analysis – Equivalent voltages and currents, Impedance and Admittance matrices, Scattering matrix, The transmission matrix. Signal flow graphs. Impedance matching and tuning – Matching with lumped elements, Single stub tuning, Double stub tuning. Quarter wave transformer, Theory of small reflections.	9
3	Microwave filters – Periodic structures – Analysis of infinite periodic structures and terminated periodic structures	9

	Filter design by image parameter method – Constant k, m-derived and composite. Filter design by insertion loss method. Filter transformation and implementation	
4	Introduction to MICSs:-Technology of hybrid MICs, monolithic MICs. Comparison of both MICs. Planar transmission lines such as strip line, microstripline, and slot line. Distributed and lumped elements of integrated circuits -capacitors, inductors, resistors, terminations, attenuators, resonators and discontinuities.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the basic principles of Microwave solid state diodes, transistors, generators and amplifiers.	**K2**
CO2	Analyse Microwave Networks using signal flow graphs	**K3**
CO3	Design microwave filters by different methods	**K3**
CO4	Illustrate the basic concepts of Monolithic Integrated Circuits	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Microwave Engineering,,	David M. Pozar,	Wiley India	4/e,2012.
2	, Foundation of Microwave Engineering,,	Robert E. Collin	Wiley India,	2/e,2012.
3	Microwave Devices & Circuits	Samuel Y. Liao,	Pearson	3/e
4	Microwave Integrated Circuits	Yoshihiro Konishi	Taylor & Francis	

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Stripline-like Transmission Lines for MIC	Bharathi Bhat and Shiban K. Koul	New Age International (P) Ltd	2007
2	., Microwave Integrated Circuits,,	I. Kneppo, J. Fabian, et al	BSP, India	2006.
3	Passive RF and Microwave Integrated Circuits	Leo Maloratsky,	Elsevier,	2006

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_ee34/preview
2	https://archive.nptel.ac.in/courses/108/101/108101112/
3	https://archive.nptel.ac.in/courses/117/105/117105138/
4	https://onlinecourses.nptel.ac.in/noc21_ee34/preview

SEMESTER S 7

MIXED SIGNAL CIRCUIT DESIGN

Course Code	PEECT755	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Solid State Devices, Network Theory	Course Type	Theory

Course Objectives:

1. To gain indepth knowledge about analysis and design of various analog and digital CMOS circuits

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**CMOS Amplifiers** **MOS small signal model:** **CMOS Amplifiers**: Common source amplifier with resistive and active loads, Common source amplifier with source degeneration, Common gate and Common drain amplifier (only voltage gain and input and output impedances of the circuits). **Cascode Amplifier:** Cascoded amplifier with cascade loads Folded cascode Amplifier.	9
2	**CMOS Differential Amplifiers** **MOS Current Mirror:** Basic circuit, PMOS and NMOS current mirrors Simple and Cascode current mirror circuits. **CMOS Differential Amplifier:** Differential Amplifier with resistive, current source and current mirror loads, MOS telescopic cascode amplifier (only voltage gain and input and output impedance of the circuits)	9
3	**CMOS Operational Amplifier Two Stage Operational Amplifiers** Frequency compensation of OPAMPS Miller compensation. **Band gap References-** Supply Independent Biasing, Temperature independent references –band gap reference	9

4	**Data Converters:** DAC specifications, ADC specifications **DAC Architecture -** Resistor String, R-2R Ladder Networks, Current Steering, Charge Scaling, cyclic and Pipeline types. **ADC Architecture-** Flash type, The Successive approximation type and oversampling ADCs.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	**15**	**10**	**10**	**40**

Criteria for Evaluation (Evaluate and Analyse): 20 marks

Criteria for Evaluation (Evaluate and Analyse): 20 marks
Evaluation Methods:

1. Experiments Using Design and Analysis Tools: (10 marks)

Students can perform specific experiments using tools QUCS, KiCad or PSPICE or LT Spice or CADENCE etc.
Each experiment can focus on designing and simulating different types of circuits

2. Course Project:
Comprehensive project involving design, modeling, and analysis of a Mixed Signal Circuit. (10 marks)
Project phases: Proposal, Design, Implementation, Testing, Final Report.Presentations and Viva Voce:
Students present their projects and experiments, explaining design choices, methodologies, and results.
Viva voce to assess understanding and ability to answer related questions.

The following topics may be identified for Assignments/ Miniproject

1. Simulation of a MOSFET Amplifier Circuits
2. Simulation of a Differential Amplifier Circuits
3. Design and Simulation of OPAMP
4. Design and Simulation of ADCs, DACs

Criteria for Evaluation: Experiments (10 marks)

1. Understanding of Concepts (3 marks)
    a. Demonstrates a clear understanding of the theoretical concepts related to the experiment.
    b. Correctly explains the purpose and expected outcomes of the experiment.
2. Implementation and Accuracy (3 marks)
    a. Correctly implements the design using appropriate tools.
    b. The design functions as expected without errors.
3. Analysis and Problem-Solving (2 marks)
    a. Effectively analyse the design to identify and resolve issues.
    b. Demonstrates problem-solving skills in addressing any encountered challenges.
4. Documentation and Reporting (1 mark)
    a. Provides clear and concise documentation of the steps and processes followed.
    b. The report includes diagrams, code snippets, and simulation results.
5. Presentation and Communication (1 mark)
    a. Clearly presents the experiment and its results.
    b. Able to answer questions and explain the design choices.

Criteria for Evaluation: Course Project (10 marks)

1. Project Proposal and Planning (2 marks)
    a. Submits a well-defined project proposal outlining objectives, methodology, and expected outcomes.
    b. Demonstrates thorough planning and a clear timeline for the project.
2. Design and Implementation (3 marks)
    a. Implements the project design accurately using appropriate tools and

techniques.

b. The design is functional and meets the project objectives.

3. Innovation and Creativity (2 marks)

a. Introduces innovative ideas or unique approaches in the design and implementation.

b. Demonstrates creativity in solving problems or optimizing designs.

4. Analysis and Testing (2 marks)

a. Effectively analyzes the project design to identify and address any issues.

b. Conducts thorough testing to verify the functionality and performance of the design.

5. Final Report and Presentation (1 mark)

a. Submits a comprehensive final report detailing the project, including objectives, design, methodology, analysis, and results.

b. Clearly presents the project and its outcomes, and effectively communicates the key points.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyze the effect of different types of loads on the performance of various MOS Amplifiers	**K4**
CO2	Apply the knowledge of amplifiers in the design of two stage OPAMP	**K3**
CO3	Demonstrate the concept of frequency compensation in OPAMP	**K3**
CO4	Implement various types of data converter circuits	**K3**
CO5	Design and Implement amplifiers, OPAMPs, ADCs, DACs etc. with given specifications	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Design of Analog CMOS Integrated Circuits	Behzad Razavi	McGraw-Hill	2/e, 2002
2	CMOS: Circuits Design, Layout and Simulation,	Baker, Li, Boyce,	Prentice Hall India,	2000
3	Microelectronic Circuits	Sedra & Smith	Oxford University Press	6/e,2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	CMOS Analog Circuit Design,	Phillip E. Allen, Douglas R. Holbery	Oxford University Press	3/e
2	Fundamentals of Microelectronics	Behzad Razavi	Wiley student Edition	2014
3	Analysis and Design of Analog Integrated Circuits	Meyer Gray , Hurst, Lewis	Wiley	5/e, 2009

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
2	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
3	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
4	Switching Circuits and Logic Design by Prof. Indranil Sengupta Lectures 47-51

SEMESTER S7

OPTICAL COMMUNICATION

Course Code	OEECT721	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PHYSICS	Course Type	Theory

Course Objectives:

1. To introduce the concepts of light transmission through optical fibers
2. To introduce the working of optical components and its usage in optical communication systems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Optical fiber Communications:** Structure of Optical fiber**,** materials, General block diagram of optical communication system, Advantages. **Optical fiber waveguides:** Principle of light guidance, Numerical Aperture, V number, Step and Graded index fibers, Single and Multi mode fibers. **Transmission Characteristics:** Attenuation, Absorption losses, Linear and Non linear scattering losses, bend losses. Dispersion- Intermodal dispersion, Chromatic dispersion, Dispersion modified fibers, Photonic crystal fibers, Polarization mode dispersion, Nonlinear effects, Solitons.	**9**
2	**Optical fibers and Cables** – Fabrication Techniques- Double crucible method, Outside Vapour phase oxidation, Modified Chemical Vapour Deposition. Optical Fiber Cables- Single and Multi fiber cables. **Optical Fiber Connections:** splices, connectors & couplers. **Optical Fiber Measurements:-** Attenuation and dispersion measurements**,** MZ interferometer, Optical Time Domain Reflectometer – Applications	**9**
3	**Optical sources:** LEDs and LDs, general structures, characteristics**,** modulators using LEDs and LDs. coupling with fibres, **Optical detectors:** Quantum efficiency and Responsivity, Structure and working of PIN and APD **Optical Receivers: -** Direct detection- noise in detectors, SNR, BER	**9**

	analysis Coherent detection principles. **Optical Amplifiers:** EDFA - Principle, structure and working, Raman amplifiers	
4	**Multiplexing Strategies:** OTDM, SCM, OFDM, WDM and Optical CDMA: concepts, components - couplers, splitters, Add/ Drop multiplexers, Fiber grating filters, tunable filters. **Optical networks** – General description of SONET/SDH **Free space optics:** Principle of LiFi technology. Visible Light Communication **Other applications of optical fibers**: Entertainment, Sensors – Types & principles	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the structure, fabrication, principle of operation and classifications of optical fibers	**K2**
CO2	Describe the transmission characteristics and evaluate losses in optical fiber	**K2**
CO3	Explain the working of sources, detectors and optical amplifiers used in optical communication system	**K2**
CO4	Describe the concepts of Multiplexing, Optical Networks and Free Space Communication	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Optical Fiber Communications	Gerd Keiser	McGraw Hill	5th/e, 2021
2	Optical Fiber Communication: Principles and Practice	John M Senior	Pearson Education	3rd/e, 2014
3	Fibre Optic Communications	Joseph C. Palais	Pearson Education	5th/e, 2013
4	Fibre optic Communication: Systems and Components	Mishra and Ugale,	Wiley	2019
5	Fibre Optic Communications Systems	G P Agrawal	WILEY	4th Ed

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fibre Optic Communication: Optical Waveguides, Devices and Applications	Sanjeev Kumar Raghuwanshi	University Press	2015
2	Optical Communication	M Mukunda Rao	University Press	2000

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=ougKUUM3hJA
2	https://www.digimat.in/nptel/courses/video/117104127/L01.html
3	https://www.youtube.com/watch?v=seHmi6AMWy4
4	https://www.youtube.com/watch?v=4W7hieXDAmc

SEMESTER S7

DIGITAL IMAGE PROCESSING

Course Code	OEECT 722	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To introduce the fundamental concepts of Digital Image Processing and study the various transforms required for image processing.
2. To study spatial and frequency domain image enhancement and image restoration methods.
3. To understand image compression and segmentation techniques.,

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Digital Image Fundamentals: Image representation, Types of images, Elements of DIP system, Basic relationship between pixels, Distance Measures, Simple image formation model. Brightness, contrast, hue, saturation, Mach band effect. Colour image fundamentals-RGB, CMY, HIS models, 2D sampling and quantization.	9
2	2D Image transforms: DFT, Properties, Walsh transform, Hadamard transform, Haar transform, DCT, KL transform and Singular Value Decomposition. Image Compression: Image compression model, Lossy, lossless compression, Concept of transform coding, JPEG Image compression standard.	9
3	Image Enhancement: Spatial domain methods: Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing spatial Filters, Sharpening spatial Filters. Frequency domain methods: low pass filtering, high pass filtering, homomorphic filtering.	9

4	Image Restoration: Degradation model, Inverse filtering- removal of blur caused by uniform linear motion, Minimum Mean Square Error (Wiener) Filtering. Image segmentation: Region based approach, clustering , Segmentation based on thresholding, edge based segmentation, Hough Transform.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain different components of image processing system	**K2**
CO2	Analyse the various concepts and mathematical transforms necessary for image processing	**K3**
CO3	Illustrate the various schemes of image compression	**K3**
CO4	Analyze the filtering and restoration of images	**K3**
CO5	Describe the basic image segmentation techniques	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Image Processing	Gonzalez Rafel C	PEARSON	4TH
2	Digital Image Processing	S Jayaraman, S Esakkirajan, T Veerakumar	McGraw Hill	Ist

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Image Processing	Kenneth R Castleman	Pearson Education	2/e,2003
2	Fundamentals of digital image processing	Anil K Jain	PHI	1988
3	Digital Image Processing	Pratt William K	John Wiley	4/e,2007

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_ee133/preview
2	https://nptel.ac.in/courses/117105135
3	https://www.youtube.com/watch?v=KiJo4-IijL4
4	https://archive.nptel.ac.in/courses/117/105/117105135/

SEMESTER S7

OPTIMIZATION TECHNIQUES

Course Code	**OEECT723**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	**Course Type**	Theory

Course Objectives:

1. Enable the learner to formulate engineering minima/maxima problems as optimization problems
2. Enable the learner to deploy various constrained and unconstrained optimization algorithms to obtain the minima/maxima of engineering problems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Engineering application of Optimization – Statement of an Optimization problem–Classification, Review of basic calculus concepts –Stationary points; Functions of single and two variables; Convexity and concavity of functions –Definition of Global and Local optima – Optimality criteria, Linear programming methods for optimum design – Standard form of linear programming (LP) problem; Canonical form of LP problem; Simplex Method, Duality, Application of LPP models in engineering	**9**
2	Optimization algorithms for solving unconstrained nonlinear optimization problems – Search based techniques: Direct search: Fibonacci and golden section search , Hookes and Jeeves , Gradient based method: Newton's method	**9**

3	Optimization algorithms for solving constrained optimization problems– direct methods – penalty function methods, barrier method -Optimization of function of multiple variables subject to equality constraints; Lagrangian function– Inequality constrained techniques-KKT conditions-constrained steepest descent method	**9**
4	Modern methods of Optimization– Metaheuristic techniques: Genetic Algorithms – Simulated Annealing – Particle Swarm optimization –Ant colony optimization– : Use of Matlab/Scilab to solve optimization problem	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Formulate an optimization problem to optimize an engineering application using the principles of basic calculus.	**K2**
CO2	Apply the Simplex method to solve a linear programming problem	**K3**
CO3	Solve the unconstrained optimization problems using gradient based method.	**K3**
CO4	Apply the various optimization techniques to solve a constrained optimization problem	**K3**
CO5	Use metaheuristic algorithms to solve constrained and unconstrained	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Optimization, Theory and Practice	S.S RAO	New Age International Publishers	4th Edition ,2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Optimization Techniques and Applications with Examples	Xin-She Yang	John Wiley & Sons	2018
2	Optimization for Engineering Design Algorithms and Examples	Deb K	Prentice Hall India	2000
3	Introduction to Optimization Design	Arora J	Elsevier Academic Press, New Delhi	2004
4	Linear Programming	Hardley G	Narosa Book Distributors Private Ltd	2002
5	Genetic Algorithms and engineering optimization	Mitsuo Gen, Runwei Cheng	John Wiley & Sons	2002
6	An introduction to optimization	Edwin KP Chong, Stanislaw, H Hak	John Wiley & Sons	Fourth Edition, 2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	NPTEL https://www.youtube.com/watch?v=a2QgdDk4Xjw
2	NPTEL https://www.youtube.com/watch?v=dPQKltPBLfc
3	NPTEL https://www.youtube.com/watch?v=qY-gKL7GxYk
4	NPTEL https://www.youtube.com/watch?v=Z_8MpZeMdD4 https://www.youtube.com/watch?v=FKBgCpJlX48

SEMESTER 8

ELECTRONICS & COMMUNICATION ENGINEERING

SEMESTER S8

WIRELESS SENSOR NETWORKS

Course Code	PEECT861	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. The course aims to expose students to computer networks taking a top-down approach of viewing from the layer of user applications and zooming into link layer protocols.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction, application, and challenges of wireless sensor networks (WSN). **Wireless LANS and PANS:** Introduction, Fundamentals of WLANs, IEEE 802.11 standard, HIPERLAN standard, Bluetooth**,** **Wireless WANs and MANs :** Cellular architecture, 2G/3G/4G/5G Cellular Networks, WLL**, IEEE 802.15 Standard:** Physical layer, Data link layer, MAC protocols **Wireless Internet**	**9**
2	Network architecture: Sensor network scenarios, Optimization goals and figures of merit, Design principles of WSNs, Service interfaces of WSNs. Communication Protocols: Physical layer: Wireless channel and communication fundamentals, Physical layer and transceiver design considerations in WSNs.	**9**

3	Mobile ad hoc networks and wireless sensor networks, Field buses and wireless sensor networks, Enabling technologies for wireless sensor networks. Mobile IP, TCP in wireless domain, TCP-BUS and Ad Hoc TCP, Split TCP, WAP, optimising Web over wireless.	**9**
4	WSN architecture: Single node architecture: Hardware components, Energy consumption of sensor nodes, Low power wireless sensor networks, Routing protocols-LEACH, PEGASIS and RPL, Operating systems and execution environments, Case Study: TinyOS and nesC 50 Other examples.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the principles of wireless networks concepts and their standards.	**K2**
CO2	Illustrate various concepts on the basics of wireless sensor networks and mobile adhoc networks.	**K2**
CO3	Develop single node wireless sensor architecture	**K3**
CO4	Analyse the network architecture and the communication protocols of wireless sensor networks	**K4**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Ad Hoc Wireless Networks: Architectures and Protocols	Siva Ram Murthy C. and Manoj B. S.	Pearson Education	2nd Edition, 2017
2	Protocols And Architectures for Wireless Sensor Networks	Holger Karl & Andreas Willig	John Wiley	2nd Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Wireless Communications and Networks	William Stallings	Prentice Hall	2nd Edition, 2017
2	Fundamentals of Wireless Sensor Networks - Theory and Practice	Waltenegus Dargie , Christian Poellabauer	John Wiley & Sons Publications	2nd Edition, 2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106105160
2	https://nptel.ac.in/courses/106105160
3	https://nptel.ac.in/courses/106105160
4	https://nptel.ac.in/courses/106105160

SEMESTER S8

RF ENGINEERING

Course Code	PEECT862	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Microwaves &Antennas	Course Type	Theory

Course Objectives:

1. To learn the analysis, design and simulation of Radio Frequency (RF) Circuits and Components for wireless communication systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	RF circuit introduction - Importance of radio frequency design, RF behaviour of resistors inductors and capacitors Planar Transmission Lines – Micro strip lines and Strip lines – Constructional Features Impedance Matching Networks-Design of Matching Circuits using Lumped Elements, Single Stub tuning, Quarter-Wave Transformers, Multi-Section Transformer – Binomial Transformer	9
2	RF Filter Design- Filter Design using insertion loss technique –Active RF components- Bipolar Junction Transistor – Construction-Functionality-Power Frequency Limitations of High Frequency transistors. GaAs devices - Familiarization of RF Field Effect Transistors and High Electron Mobility Transistors–Constructional details RF circuit measurements and characterization- Using Vector Network analyser – S parameter, Reflection Coefficient and Insertion Loss Measurement Modelling and Simulation of RF circuits using – Open source or Commercial EM Simulation Software	11
3	Amplifier design using S-parameters - Characteristics of Amplifier Power Relations, Stability Considerations – Stability Circles, Tests for	8

	Unconditional Stability High frequency amplifier design – Single stage amplifier Design – Design for maximum gain, Low noise amplifier design	
4	Basic oscillator model -Feedback oscillator design—Negative Resistance Oscillator- Dielectric Resonator Oscillator - YIG Tuned Oscillator Mixer - Basic characteristics – Single-Ended Mixer Design, Single-balanced and double-balanced mixers	**8**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basic idea about RF networks and working of RF filter circuits	**K2**
CO2	Describe the behaviour of RF components and application of Network analyser in parameter measurement	**K2**
CO3	Apply the principle of RF networks in the designing of RF amplifiers,	**K3**
CO4	Apply the principle of RF networks in the designing RF Oscillators and Mixers	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	RF Circuit Design: Theory & Applications	Ludwig, Reinhold	Pearson Education India	2/e., 2000.
2	Microwave and RF design of wireless systems	Pozar, David M.	John Wiley & Sons	2/e, 2011

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Advanced RF & microwave circuit design: the ultimate guide to superior design.	Radmanesh, Matthew M	Author House,	2/e, 2017
2	Secrets of RF circuit design	Carr, Joseph J.	McGraw-Hill Education.	2/e, 2001
3	Radio-frequency and microwave communication circuits: analysis and design.	Misra, Devendra K	John Wiley & Sons,	2/e, 2019
4	Radio Frequency & Microwave Electronics	Mathew M. Radmanesh	Pearson Education Asia,	2nd Edition, 2017
5	RF/microwave circuit design for wireless applications.	Rohde, Ulrich L., and David P. Newkirk	John Wiley & Sons,	2nd Edition, 2017
6	Radio frequency circuit design.	Davis, W. Alan, and Krishna Kumar Agarwal.	John Wiley,	2nd Edition, 2017
7	RF Circuit Design.	Christopher, Bowick, Ajluni Cheryl, and Blyler John.	Newnes,	2nd Edition, 2015
8	Design of RF and microwave amplifiers and oscillators.	Abrie, Pieter LD.	Artech House	2nd Edition, 2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc23_ee36/preview
2	https://archive.nptel.ac.in/courses/108/105/108105189/
3	https://archive.nptel.ac.in/courses/117/102/117102012/

SEMESTER S8

RENEWABLE ENERGY SYSTEMS

Course Code	PEECT 863	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To develop in-depth knowledge for the various renewable energy resources available at a location and assessments of its potential, using tools and techniques.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Renewable Energy (RE)Sources: World energy scenario, Over view of conventional energy sources, their limitation, need of renewable energy, potential & development of renewable energy sources, Renewable energy in India, An overview of types of renewable energy systems - Wind power, Hydropower (micro and mini), Solar energy, Biomass, Bio-fuel, Geothermal Heat energy, Pros and cons; Applications.	9
2	Solar Energy: Introduction to photovoltaic (PV) systems - Principle of PV conversion; Commercial solar cell, Thin film PV device fabrication - LPCVD, APCVD, PECVD; Tandem Solar cell fabrication; Solar power extraction using PV-Cells, I-V Characteristics, PV-Inverters without D.C. to D.C. converters, stand alone and grid collected PV systems, Grid interfacing-with isolation, without isolation, Maximum power point tracking-Methods(MPPT), PV-Inverters with D.C. to D.C. converters-on low frequency side and high frequency side with isolation, without isolation.	9
3	Wind Energy: Sources and potentials, of Wind Intensity, Topography, General Classification of Wind Turbines-Rotor Turbines, Multiple-Blade Turbines, Drag Turbines, Lifting Turbines, System Toroidal Rotor Amplifier Platform (TARP)–Wind amplified rotor platform (WARP), Generators and speed control used in wind power energy: Fixed speed with capacitor bank,	9

	Rotor resistance control, SCIG and DFIG, Synchronous Generator-external magnetized, Synchronous Generator-permanent magnets.	
4	Electronic conversion systems application to renewable energy generation systems: Basic schemes and functional advantages, Power control and management systems for grid integration, island detection systems, synchronizing with the grid; Issues in integration of converter based sources; Network voltage management; Power quality management and Frequency management; Influence of PV/WECS on system transient response. Introduction to grid connectivity of RE systems, smart grid and emerging technologies, operating principles and models of smart gird components.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the need, importance and scope of various Non-Conventional sources of energy	**K2**
CO2	Outline the concepts and technologies related to renewable energy systems using wind and Solar-PV	**K2**
CO3	Illustrate the integration of smart grid with renewable energy systems	**K3**
CO4	Explain the concept of distribution management system.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Solar Energy: Principles of Thermal Collection and Storage	Nayak J. K. and Sukhatme S. P.	Tata McGraw Hill	3/e. 2008
2	Power Electronics: Circuits, Devices and Applications	Muhannad H. R.	Pearson Prentice Hall	4/e, 2017
3	Smart Grid Technology and Applications	Nick Jenkins, Janaka Ekanayake [et al.]	Wiley India Ltd	1/e, 2015
4	Design of Smart Power Grid Renewable Energy Systems	Ali Keyhani	Wiley-IEEE Press	1/e, 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Handbook of renewable energy technology	Ahmed F Zobaa and Ramesh Bansal	World Scientific	1/e, 2011
2	Solar Energy: Fundamental and Application	Garg H. P. and Prakash S.	Tata McGraw Hill	2/e, 2015
3	The Smart Grid: Enabling Energy Efficiency and Demand Response	Gellings C. W.	CRC Press	1/e, 2009
4	Grid Converters for Photovoltaic and wind Power Systems,	Teodorescu R. Liserre M. Rodriguez P.	Wiley – IEEE press	1/e, 2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_ph33/preview
2	https://nptel.ac.in/courses/103103206
3	https://onlinecourses.nptel.ac.in/noc22_ch27/preview

SEMESTER S8

CYBER SECURITY

Course Code	PEECT864	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand the fundamental concepts of cybersecurity, including various types of cyber threats and attacks.
2. To learn and apply basic security measures, mechanisms, and best practices to protect systems and data from threats

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction**: **Security basics** – Aspects of network security – Attacks – Different types – Hackers – Crackers – Common intrusion techniques –Trojan Horse, Virus, Worm. **Security threats** - Sources of security threats- Motives - Target Assets and vulnerabilities – Consequences of threats- E-mail threats - Web-threats - Intruders and Hackers, Insider threats, Cybercrimes.	9
2	Security services and mechanisms, OS **Security** – Protection Mechanisms –Authentication & Access control – Discretionary and Mandatory access control **Firewall**- Need for firewall, Characteristics, Types of firewall, Firewall Basing, **Intrusion Detection System**- Types, Goals of IDS, IDS strengths and Limitations.	9

3	**Cryptography**: **Basic Encryption & Decryption** – Transposition & substitution ciphers – Caesar substitution – Polyalphabetic substitutions – Crypt analysis – **Symmetric key algorithms** – Feistel Networks – Confusion – Diffusion – DES Algorithm – Strength of DES – Comparison & important features of modern symmetric key algorithms – **Public key cryptosystems** – The RSA Algorithm – Diffie Hellman key exchange – comparison of RSA & DES – Message Authentication & Hash functions – Digital signature	**9**
4	**Introduction to Cyber Crime and law:** Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Comp. as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basics of network security, including different types of attacks, common intrusion techniques, and various security threats, including those posed by hackers, crackers, and cybercriminals.	**K2**
CO2	Identify and explain various security services and mechanisms, including OS security, authentication and access control, firewall types and characteristics, and intrusion detection systems	**K2**
CO3	Describe cryptography principles, including encryption, ciphers, symmetric and public key algorithms, RSA, Diffie Hellman, authentication, hash functions, and digital signatures.	**K2**
CO4	Illustrate cybercrime and related laws, including types, attack vectors, incident response, digital forensics, and the Indian IT Act 2000.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Network Security	Joseph M Kizza	Springer Verlag	2/e, 2013
2	Cryptography and Network Security Principles and Practice	William Stallings	Pearson Education Asia	10/e, 2022
3	Network Security Essentials	William Stallings	Pearson Education	6/e, 2022
4	Fundamentals of Network Security	Eric Maiwald	Tata McGraw-Hill	2/e, 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Anti-Hacker Tool Kit	Mike Shema	Mc Graw Hill	4/e, 2018
2	Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	Nina Godbole and Sunit Belpure	Wiley	2/e, 2019
2	Mark Stamp's Information Security Principles and Practice	Deven N. Shah	Wiley	4/e, 2021

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Introduction to Cyber Security, by Dr. Jeetendra Pande, Uttarakhand Open University, Haldwani:-https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
2	Firewalls and Intrusion Detection Systems on Computer - Cryptography and Network Security by Prof. D. Mukhopadhyay, Department of Computer Science and Engineering, IIT Kharagpur
3	Cryptography and Network Security, by Prof. Sourav Mukhopadhyay, IIT Kharagpur:- https://onlinecourses.nptel.ac.in/noc22_cs90/preview
4	https://www.meity.gov.in/writereaddata/files/itbill2000.pdf https://www.meity.gov.in/writereaddata/files/it_amendment_act2008%20%281%29_0.pdf

SEMESTER S8

LOW POWER VLSI

Course Code	PEECT866	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To impart knowledge on different sources of power dissipation, power minimization techniques, switched capacitance minimization and working principle of adiabatic logic circuits

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Physics of Power dissipation in MOSFET devices** Need for low power circuit design, MIS Structure **Deep submicron transistor design issues: Short channel effects** Channel Length Modulation , Surface scattering, Punch through, Velocity saturation, Impact ionization, Hot electron effects, Body Effect, Narrow width effect, V_{th} roll-off, Drain Induced Barrier Lowering, Gate Induced drain leakage, Tunneling Through Gate Oxide, Subthreshold Leakage Current, **Emerging Technologies for Low Power:** Hi-K Gate Dielectric, Lightly Doped Drain–Source, Silicon on Insulator,	9
2	**Sources of power dissipation in digital ICs** – **Dynamic Power Dissipation:** Short Circuit Power: Short Circuit Current of Inverter , Short circuit current dependency on input rise and fall time, Variation of shortcircuit current with load capacitance. Switching power dissipation: Switching Power of CMOS Inverter, Switching activity and its effects. Glitching Power: Glitches and its effect on power dissipation	9

	Static Power Dissipation: Sources of Leakage Power, Effects of V_{dd} and V_t on speed, Constraints on V_t Reduction.	
3	**Low-Power Design Approaches-** **Supply Voltage Scaling for Low Power:** Effect of Supply voltage on Delay and Power Effect of Supply voltage on Static and Dynamic Power Multi VDD ,Dynamic VDD, Dynamic Voltage and Frequency Scaling (DVFS) Approaches. Architectural Level Approaches: Pipelining and Parallel Processing **Leakage power reduction Techniques:** Effect of threshold voltage on Leakage Power Transistor stacking, MTCMOS, VTCMOS Power gating& Clock gating Techniques.	**9**
4	**Circuit Design Styles for Low Power-** **Non clocked circuit design style:** Fully Complementary logic. NMOS and Pseudo –NMOS logic, Differential Cascode Voltage Switch logic(DCVS) **Clocked design style:** Basic concept, Dynamic Logic, Domino logic, Differential Current Switch Logic. **Adiabatic switching** – Adiabatic charging, Adiabatic amplification, Adiabatic logic gates, Pulsed power supplies.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the impact of technology scaling on power dissipation in digital ICs and various short channel effects	**K2**
CO2	Discuss the different sources of power dissipation in digital ICs.	**K2**
CO3	Describe the various approaches for power management in digital ICs.	**K2**
CO4	Apply various clocked and non-clocked design styles for logic implementation	**K3**
CO5	Describe the use of Adiabatic switching for power management in digital ICs.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Design of Analog CMOS Integrated Circuits	Behzad Razavi	McGraw-Hill	2/e, 2002
2	CMOS: Circuits Design, Layout and Simulation,	Baker, Li, Boyce,	Prentice Hall India,	4/e, 2015
3	Microelectronic Circuits	Sedra & Smith	Oxford University Press	8/e,2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	CMOS Analog Circuit Design,	Phillip E. Allen, Douglas R. Holbery	Oxford University Press	3/e, 2018
2	Fundamentals of Microelectronics	Behzad Razavi	Wiley student Edition	2/e, 2018
3	Analysis and Design of Analog Integrated Circuits	Meyer Gray, Hurst, Lewis	Wiley	6/e, 2020

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
2	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
3	www.youtube.com/@b_razavi, www.youtube.com/@analogicdesign-iitm5234
4	Switching Circuits and Logic Design by Prof. Indranil Sengupta Lectures 47-51

SEMESTER S8

BLOCK CHAIN

Course Code	PEECT867	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To create awareness and understanding among students on the foundation of block chain technology

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Blockchain – Definition, architecture, elements of blockchain, benefits and limitations, types of blockchain. Consensus – definition, types, consensus in blockchain. Decentralization – Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization.	9
2	Consensus Algorithms, Crash fault-tolerance (CFT) algorithms – Paxos, Raft. Byzantine fault- tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT), Proof of work (PoW), Proof of stake (PoS), Types of PoS. Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses. Transactions – Lifecycle, coinbase transactions, transaction validation. Blockchain – The genesis block. Mining – Tasks of miners, mining algorithm, hash rate. Wallets – Types of wallets.	9
3	Smart Contracts – Definition, Smart contract templates, Oracles, Types of oracles, Deploying smart contracts. Decentralization terminology –	9

	Decentralized applications, Decentralized Autonomous Organizations. Use cases of Blockchain technology – Government, Health care, Finance, Supply chain management. Blockchain and allied technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence.	
4	Ethereum – The Ethereum network. Components of the Ethereum ecosystem – Keys and addresses, Accounts, Transactions and messages. The Ethereum Virtual Machine, Blocks and blockchain. The Solidity language – The layout of a Solidity source code, Structure of a smart contract, variables, data types, control structures, events, inheritance, libraries, functions, error handling. Smart contracts Case study: Voting, Auction.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	Explain the fundamental concepts of blockchain technology.	**K2**
CO2	Summarize the classification of consensus algorithms.	**K2**
CO3	Explain the concepts of first decentralized cryptocurrency bitcoin.	**K2**
CO4	Explain the use of smart contracts and its use cases.	**K2**
CO5	Develop simple applications using Solidity language on Ethereum platform	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more,	Imran Bashir	Packt Publishing,	Third edition, 2020.

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain,.	Ritesh Modi,	Packt Publishing,	First edition, 2018
2	Blockchain Technology: Concepts and Applications,	Kumar Saurabh, Ashutosh Saxena,	Wiley Publications,	First Edition, 2020
3	Blockchain Technology, ,	Chandramouli Subramanian, Asha A George, et al	Universities Press (India) Pvt. Ltd	First edition, August 2020.
4	Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications,	Lorne Lantz, Daniel Cawrey	O'Reilly Media	First edition, 2020.
5	Mastering Ethereum: Building Smart Contracts and DApps,	Andreas M. Antonopoulos, Gavin Wood	O'Reilly Media	First edition, 2018

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc22_cs44/preview
2	https://onlinecourses.swayam2.ac.in/aic21_ge01/preview
3	https://archive.nptel.ac.in/courses/106/104/106104220/
4	https://onlinecourses.nptel.ac.in/noc20_cs01/preview

SEMESTER S8

ANTENNA THEORY AND WAVE PROPAGATION

Course Code	PEECT868	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	ELECTROMAGNETICS	Course Type	Theory

Course Objectives:

1. To gain a comprehensive knowledge about design and development of advanced antennas

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Antenna theory**: Radiation mechanism from an antenna, Current Distribution on a Thin Wire Antenna, Friis Transmission Equation and Radar Range Equation. Infinitesimal dipole, small dipole, Small circular loop antenna. Biconical antenna, Triangular sheet and Bow-tie antenna TravelingWave and Broadband Antennas, Fractal Antennas	9
2	**Microstrip antennas**: Radiation mechanism, Rectangular Patch and Circular Patch, Quality Factor, Bandwidth, and Efficiency, Input Impedance, Coupling, Circular Polarisation, Substrates for microstrip antennas **Antenna Measurements** Measurement of Antenna Range, Radiation Patterns, Gain and Directivity, Radiation Efficiency, Impedance, Current Polarization	9

3	**Reconfigurable antennas-types-** principles of frequency, polarisation and pattern reconfigurable antennas **Metamaterial based antennas-** Fundamentals of metamaterials, metasurface, SRR **Smart Antennas:** Introduction, Smart-Antenna Analogy Smart Antennas' Benefits and drawbacks, Antenna Beamforming ,Mobile Ad hoc Networks (MANETs)	**9**
4	**Radio Wave Propagation** Ground wave propagation, Plane earth reflection, Space wave and surface wave, Spherical earth propagation, Tropospheric waves, Ionospheric propagation, Effects of earth's magnetic field, Critical frequency, Maximum usable Frequency, Virtual height.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse the radiation mechanism of antennas	**K3**
CO2	Design and measure the parameters of a microstrip antenna	**K4**
CO3	Analyse and design advanced antennas	**K4**
CO4	Explain the different modes and parameters of radio wave propagation	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Antenna Theory: Analysis and Design,	Constantine A. Balanis	Wiley	4th Edition, 2016
2	Microstrip Antenna Design Handbook	By Ramesh Garg ·	Artech	1/e, 2001
3	Antennas and radio Wave propagation	R.E.Collin	McGraw Hill	2/e, 2001
4	Metamaterials for Antenna Applications	Amit K. Singh, Mahesh P. Abegaonkar, Shiban Kishen Koul ·	CRC Press	2/e, 2021
5	Reconfigurable antennas	Suvadeep Choudhury	IoP Publishing	2/e, 2023

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Microwave Engineering,	David M. Pozar	Wiley India	4/e, 2012.
2	Antenna and Wave Propagation	Raju GSN	Pearson	1/e, 2009
3	Modern Antenna Design,	Thomas A. Milligan	IEEE PRESS, Wiley Inter science	2/e, 2005
4	Antennas for all applications	J D Kraus	Tata McGraw hill	3/e, 2002

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/101/108101092/
2	https://nptel.ac.in/courses/108101092
3	https://www.youtube.com/watch?v=TziHD1NDQ0I
4	https://archive.nptel.ac.in/courses/112/105/112105165/

SEMESTER S8

ANTENNA THEORY AND DESIGN

Course Code	PEECT865	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	ELECTROMAGNETICS	Course Type	Theory

Course Objectives:

1. To gain a comprehensive knowledge about design and development of advanced antennas

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Antenna theory: Radiation mechanism from an antenna, Current Distribution on a Thin Wire Antenna, Friis Transmission Equation and Radar Range Equation. Retarded potential concept, Infinitesimal dipole, small dipole, Small circular loop antenna. Biconical antenna, Triangular sheet and Bow-tie antenna Traveling Wave and Broadband Antennas, Fractal Antennas Array antennas; Binomial array, Dolph Chebyshev array, Electronic Beam steering principle	11
2	Microstrip antennas: Radiation mechanism, Rectangular Patch and Circular Patch, Quality Factor, Bandwidth, and Efficiency, Input Impedance, Coupling, Circular Polarisation, Substrates for microstrip antennas, Feeding methods, Transmission line model Broad banding of microstrip antenna using stacked elements, compact circularly polarised antennas, Design of microstrip line (using software) Antenna Measurements Measurement of Antenna Range, Radiation Patterns, Gain and Directivity, Radiation Efficiency, Impedance, Current Polarization	11
3	Reconfigurable antennas-types- principles of frequency, polarisation and pattern reconfigurable antennas	11

	Metamaterial based antennas- Fundamentals of metamaterials, metasurface, SRR Smart Antennas: Introduction, Smart-Antenna Analogy Smart Antennas' Benefits and drawbacks, Antenna Beamforming, Mobile Ad hoc Networks (MANETs)	
4	Radio Wave Propagation Ground wave propagation, Plane earth reflection, Space wave and surface wave, Duct propagation, Spherical earth propagation, Tropospheric waves, Tropospheric scatter, Ionospheric propagation, Effects of earth's magnetic field, Critical frequency, Maximum usable Frequency, Virtual height.	**11**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

Criteria for Evaluation (Evaluate and Analyse): 20 marks

1. Familiarise design tools for a microstrip antenna; Design and simulate any one of the types of antennas mentioned in the syllabus. The parameters for evaluation are Gain, directivity, radiation efficiency, return loss, radiation patterns etc. (10 marks)
2. Using lithographic techniques and design tools, fabricate the actual prototype of the designed antenna. (5 marks)
3. Measure the performance parameters in terms of return loss gain and radiation pattern using the network analyser, anechoic chamber and associated equipment.(5 marks)

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse the radiation mechanism of antennas	**K3**
CO2	Design and measure the parameters of a microstrip antenna	**K4**
CO3	Analyse and design advanced antennas	**K4**
CO4	Explain the different modes and parameters of radio wave propagation	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Antenna Theory: Analysis and Design,	Constantine A. Balanis	Wiley	4th Edition, 2016
2	Microstrip Antenna Design Handbook	By Ramesh Garg ·	Artech	1/e, 2001
3	Antennas and radio Wave propagation	R.E. Collin	McGraw Hill	2/e, 2001
4	Metamaterials for Antenna Applications	Amit K. Singh, Mahesh P. Abegaonkar, Shiban Kishen Koul ·	CRC Press	2/e, 2021
5	Reconfigurable antennas	Suvadeep Choudhury	IoP Publishing	2/e, 2023

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Microwave Engineering,	David M. Pozar	Wiley India	4/e, 2012.
2	Antenna and Wave Propagation	Raju GSN	Pearson	1/e, 2009
3	Modern Antenna Design,	Thomas A. Milligan	IEEE PRESS, Wiley Inter science	2/e, 2005
4	Antennas for all applications	J D Kraus	Tata McGraw hill	3/e, 2002

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/101/108101092/
2	https://nptel.ac.in/courses/108101092
3	https://www.youtube.com/watch?v=TziHD1NDQ0I
4	https://archive.nptel.ac.in/courses/112/105/112105165/

SEMESTER S8

INTERNET OF THINGS

Course Code	OEECT 831	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. This course aims to introduce IoT fundamentals.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to IoT technology:** Definitions of IoT, Characteristics of IoT devices – power, computational constraints, IoT Architectural view – Middleware based architecture, Service oriented architecture, M2M Communication and IoT, Typical application areas of IoT technology (case studies of at least four domains) - Energy management and Smart grid, IoT for Home, Cities, Environment monitoring, Agriculture, Supply chain and customer monitoring	9
2	**Components of IoT technology:** Identification/Addressing - Electronic Product Codes, RFID, ubiquitous code, IPv4, IPv6. Sensors and Actuators*. IoT Hardware**, IoT Software – overview of Operating systems, Firmware, Middle ware, Application software used in IoT. Connectivity for IoT devices – characteristics.	9
3	**Communication technologies for IoT :** Zigbee - key features, architecture, limitations, Bluetooth technology - bluetooth stack, piconet, scatternet, limitations, Bluetooth Low Energy (key features, architecture, limitations), Wifi (IEEE 802.11) technology – key features, limitations, Cellular	9

	technology – GSM, 3G, 4GLTE (overview), features, limitations, LoRa technology – features, LoRaWAN architecture, 6LoWPAN – features, protocol stack, Narrow Band (NB- IoT) – features, applications, Sigfox – features, applications	
4	**IoT Data Management :** Storage technologies for IoT hardware – Volatile, Non-volatile, Embedded (MTP/OTP), external flash (NAND/NOR), DRAM, eflash, UFS, eMMC (overview of technologies). Cloud and IoT, Cloud computing – architecture, advantages of cloud computing, Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS). Case study of commercial cloud computing platforms like - Microsoft Azure IoT Suite, Google Cloud's IoT Platform, IBM Watson IoT Platform. IoT analytics	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain in a concise manner the architecture of IoT	**K2**
CO2	Identify various hardware and software components used in IoT	**K3**
CO3	Discuss the various communication technologies and interfaces in IoT	**K2**
CO4	Describe the usage of modern technologies like cloud computing for data management in IoT	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping od Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Internet of Things: Architecture and Design Principles	Rajkamal	McGraw Hill (India) Private Limited.	2nd edition, 2022
2	Internet of Things (A Hands-on- Approach)	Vijay Madisetti and Arshdeep Bahga	Orient Blackswan Private Limited - New Delhi	1st Edition, 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Internet of things: A survey on enabling technologies, protocols, and applications	Al-Fuqaha	IEEE Communications Surveys & Tutorials	1/e, 2015
2	The Internet of Things	Samuel Greengard	The MIT Press Essential Knowledge series Paperback	1/e, 2015
3	The Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems	Ovidu Vermesan and Peter Friess	River Publishers	1/e, 2013
4	. Internet of Things - From Research and Innovation to Market Deployment	Peter Friess, Ovidiu Vermesan	River Publishers	1/e, 2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/WUYAjxnwjU4?si=s58W-NKMrEQMaJ8m https://youtu.be/BXDxYh1EV2w?si=8oFtQB9vycC_c-t2
2	https://youtu.be/z3VEZPwl5gA?si=tNuzG_By-KBU3ks_ https://youtu.be/SXz0XR68dwE?si=1tVN1g9FQcGp87li https://youtu.be/TvzgzO6xKrY?si=gYzJstW51MTNsgKj
3	https://youtu.be/qko-f1VDhCM?si=0tWM_OHS395ESV_w https://youtu.be/d9QfVpCG00Y?si=qeHk8tPg_torr2yX https://youtu.be/1zQ8wbBozqI?si=7vOSHMt8OT3nQINO
4	https://youtube.com/playlist?list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE&si=rr5Fpuew5q9_Y4qg

SEMESTER S8

SATELLITE AND RADAR COMMUNICATION

Course Code	OEECT832	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To analyze operational principles of satellite communication systems
2. To apply radar techniques to detect and track targets

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Satellite orbit and orbital equations, Kepler‟s laws of planetary motion, locating satellite in the orbit, locating satellite with respect to earth, Look angle calculation, coverage angle and slant range, orbital perturbations, satellite launching, orbital effects in communication subsystem performance. Satellite subsystems, Attitude and orbit control system, Telemetry tracking command and monitoring, power system, communication subsystem, satellite antennas.	9
2	Satellite link design- Basic link analysis, Interference analysis, terrestrial interference, Intermodulation interference, inter-symbol interference and rain induced attenuation, uplink power control, system availability, system design for link without frequency reuse and system design for link with frequency reuse.	9
3	Basics of Radar: Introduction, Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable	9

	Signal, Receiver Noise, Modified Radar Range Equation	
4	CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Applications of CW radar. FM-CW Radar: FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar. MTI and Pulse Doppler Radar: Introduction, Principle. MTI versus Pulse Doppler Radar. Tracking Radar: various techniques of Tracking with Radar	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the principles of satellite communication	**K2**
CO2	Design and analysis of satellite link	**K3**
CO3	Illustrate Radar Fundamentals like Radar Equation and Applications.	**K2**
CO4	Compare various types of Radars and tracking techniques	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Satellite Communications	Timothy Pratt, Jeremy Allnutt	Wiley	3rd Edition, 2021
2	Introduction to Radar Systems	Merrill I. Skolnik	Tata McGraw-Hill	2nd Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Satellite Communications	Tri, T.Ha,	McGraw-Hill Education	2nd Edition, 2017
2	Satellite Communications Systems Engineering	Pritchard,	Pearson Education	2nd Edition, 2006
3	Radar: Principles, Technology, Applications	Byron Edde	Pearson	1st Edition, 2004
4	Understanding Radar Systems	Simon Kinsley and Shaun Quegan	John Wiley& Sons	1st Edition 1999

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/105/117105131/
2	Same as above
3	https://archive.nptel.ac.in/courses/108/105/108105154/
4	Same as above