LBS INSTITUTE OF TECHNOLOGY FOR WOMEN,

POOJAPPURA, THIRUVANANTHAPURAM

B TECH-CURRICULUM & SYLLABUS (2024 SCHEME)

ELECTRONICS AND COMPUTER ENGINEERING

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

(A State Government University)

B. Tech

Curriculum (2024)- Semester I to VIII

Electronics & Computer Engineering

Branch Code: ER

(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.														

****Valuation for HMC courses will be done at college level, Question papers will be provided by the University.***
****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

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**

***Note**: Physics, Chemistry, Health and Wellness and Life skill and Professional Communication shall be offered in both S1 and S2.*

Institutions can advise students belonging to about 50% of the number of branches in the Institution to opt for Physics/ Health and Wellness in SI and Chemistry/ Life Skills and Professional Communication in S2 & vice versa.

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
4	D	GXEST204	ESC	GC	Programming in C	3	0	2	0	5.5	40	60	4	5
5	E	PCERT205	PC	PC	Digital Electronics	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.***

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	PCERT302	PC	PC	Data Structures	3	1	0	0	5	40	60	4	4
3	C	PCERT303	PC	PC	Digital System Design Using Verilog	3	1	0	0	5	40	60	4	4
4	D	PBERT304	PC-PBL	PB	Electronic Devices and Circuits	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 UCHUT347	HMC	UC	Economics for Engineers Engineering Ethics and Sustainable Development	2	0	0	0	3	50	50	2	2
7	L	PCERL307	PCL	PC	Data Structures Lab	0	0	3	0	1.5	50	50	2	3
8	Q	PCERL308	PCL	PC	Digital System 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	PCERT402	PC	PC	Computer Organization and Architecture	3	1	0	0	5	40	60	4	4
3	C	PCERT403	PC	PC	Computer Networks	3	1	0	0	5	40	60	4	4
4	D	PBERT404	PC-PBL	PB	Integrated Circuits	3	0	0	1	5.5	60	40	4	4
5	E	PEERT41N	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	PCERL407	PCL	PC	Computer Networking Lab	0	0	3	0	1.5	50	50	2	3
8	Q	PCERL408	PCL	PC	Integrated Circuits 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: PEERT 41N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
E	PEERT 411	Communication Engineering	3-0-0-0	3	3
	PEERT 412	Basic VLSI Design	3-0-0-0		3
	PEERT 413	Biomedical Signals and Transducers	3-0-0-0		3
	PEERT 414	Foundations of Machine Learning	3-0-0-0		3
	PEERT 416	Object Oriented Programming Using Java	3-0-0-0		3
	PEERT 415	Java Programming & Application development	**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	PCERT501	PC	PC	Digital Signal Processing	3	1	0	0	5	40	60	4	4
2	B	PCERT502	PC	PC	Theory of Computation	3	1	0	0	5	40	60	4	4
3	C	PCERT503	PC	PC	Microcontrollers and Interfacing	3	0	0	0	4.5	40	60	3	3
4	D	PBERT504	PC-PBL	PB	Database Management Systems	3	0	0	1	5.5	60	40	4	4
5	E	PEERT52N	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	PCERL507	PCL	PC	Digital Signal Processing Lab	0	0	3	0	1.5	50	50	2	3
8	Q	PCERL508	PCL	PC	Database Management Systems 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*
	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: PEERT 52N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
E	PEERT 521	Wireless Sensor Networks	3-0-0-0	3	3
	PEERT 522	CMOS VLSI Design	3-0-0-0		3
	PEECT 523	Sensors and Actuators	3-0-0-0		3
	PEERT 524	Cloud Computing	3-0-0-0		3
	PEERT 526	Python for Machine Learning	3-0-0-0		3
	PEERT 525	Computational Fundamentals for Machine Learning	**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	PCERT601	PC	PC	Operating Systems	3	1	0	0	5	40	60	4	4
2	B	PCERT602	PC	PC	Data Communication and Networking	3	0	0	0	4.5	40	60	3	3
3	C	PEERT63N	PE	PE	PE-3	3	0	0	0	4.5	40	60	3	3
4	D	PBERT604	PC-PBL	PB	Embedded Systems and IoT	3	0	0	1	5.5	60	40	4	4
5	F	GYEST605	ESC	GC	Design Thinking and Product Development (Group Specific Syllabus)	2	0	0	0	3	40	60	2	2
6	O	OEERT61N /IEERT61N	OE/ ILE	OE/IE	OE/ILE-1	3	0	0	0	4.5	40	60	3	3
7	L	PCERL607	PCL	PC	Embedded Systems and IoT Lab	0	0	3	0	1.5	50	50	2	3
8	P	PCERP608	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: PEERT 63N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
C	PEERT 631	Network and Linear Control Systems	3-0-0-0	3	3
	PEERT 632	Micro-Electro-Mechanical-Systems	3-0-0-0		3
	PEERT 633	Foundations of Data Science	3-0-0-0		3
	PEERT 634	Compiler Design	3-0-0-0		3
	PEERT 636	Algorithm Analysis and Design	3-0-0-0		3
	PEERT 635	Design & Analysis of Algorithms	3-0-0-0		5/3

OPEN ELECTIVE 1: OEERT 61N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
O	OEERT611	Basics of Analog and Digital Communication	3-0-0-0	3	3
	OEERT612	Robotics and Automation	3-0-0-0		3
	OEERT613	Object Oriented Concepts	3-0-0-0		3
	OEERT614	Internet of Things	3-0-0-0		3
	OEERT615	Introduction to Artificial Intelligence	3-0-0-0		3

SEVENTH SEMESTER (July-December)														
Sl. No	**Slot**	**Course Code**	**Course**	**Course Category**	**Course Title (Course Name)**	**Credit Structure**				**SS**	**Total Marks**		**Credits**	**Hrs/ Week**
						L	**T**	**P**	**R**		**CIA**	**ESE**		
1	A	PEERT74N / PEERM74N	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	PEERT75N/ PEERM75N	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	OEERT72N /IEERT72N/ OEERM72N	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	PCERS705	PWS	PC	Seminar	0	0	3	0	1.5	50	0	2	3
6	P	PCERP706/ PCERI706	PWS	PC	Option 1: Major Project Option 2: Internship (4-6 Months)	0	0	0	8	8	100	0	4	8
Total										**26**			**17**	**22**

**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: PEERT 74N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
A	PEERT 741	Image Processing	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
	PEERT 744	Nano electronics	3-0-0-0		3
	PEERT 746	Block Chain Technologies	3-0-0-0		3
	PEERT 745	**Network Security**	3-0-0-0		5/3

PROGRAM ELECTIVE 5: PEERT 75N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
B	PEERT 751	Web Programming	3-0-0-0	3	3
	PEERT 752	Low Power VLSI Design	3-0-0-0		3
	PEECT 753	Real Time Operating Systems	3-0-0-0		3
	PEERT 754	Client Server Architecture	3-0-0-0		3
	PEECT 756	Speech and Audio Processing	3-0-0-0		3
	PEERT 755	**Neural Networks & Deep Learning**	3-0-0-0		5/3

OPEN ELECTIVE 2: OEERT 72N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
O	OEERT 721	Sensors and Instrumentation	3-0-0-0	3	3
	OEERT 722	Biomedical Instrumentation	3-0-0-0		3
	OEERT 723	Embedded System Design and Applications	3-0-0-0		3
	OEERT 724	Digital Image Processing	3-0-0-0		3
	OEERT 725	Concepts in Machine Learning	3-0-0-0		3

SL. No	**Course Code**	**Slot I: HMC Elective**
1	UEHUT704	Project Management: Planning, Execution, Evaluation and Control
2	UEHUM701	Proficiency course in French. (MOOC) (B1 level)
3	UEHUM702	Proficiency Course in German (B1 Level). (MOOC)
4	UEHUM703	Proficiency Course in Spanish (B1 Level) (MOOC)
5	UEHUM704	Introduction to Japanese Language and Culture (N5 level). (MOOC)

EIGHT 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	PEERT86N / PEERM86N	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	OEERT83N /IEERT83N/ OEERM83N	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	PCERP806/ PCERI806/ PCERJ806	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: PEERT 86N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
A	PEERT 861	PLC and Data Acquisition Systems	3-0-0-0	3	3
	PEERT 862	Electronic Product Design	3-0-0-0		3
	PEERT 863	System Software	3-0-0-0		3
	PEECT 864	Cyber Security	3-0-0-0		3
	PEERT 866	Cryptography and Network Security	3-0-0-0		3
	PEERT 865	**Cyber Forensics**	3-0-0-0		5/3

OPEN ELECTIVE 3: OEERT 83N

SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
O	OEERT 831	Biomedical Signal Processing	3-0-0-0	3	3
	OEERT 832	Hybrid and Electric Vehicles	3-0-0-0		3
	OEERT 833	Fundamentals of Computer Networks	3-0-0-0		3
	OEERT 834	Cloud Computing and Applications	3-0-0-0		3
	OEERT 835	Introduction to Deep Learning	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			
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	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**	Digital Electronics	4
2	**S3**	Data Structures	4
3		Digital System Design Using Verilog	4
4		Data Structures Lab	2
5		Digital System Design Lab	2
6	**S4**	Computer Organization and Architecture	4
7		Computer Networks	4
8		Computer Networking Lab	2
9		Integrated Circuits Lab	2
10	**S5**	Digital Signal Processing	4
11		Theory of Computation	4

12		Microcontrollers and Interfacing	3
13		Digital Signal Processing Lab	2
14		Database Management Systems Lab	2
15	**S6**	Operating Systems	4
16		Data Communication and Networking	3
17		Embedded Systems and IoT Lab	2
Total Credits (Theory -10, Lab-7)			**52**

Program Core-Project Based Learning (PBL)			
Sl. No:	**Semester**	**Course Area**	**Credits**
1	**S3**	Electronic Devices & Circuits	4
2	**S4**	Integrated Circuits	4
3	**S5**	Database Management Systems	4
4	**S6**	Embedded Systems & IoT	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}, $kcos\omega x$, $ksin\omega x$, $ke^{\alpha x}cos\omega x$, $ke^{\alpha x}sin\omega x$), 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	15^{th} edition, 2023
2	Essential Calculus	J. Stewart	Cengage	2^{nd} edition, 2017
3	Elementary Linear Algebra	Howard Anton, Chris Rorres	Wiley	11^{th} edition, 2019
4	Bird's Higher Engineering Mathematics	John Bird	Taylor & Francis	9^{th} edition, 2021
5	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39^{th} edition, 2023
6	Calculus	H. Anton, I. Biven, S.Davis	Wiley	12^{th} edition, 2024
7	Signals and Systems	Simon Haykin, Barry Van Veen	Wiley	2^{nd} 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. <u>Continuous Assessment (10 Marks)</u>

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	17^{th} 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	4^{th} 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

<u>Scoring for Modified Push Ups for Female</u>

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.

<u>Scoring for 2Km Run/walk for Male</u>

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

<u>Scoring for 2Km Run/walk for Female</u>

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	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	15^{th} edition, 2023
2	Essential Calculus	J. Stewart	Cengage	2^{nd} edition, 2017
3	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10^{th} edition, 2016
4	Bird's Higher Engineering Mathematics	John Bird	Taylor & Francis	9^{th} edition, 2021
5	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39^{th} 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. <u>Continuous Assessment (10 Marks)</u>

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	17^{th} 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	4^{th} 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	2^{nd} 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	2^{nd} edn/ 2020
8	The Law of Copyright and Designs	B.L. Wadehra	Universal Law	5^{th} 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.

<u>Tests to evaluated as per Criterion - 2 and Benchmark Scores</u>

<u>V Sit Reach Test</u>

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.

<u>Scoring for V Sit Reach Test for Males</u>

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

<u>Scoring for V Sit Reach Test for Females</u>

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	4^{th} Edition, 2006
2	Digital Fundamentals	Thomas L Floyd, Digital	Pearson Education	10^{th} Edition , 2009
3	Modern digital Electronics	R.P. Jain	Tata McGraw Hill,	4^{th} 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	1^{st} Edition, 2003
2	Fundamentals of Digital Circuits	A. Ananthakumar	Prentice Hall	2^{nd} Edition, 2016
3	Digital Design: Principles and Practices	Wakerly J.F	Pearson India	4^{th} edition, 2008
4	Digital Electronics – An introduction to theory and practice	W.H. Gothmann,	PHI	2^{nd} 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 & COMPUTER 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*=z2, w=ez,*w*=1z, 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	**9**

	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)**	
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	10th 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

DATA STRUCTURES

Course Code	PCERT 302	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)	UCEST105- Algorithmic thinking with python GBEST204 – Programming in C	Course Type	Theory

Course Objectives:

1. To impart a thorough understanding of linear data structures such as arrays, stacks, queues and linked lists and their applications.
2. To impart a thorough understanding of non-linear data structures such as trees, graphs and their applications.
3. To impart familiarity with various sorting, searching and hashing techniques and their performance comparison.

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	11
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	11
3	Trees and Graphs: Trees, Binary Trees-Tree Operations, Binary Tree Representation, Tree Traversals, Binary SearchTrees- Binary Search Tree OperationsGraphs, Representation of Graphs, Depth First Search and Breadth First Search on Graphs, Applications of Graphs	11
4	Sorting and Hashing: Sorting Techniques – Selection Sort, Insertion Sort, Quick Sort, Merge Sort and Heap Sort	11

	Hashing- Hashing Techniques, Collision Resolution, Overflow handling, Hashing functions – Mid square, Division,Folding, Digit Analysis	

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 of 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,SartajSahni 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, 2007
2	Data Structures and Algorithms	Aho A. V., J. E. Hopcroft and J. D. Ullman	Pearson Publication	1983
3	Introduction to Data Structures with Applications	Tremblay J. P. and P. G. Sorenson	Tata McGraw Hill	1995
4	Advanced Data Structures	Peter Brass	Cambridge University Press	2008
5	Theory and Problems of Data Structures	Lipschuts S.	Schaum’s Series	1986

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 S3

DIGITAL SYSTEM DESIGN USING VERILOG

Course Code	**PCERT 303**	**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)	Digital Electronics	**Course Type**	Theory

Course Objectives:

1. This course enables students to design/model Digital systems, consisting of combinational and sequential circuits, using Verilog HDL.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-based design flow, Importance of Verilog HDL, trends in HDLs. Hierarchical Modelling Concepts -Top-down and bottom-up design methodology. Basic Concepts of Lexical conventions, data types.	**10**
2	Verilog for Digital Logic Design: Dataflow, behavioural, structural modelling. Verilog implementation of basic gates &combinational circuits (Half adder& full adder, Half subtractor & full subtractor, decoder, encoder, multiplexer, demultiplexer), simple test bench for combinational circuits. Modelling of flipflops in Verilog (with test bench).	**12**
3	Finite State machine: State diagram, State Table, State assignments, state graphs, capabilities and limitations of FSM. Mealy and Moore machines, Modelling of clocked synchronous circuits as Mealy and Moore machines: Serial binary adder, sequence detector design examples.	**12**

4	Introduction to FPGAs: Evolution of Programmable Devices, what is an FPGA - Logic Blocks, Interconnection Resources, Applications of FPGAs, Implementation Process. Programming Technologies - Static RAM Programming Technology, Anti-fuse Programming Technology, EPROM and EEPROM Programming Technology. Xilinx FPGA - Xilinx XC2000. FPGA Design Flow Example.	**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 =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 programming concepts in Verilog HDL.	**K2**
CO2	Design and implement combinational and sequential digital circuits using Verilog HDL, incorporating test benches for verification.	**K3**
CO3	Apply the concepts of finite state machines (FSMs) to design synchronous digital circuits.	**K3**
CO4	Explain the fundamental principles of Field-Programmable Gate Arrays (FPGAs), including their architecture, programming technologies, and design flow.	**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		2							2
CO2	3	2	2		2							2
CO3	3	2	2									2
CO4	2	1	1		1							2

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fundamentals of Digital Design	Charles H. Roth	Thomson Press (India) Ltd	7th Edition, 2015
2	Verilog HDL A Guide to Digital Design & Synthesis	Samir Palitkar	Pearson	2nd Edition, 2003
3	Field-Programmable Gate Arrays	Stephen D. Brown	Springer	1st Edition, 2012
4	Digital Design with an Introduction to the Verilog HDL	Mano M.M, Ciletti M.D	Pearson	6th Edition, 2022

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to digital systems	Milos D. Ercegovac	John Wiley Sons	1/e 1998
2	Digital Fundamentals	Thomas L Floyd	Pearson Education	10th Edition, 2009
3	Digital Principles and Design	Donald D Givone	Tata McGraw Hill	1st Edition, 2003
4	Fundamentals of Digital Circuits	A. Ananthakumar	Prentice Hall	2nd Edition, 2016
5	Fundamentals of Digital Logic with Verilog HDL	S Brown & Z. Varanestic,	Mc Graw Hill.	2nd Edition, 2007

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	NPTEL : Computer Science and Engineering - NOC: Hardware Modeling Using Verilog; Prof. Indranil Sen Gupta, IIT Kharagpur; Lecture 9 https://archive.nptel.ac.in/courses/106/105/106105165/
2	NPTEL : Electrical Engineering - NOC: Digital System Design; Prof. Neeraj Goel, IIT Ropar; Lecture 20 https://archive.nptel.ac.in/courses/108/106/108106177/
3	NPTEL : Electrical Engineering - NOC: Digital System Design; Prof. Neeraj Goel, IIT Ropar; Lecture 51 https://archive.nptel.ac.in/courses/108/106/108106177/
4	NPTEL : Electrical Engineering - NOC: Digital System Design; Prof. Neeraj Goel , IIT Ropar; Lecture 65 https://archive.nptel.ac.in/courses/108/106/108106177/

SEMESTER S3

ELECTRONIC DEVICES AND CIRCUITS

Course Code	**PBERT 304**	**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)	None	**Course Type**	Theory

Course Objectives:

1. To develop the skill of the design of various analog circuits.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Wave shaping circuits and Transistors:** First order RC low pass and high pass filters. First order RC differentiating and integrating circuits, Diode Clipping circuits. Diode Clamping circuits. Bipolar Junction Transistors: Review of BJT characteristics- Operating point of BJT – Factors affecting stability of Q-point. DC Biasing–Biasing circuits: fixed bias, collector to base bias, voltage divider bias. Stability factor. Transistor as switch	9
2	**BJT Amplifiers:** RC coupled amplifier (CE configuration)–need of various components and design, Concept of AC load lines, voltage gain and frequency response. Small signal analysis of CE configuration using small signal hybrid-pi model for mid frequency and low frequency. (Gain, input and output impedance). High frequency equivalent circuits of BJT Multistage amplifiers: Direct, RC, transformer coupled Amplifiers, Applications. Power amplifiers using BJT: Class A, Class B, Class AB, Class C and Class D. Conversion efficiency – Derivation (Class A and Class B). Distortion in power amplifiers.	9
3	**Wave Generating circuits: Multivibrator and Oscillator Circuits:**	9

	Multivibrators - Types of multivibrators (Astable and monostable) - Feedback concepts, Barkhausen's criterion for oscillation - Types of oscillators – RC phase shift, Wien bridge, crystal oscillators. (Analysis of RC phase shift and Wien bridge oscillator required)	
4	**Feedback amplifiers and Power supplies**: Effect of positive and negative feedback on gain, frequency response 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. Regulated power supply: Shunt voltage regulator, series voltage regulator, Short circuit protection and fold back protection, Output current boosting, SMPS.	**9**

Suggestion on Project Topics

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	Design analog signal processing circuits using diodes and first order RC circuits.	**K3**
CO2	Analyse various transistor biasing circuits and BJT amplifier circuits.	**K3**
CO3	Design and analyse the wave-shaping multivibrator and oscillator circuits using BJT	**K3**
CO4	Design and develop feedback amplifiers and regulated power supplies	**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
CO2	3	3			3	2			3	2		3
CO3	3	3			3	3			3	2		3
CO4	3	3			3	3			3	2		3

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	11/e, 2015
2	Microelectronic Circuits	Sedra A.S and K.C. Smith	Oxford University Press	6/e,2013
3	Electronic Circuits, Analysis and Design	Neamen D	TMH	3/e,2007

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	2015
2	Integrated Electronics	Millman J.andC.Halkias	McGraw-Hill	2/e, 2010.
3	Microelectronic Circuits- Analysis and Design	Rashid M.H.,	Cengage Learning	2/e, 2011
4	Electronic Devices and Circuits	David A Bell	Oxford University Press	2008.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/103/117103063
2	https://archive.nptel.ac.in/courses/117/103/117103063
3	https://archive.nptel.ac.in/courses/117/103/117103063
4	https://archive.nptel.ac.in/courses/117/103/117103063

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 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	6^{th} edition, 2023
2	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Media, Inc.	2^{nd} edition,2022
3	Mathematics for machine learning	Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong	Cambridge University Press	1^{st} edition. 2020
4	Fundamentals of mathematical statistics	Gupta, S. C., and V. K. Kapoor	Sultan Chand & Sons	9^{th} edition, 2020
5	Introducing data science: big data, machine learning, and more, using Python tools	Cielen, Davy, and Arno Meysman	Simon and Schuster	1^{st} 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/S4

ECONOMICS FOR ENGINEERS

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: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case Study/ 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 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	7^{TH} 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	**6**

	Science & Technology, Gendered technologies & innovations**, Ethical values and practices in connection with gender** - equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	
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 ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	**6**
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	**6**

	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.	

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.
7	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

DATA STRUCTURES LAB

Course Code	**PCERL307**	**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)	GBEST204: Programming in C	**Course Type**	Lab

Course Objectives:

1. To implement various linear data structures and applications using them
2. To implement various non-linear data structures and applications using them
3. To implement algorithms for various sorting techniques

Details of Experiment

Expt. No	Experiment
1	Implementation of linear search and binary search *
2	Implementation of Stack and linear Queue using arrays *
3	Implementation of Priority Queues, DEQUEUE and Circular Queues using arrays *
4	Conversion of expression from one notation to another notation *
5	Implementation of various operations on singly linked list *
6	Implementation of stack and queue using linked list *
7	Polynomial addition using linked list *
8	Polynomial multiplication using linked list.
9	Implementation of binary search tree – creation, insertion, deletion, search *
10	Implementation of tree traversals – inorder, preorder, postorder
11	Implementation of sorting algorithms bubble sort, insertion sort and selection sort *
12	Implementation of Merge sort *
13	Implementation of Quick sort *
14	Implementation of BFS and DFS on graph *

**Mandatory programs*

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	Implement and analyze various searching and sorting algorithms, evaluating their efficiency and applicability in different scenarios.	**K3**
CO2	Efficiently implement array-based data structures and perform expression notation conversions, demonstrating proficiency in algorithmic design and data structure utilization.	**K3**
CO3	Effectively utilize linked lists for implementing various operations such as stacks, queues, and polynomial manipulations, demonstrating practical skills in data structure application and algorithmic problem-solving.	**K3**
CO4	Master the implementation of binary search trees, tree traversals, and graph traversal algorithms, demonstrating proficiency in fundamental data structure operations and algorithmic techniques.	**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	1				2	2	3		3
CO2	3	3	3	1				2	2	3		3
CO3	3	3	3	1				2	2	3		3
CO4	3	3	3	1				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	Fundamentals of Data Structures in C	Ellis Horowitz,Sartaj Sahni and Susan Anderson-Freed	Universities Press	2e, 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	1983
3	Introduction to Data Structures with Applications	Tremblay J. P. and P. G. Sorenson	Tata McGraw Hill	1995
4	Advanced Data Structures	Peter Brass	Cambridge University Press	2008

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://nptel.ac.in/courses/106102064

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 S3

DIGITAL SYSTEM DESIGN LAB

Course Code	PCERL 308	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. Familiarize with the implementation of Logic Circuits using basiclogic gates ICs.
2. Familiarize with the Verilog HDL based Digital Design Flow.

Details of Experiment

Expt. No	Experiment
1	Familiarization of logic gates
2	Realization of functions using basic and universal gates (SOP and POS forms).
3	Half adder and full adder using NAND
4	Realization of 8:1 MUX and 1:8 DEMUX
5	Flip-flop circuits (SR, JK,T,D &Master slave)
6	Asynchronous up/down counter
7	Familiarization of FPGA devices and Verilog HDL
8	Implementation of basic gates using Verilog & simulate the result using test bench
9	Implementation of half adder & full adder using Verilog & simulate the result using test bench
10	Implementation of MUX & DEMUX using Verilog & simulate the result using test bench
11	Implementation of encoder & decoder using Verilog & simulate the result using test bench
12	Implementation of flip-flops using Verilog & simulate the result using test bench

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	Realize digital circuits with Logic Gates and Hardware Description Language	Apply (K3)
CO2	Design and implement combinational logic circuits.	Apply (K3)
CO3	Design and implement sequential logic circuits.	Apply (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	2	2	1	2							2
CO2	3	2	2	2	2							2
CO3	3	2	2	2	2							2

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: A Guide to Digital Design and Synthesis	Samir Palnitkar	Pearson	2^{nd} Edition, 2003
2	A Verilog HDL Primer	Bhasker J	BS Publication	
3	Modern digital Electronics	R.P. Jain	Tata McGraw Hill	4th edition, 2009
4	Fundamentals of Digital Circuits	A. Ananthakumar	Prentice Hall	2nd edition, 2016

Continuous Assessment (25 Marks)

5. 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.

6. 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.

7. 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.

8. 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)

6. 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.

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

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

8. 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.

9. 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.

10. Record (5 Marks)

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

SEMESTER 4

ELECTRONICS AND COMPUTER ENGINEERING

SEMESTER S4

MATHEMATICS FOR ELECTRICAL SCIENCE – 4

(B Group)

Course Code	**GBMAT401**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2Hrs. 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 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]**	**9**
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/ 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 concept, properties and important models of discrete random variables and to apply in suitable random phenomena.	**K3**
CO2	Understand 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/

SEMESTER S4

COMPUTER ORGANIZATION AND ARCHITECTURE

Course Code	**PCERT 402**	**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)	PCERT 205 Digital Electronics	**Course Type**	Theory

Course Objectives:

1. Discuss the basic concepts and structure of computers.
2. Describe the various addressing modes and memory structure kinds.
3. Define interrupts and their role in managing I/O operations and system events.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Basic Structure of computers** –functional units - basic operational concepts - bus structures. Memory locations and addresses - memory operations, Instructions and instruction sequencing, addressing modes. **Basic processing unit** – fundamental concepts – instruction cycle – execution of a complete instruction - single bus and multiple bus organization.	10
2	**Register transfer logic:** Inter register transfer – arithmetic, logic and shift micro-operations. **Processor logic design:** - processor organization – Arithmetic logic unit - design of arithmetic circuit - design of logic circuit – Design of arithmetic logic unit - status register – design of shifter - processor unit – design of accumulator (Basic Concept Only).	11
3	**Control Logic Design:** Hardwired control-microprogrammed control-Microinstructions, Microprogram Sequencing. **Arithmetic algorithms:** Signed-Operand multiplication, Booth Algorithm,	12

	fast multiplication-bit pair recoding of multipliers. **Pipelining:** Basic principles**,** classification of pipeline processors, instruction and arithmetic pipelines (Design examples not required), hazard detection and resolution.	
4	**Memory system:** Types of memory (**Concepts only),** Virtual memory**,** Content addressable memory, cache memories - mapping functions. **I/O organization:** Characteristics of I/O devices, Data transfer schemes - Programmed controlled I/O transfer, Interrupt controlled I/O transfer. Organization of interrupts - vectored interrupts – Servicing of multiple input/output devices – Polling and daisy chaining schemes. Direct memory accessing (DMA)	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 Functional Units and Basic Operational Concepts	**K2**
CO2	Describe various micro-operations including arithmetic, logic, and shift operations.	**K2**
CO3	Analyze existing processor architectures to understand the implementation of pipelining and control strategies.	**K3**
CO4	Define interrupts and their role in handling I/O operations and system events.	**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	1						2		3
CO2	3	2	2	1						2		3
CO3	3	2	2	1						2		3
CO4	3	2	2	1						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 Organization	Hamacher C., Z. Vranesic and S. Zaky	McGraw Hill	5/e,2011
2	Digital Logic & Computer Design	Mano M. M	PHI	2004
3	Computer System Architecture	Mano M. M	PHI	2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Organization and Design	Patterson D.A. and J. L. Hennessy	Morgan Kaufmann Publishers	5/e,2013
2	Computer Organization and Architecture: Designing for Performance	William Stallings	Pearson,	9/e, 2013.
3	Computer Organization and Design	Chaudhuri P	Prentice Hall	2/e, 2008.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=msqxkEKFg8I&list=PLgHucKw979AvcnTpPNZMZyORdL5HvTr9m,, https://www.youtube.com/watch?v=k_QgyvsqtwA&list=PLgHucKw979AvcnTpPNZMZyORdL5HvTr9m&index=12
2	https://www.youtube.com/watch?v=0B-y1RPDXjs&list=PL59E5B57A04EAE09C&index=17
3	https://www.youtube.com/watch?v=AgoC0mlL6eQ&list=PLdS3u59E0DKjUKPcnCYxVxssEkX2zo-kV&index=8 https://www.youtube.com/watch?v=6CCwWCstDGc&list=PL1A5A6AE8AFC187B7&index=9https://www.youtube.com/watch?v=IQql2ojVzsU&list=PLEAYkSg4uSQ3dmkbCah82ek0KJnpz_DxL&index=5
4	https://www.youtube.com/watch?v=Wfau1WC5m4c

SEMESTER S4

COMPUTER NETWORKS

Course Code	**PCERT403**	**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 acquire practical skills in network design, configuration, and management which include learning about different network topologies, transmission media, routing algorithms, and quality of service techniques**.**

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction – Uses of computer networks, Network hardware, Network Software. Reference models – The OSI reference model, The TCP/IP reference model, Comparison of OSI and TCP/IP reference models. Physical Layer – Modes of communication, Physical topologies, Transmission media.	**8**
2	Data link layer - design issues, Error detection and correction, Sliding window protocols, High-Level Data Link Control (HDLC) protocol. Medium Access Control (MAC) sublayer –Channel allocation problem, Multiple access protocols, Ethernet, Wireless LANs - 802.11. Repeaters, Hubs, Bridges, Switches, Routers and Gateways.	**10**
3	Network layer Services. Routing algorithms - Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Congestion control algorithms. Quality of Service (QoS) - requirements, Techniques for achieving good QoS. Internet Protocols - IPv4-IPv4 addresses-IPv6 -The Internet Control	**14**

	Message Protocol - The Address Resolution Protocol-The Dynamic Host Configuration Protocol - Network Address Translation - Internet multicasting.	
4	Transport service – Services provided to the upper layers, Transport service primitives. User Datagram Protocol (UDP). Transmission Control Protocol (TCP) – Overview of TCP, TCP segment header, Connection establishment & release, Connection management modelling, TCP retransmission policy, TCP congestion control. Application Layer –File Transfer Protocol (FTP), Domain Name System (DNS), Electronic Mail (SMTP), Simple Network Management Protocol (SNMP), World Wide Web(WWW), Multimedia in the Internet, Real time interactive protocols-RTP,RTCP,SIP.	**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 uses of computer networks, their hardware, software, and different reference models.	**K2**
CO2	Analyze data link layer design issues, error detection, correction and various medium access control protocols.	**K3**
CO3	Design and evaluate network layer solutions characterized by routing and congestion control algorithms and implement IP protocols.	**K2**
CO4	Comprehend the concepts of TCP/UDP protocols and connection management including congestion control and retransmission policy.	**K2**
CO5	Understand the application layer protocols and techniques for implementing web based applications.	**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	3	-	-	-	-	-	-	-	-	-	1
CO2	2	2	3	2	-	-	-	-	-	-	-	2
CO3	2	3	2	-	-	-	-	-	-	-	-	2
CO4	2	3	3	-	-	-	-	-	-	-	-	2
CO5	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	Computer Networks	Andrew S. Tanenbaum	PHI (Prentice Hall India)	4/e,2008
2	Data Communication and Networking	Behrouz A Forouzan	Tata McGraw Hill	5/e,2013

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 and Bruce S Dave	Morgan Kaufmann.	5/e,2011
2	Computer Networking and the Internet	Fred Halsall	Addison-Wesley.	5/e,2005
3	James F. Kurose, Keith W. Ross	Computer Networking: A Top-Down Approach	Pearson Education	6/e,2012
4	Computer Networking with Internet Protocols.	William Stallings	Prentice-Hall,	4/e,2004
5	Data Communications and Computer Networks A Business User's Approach	Curt M. White	Course Technology, Cengage Learning	7/e, 2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106105183
2	https://nptel.ac.in/courses/106106091
3	https://onlinecourses.swayam2.ac.in/cec21_cs04/preview
4	https://onlinecourses.nptel.ac.in/noc22_cs19/preview

SEMESTER S4

INTEGRATED CIRCUITS

Course Code	**PBERT 404**	**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)	PBERT 304 Electronics Devices and Circuits	**Course Type**	Theory

Course Objectives:

1. To introduce students about integrated circuits and teach them how to construct and analyze circuits with the help of op-amps and other specialized ICs.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Operational amplifiers** Introduction of op-amp – block diagram of op-amp –Basic information of op-amp (741 op-amp) - Power supply requirements. Characteristics of Operational Amplifiers Ideal op amp characteristics - DC characteristics - input bias current, input offset current, input offset voltage, thermal drift, CMRR, PSRR - AC characteristics - frequency response, slew rate. Basic applications-inverting amplifier, non-inverting amplifier.	**9**
2	**Applications of Operational amplifiers** Differential amplifier, summing amplifier, scale changer, voltage follower, V-I converter (grounded load type and floating load type), I-V converter. Instrumentation amplifier (3 op amp) - op amp integrator - op amp differentiator, precision rectifier (half and full wave), peak detector, sample and hold circuit, Comparator (inverting and non-inverting type) – applications of comparator - zero crossing detector, Schmitt trigger, window detector	**9**

3	**Waveform generators and Oscillators** Timer IC 555- Functional block diagram – Waveform generators – Astable and mono stable – Design and working (using 555 and 741). Triangular and sawtooth –RC phase shift and Wien bridge oscillators (No analysis required) Voltage regulator - Introduction, series op amp regulator -IC regulators - 78XX and 79XX characteristics - voltage regulator as current source using 7805, Low voltage and high voltage regulators using 723 general purpose IC.	**9**
4	**Filters, PLL and Data Converters** Types of filters, first and second order LPF and HPF. Phase Locked Loop – Operation, Lock and capture range (No analysis), PLL IC 565, Applications - frequency multiplier, frequency translation. Data Converters: Digital to Analog converters, Specifications, Weighted resistor type and R-2R Ladder type. Analog to Digital Converters: Specifications, ADC –Direct type – Flash type, counter type, successive approximation type - Integrating type ADC - Single slope type.	**9**

Suggestion on Project Topics

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	Describe basics of operational amplifier and characteristics of op-amps.	**K2**
CO2	Design linear and nonlinear circuits using op-amp.	**K3**
CO3	Design op-amp oscillators, waveform generators and voltage regulators.	**K3**
CO4	Design circuits using Filters, PLL, DAC and ADC.	**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
CO2	3	2			3	2			3	2		3
CO3	3	2			3	3			3	2		3
CO4	3	2			3	3			3	2		3

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 Choudhury and Shail B Jain	New Age International Publishers	4/e, 2017
2	Op-Amps and Linear Integrated Circuits	Ramakant A. Gayakwad	Pearson	4/e, 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	Coughlin & Driscoll	Prentice Hall	6/e, 2009
2	Design with operational Amplifiers & Analog Integrated Circuits	Sergio Franco	Mc Graw Hill India	4/e, 2016
3	Integrated Circuits	K R Botkar	Khanna Publishers	10/e, 2010

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/108/108108111
2	https://archive.nptel.ac.in/courses/108/108/108108111
3	https://archive.nptel.ac.in/courses/108/108/108108111
4	https://archive.nptel.ac.in/courses/108/106/108106184

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

COMMUNICATION ENGINEERING

Course Code	**PEERT411**	**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)	GYEST104 Introduction to Electrical and Electronics Engineering	**Course Type**	Theory

Course Objectives:

1. To introduce the basic principles of analog and digital communication systems.
2. To familiarize with the satellite communication and cellular communication systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Analog Communication:** Introduction, elements of communication systems, need for modulation. Amplitude modulation: modulation index, average power, equation and spectrum of AM signal. Concept of DSB-SC and SSB. Angle modulation- frequency and phase modulation. FM frequency spectrum, modulation index, equation and spectrum of FM signal Narrow and wide band FM, Comparison of AM and FM.	9
2	**Digital Communication:** Principles of digital communication – sampling theorem, Nyquist criterion, quantization, encoding techniques-unipolar, bipolar and Manchester. Pulse modulation techniques- sampling process - PAM, PWM and PPM concepts, block diagram of PCM encoder and decoder.	9
3	**Satellite communication:** Introduction to satellite communication, types of satellite orbits. Space segment - introduction, power supply, Attitude and Orbit Control System (AOCS), thermal control subsystem, TT&C	9

	subsystem, transponders, antenna subsystem. Earth segment - types of earth station, Multiple Access (MA) techniques - FDMA, TDMA, CDMA, SDMA.	
4	**Cellular Communication:** Basic concepts, frequency reuse, interference, cell splitting, sectoring, cell system layout, Hand off-types and strategies, Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi-Max based communication.	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	Understand basic elements of AM and FM communication systems.	**K2**
CO2	Understand the concepts of digital communication systems.	**K2**
CO3	Understand various subsystems and multiple access techniques used in satellite communication systems	**K2**
CO4	Understand various aspects of frequency reuse, Handoffs, cell splitting and channel assignment	**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
CO2	3											3
CO3	3					2						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	Electronic Communication Systems	Kennedy G.	McGraw-Hill, New York,	6th edition, 2017
2	Digital Communications	Bernard Sklar	Pearson	2nd edition, 2009
3	Satellite Communication	Dennis Roddy	McGraw-Hill	4th edition 2017
4	Wireless Communication Principles and practice	Theodore S Rappaport	Pearson	2nd edition, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Communication Systems	William Scheweber	Prentice Hall of India LTD, New Delhi	4^{th} edition, 2004
2	Electronic Communication Systems	Wayne Tomasi	Prentice Hall of India LTD, New Delhi, 2004.	5^{th} edition, 2003
3	Electronic Communication	Roody and Coolen	Prentice Hall of India	4^{th} edition, 2008
4	Communication Systems	Simon Haykins	John Wiley	4^{th} edition, 2006

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	http://acl.digimat.in/nptel/courses/video/117105143/L16.html
2	https://nptel.ac.in/courses/117101051
3	https://archive.nptel.ac.in/courses/117/105/117105131
4	https://nptel.ac.in/courses/106106167

SEMESTER S4

BASIC VLSI DESIGN

Course Code	PEERT 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)	None	Course Type	Theory

Course Objectives:

1. To bring circuits and system views on design together.
2. To understand the design of digital VLSI circuits for hardware design.
3. To develop the skill to design various VLSI circuits.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Overview of CMOS device fundamentals (Pre-requisite). The CMOS inverter: - Voltage Transfer Characteristics, Static Behavior - Switching Threshold - Noise Margins, Dynamic behavior - Device Capacitances - Propagation Delay - Power Consumption-SPICE code of an Inverter	9
2	CMOS fabrication Processes: -N-Tub, P-Tub and Twin Tub.Layout design of static MOS circuits -MOS Circuit Layout – Use of Stick diagrams, Layout design rules, Transistor layout - PMOS and NMOS, Gate Layout - Inverter, NAND, NOR.	9
3	Combinational logic Circuits: - Static MOS - Complementary MOS - Ratioed logic - Pass Transistor logic - Differential Pass Transistor Logic - Transmission gate logic, Dynamic MOS - Basic Principles - Speed and power Dissipation, Domino Logic	9
4	Design of the Memory Core - Read Only Memories - Non-volatile Read Write Memories - Read Write memories - SRAM and DRAM. Scaling of MOS circuits: scaling models and scaling factors for device parameters.	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 static and dynamic characteristics of CMOS Inverters	**K2**
CO2	Explain physical layout for various MOS Circuits	**K2**
CO3	Explain various Combinational Logic Circuits	**K2**
CO4	Explain various types of Memory Elements	**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			3							3
CO2	3	2			3							3
CO3	3	2										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 Integrated Circuits- A Design Perspective	J.M. Rabaey, A. Chandrakasan and B. Nikolic	Pearson	Second Edition, 2003
2	Basic VLSI Design	Douglas A. Pucknell& Kamran Eshraghian	PHI	Third Edition, 1995
3	CMOS digital integrated circuits: Analysis and design	Sung-Mo Kang, Yusuf Lablebici	TATA McGraw-Hill	Third Edition, 2002

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	CMOS Logic Circuit Design	John P. Uyemura	Springer India Pvt. Ltd	First Edition, 1999
2	CMOS VLSI Design, a Circuits and Systems Perspective	Neil H. E. Weste, David Money Harris	PEARSON	Fourth Edition, 2015

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/117106092
2	https://onlinecourses.nptel.ac.in/noc22_ee08/preview
3	https://nptel.ac.in/courses/117106092
4	https://onlinecourses.nptel.ac.in/noc22_ee08/preview

SEMESTER S4

BIOMEDICAL SIGNALS &TRANSDUCERS

Course Code	**PEERT413**	**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 is intended to provide students an insight into cellular electrophysiology and variousbiomedical transducers used for signal acquisition

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Cell Potentials**: Cell membrane- Action potentials – ionic basis of generation – Nernst potential, Goldman Hodgkin Katz equation. Auto rhythmic cells - cardiac action potentials.Synapses&Neuronal Integration Synaptic potentials – EPSP & IPSP -Neurotransmitters – types	9
2	**Biosignals and Acquisition Methods:** ECG- Generation of cardiac action potentials -Characteristics of ECG Signal -Lead systems- Clinical applications of ECG. EEG- Brain action potentials- characteristics of signal-Electrode system - Clinical applications of EEG. EMG-Electrical activity of muscles –Characteristics of EMG signal- Clinical applications of EMG	9
3	**Biosensors:** Photochemistry of vision--Hearing- endo cochlear potentials. Biosensors-Types-Bio recognition elements in biosensors-immobilization methods-ISFET- Enzyme electrodes. Nanomaterial based biosensors-Applications of biosensors-Biosensors for clinical diagnostics **Biomedical Transducers and Electrodes**: Temperature transducers-Displacement &Pressure transducers- piezo electric transducers- Electrodes for biopotential measurement- catheter tip transducers	9
4	**Diagnostic Radiology**: Production of diagnostic X-ray-X-ray tubes-principle of image formation-Functional blocks of X-ray machine – tubes for various applications.	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	Understand the cellular mechanism of production of action potentials	**K2**
CO2	Understand the characteristics of bio signals and biomedical signal acquisition systems	**K2**
CO3	Understand the fundamentals of biosensors and its applications	**K2**
CO4	Apply the knowledge of electrodes& transducers for various biomedical measurements	**K3**
CO5	Understand the basic principles of diagnostic radiology	**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								2
CO2	1	2	2	2	2	2						2
CO3		2	2	2	2	2						2
CO4	2	2	2	2	2	2						2
CO5		2	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	Text book of Medical Physiology	Guyton and Hall:	Saunders, an imprint of Elsevier Inc.	12thedn, 2011
2	Principles of Biomedical Instrumentation and measurements	Richard Aston:		
3	Biosensors Fundamentals and Applications,	Bansi DharMalhotra, Chandra Mouleypandy:	Smithersrapra,	Ist edn,2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Biosensors an introductory text book,	JagrithiNarang, ChandrashekharPundir	Pan Stanford Publishing,	I[st]edn, 2017
2	Hand book of biomedical Instrumentation,	R S Khandpur:	Mc Graw Hill, 2nd edition	2nd edition
3	Principles of Applied Biomedical Instrumentation,	Geddes and Baker:	Wiley Inter science publications,	1989
4	A Manual of radiographic equipment,	Sybil M Stockly;	Churchil Living Stone,	, 1986

SEMESTER S4

FOUNDATIONS OF MACHINE LEARNING

Course Code	PEERT 414	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 basic principles of machine learning
2. To study the basics of supervised and unsupervised learning.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Machine Learning-** Machine learning paradigms-supervised, semi-supervised, unsupervised, reinforcement learning. Features: Types of Data (Qualitative and Quantitative), Scales of Measurement (Nominal, Ordinal, Interval, Ratio), Concept of Feature, Feature Construction, Feature Selection and Transformation.	9
2	**Supervised Learning -** Classification: K-Nearest Neighbour, Naïve Bayes, Decision Tree algorithm ID3, Support Vector Machine,Regression: Linear regression, logistic regression, Neural Networks- The Perceptron, Activation Functions, Training Feed Forward Network by Back Propagation.	9
3	**Unsupervised Learning** - Clustering Methods - K-means clustering,Hierarchical Clustering Methods, Density based clustering.Dimensionality Reduction Techniques- Principal component analysis, Linear Discriminant Analysis.	9
4	**Evaluating model performance-**Confusion matrices, Precision and recall, Sensitivity and specificity, F-measure, ROC curves, Cross validation, K-fold cross validation, Bootstrap sampling. Improving model performance - Bagging, Boosting, Random forests.	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 Machine Learning concepts (Cognitive Knowledge Level: Understand)	**K2**
CO2	Illustrate the concepts of classification methods (Cognitive Knowledge Level: Apply)	**K3**
CO3	analyze clusters using different methods (Cognitive Knowledge Level: Apply)	**K3**
CO4	Evaluate & improve the performance of machine learning classification models (Cognitive Knowledge Level: Apply)	**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
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	Introduction to Machine Learning,	EthemAlphaydin	MIT Press	$3rd$ Edition, MIT Press,2014
2	Machine Learning	Mitchell, Tom	New York, NY: McGraw-Hill	1997. ISBN: 9780070428072

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	Christopher M. Bishop	Springer	2006
2	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy.	MIT Press	2012
3	Elements of Machine Learning,	P. Langley	Morgan Kaufmann	1995
4	Data Mining and Analysis: Fundamental Concepts and Algorithms	Mohammed J. Zaki and Wagner Meira	Cambridge University Press,	First South Asia edition, 2016
5	Introduction to Machine Learning with Python: A Guide for Data Scientists	Andreas Muller and Sarah Guido,	Shroff/O'Reilly	2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=fC7V8QsPBec&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&index=2 https://www.youtube.com/watch?v=9vMpHk44XXo&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&index=5
2	https://www.youtube.com/watch?v=OTAR0kT1swg&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&index=3 https://www.youtube.com/watch?v=_M7Km1XZERU&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&index=9 https://www.youtube.com/watch?v=yG1nETGyW2E
3	https://www.youtube.com/watch?v=HTSCbxSxs-g https://www.youtube.com/watch?v=tlIv3IT_hHk
4	https://www.youtube.com/watch?v=sosZp0cUsIk&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&index=45 https://www.youtube.com/watch?v=9Iq6pz9XJ7w&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&index=46 https://www.youtube.com/watch?v=foWzsWFAmas&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&index=54 https://www.youtube.com/watch?v=NrdtKndsC1I&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&index=55 https://www.youtube.com/watch?v=6K48CbOm99Y&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77&index=57

SEMESTER S4

OBJECT ORIENTED PROGRAMMING USING JAVA

Course Code	**PEERT416**	**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)	GBEST204	**Course Type**	Theory

Course Objectives:

1. Understand and apply foundational object-oriented programming concepts in Java, including classes, objects, inheritance, polymorphism, encapsulation, and abstraction.
2. Design and implement Java applications that leverage OOP principles to achieve modularity, reusability, and scalability in software development.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Object-Oriented concepts, Introduction to Java - Java programming and Runtime Environment, Development Platforms- Java Virtual Machine (JVM), Java compiler, Bytecode, Java Buzzwords, Java program structure, Comments. Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, 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**
2	Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Introduction to Methods, Constructors, this Keyword, Method Overloading, Using Objects as Parameters, Returning Objects. Static Members, Final Variables, Inner Classes. Inheritance - Super Class, Sub Class, The Keyword super, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, using final with Inheritance.	**9**

	Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.	
3	Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw, throws and finally. Java Library - String Handling – String Constructors, String Length, Special String Operations -Character Extraction, String Comparison, Searching Strings, Modifying Strings. Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.	**9**
4	Event handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces. Swings fundamentals-Swing Controls, Components and Containers, Swing Packages, Event Handling in Swings, Swing Layout Managers, Exploring Swings –JFrame, JLabel , Swing Buttons, JText Field. Java Database Connectivity (JDBC) - JDBC overview, Creating and Executing Queries – create table, delete, insert, select.	**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	Understand and apply fundamental Java programming concepts, including the runtime environment, primitive data types, operators, and control statements, to develop efficient and well-structured Java applications.	**K2**
CO2	Apply key object-oriented programming principles in Java, leveraging packages and interfaces effectively to design and implement Java applications.	**K3**
CO3	Confidently handle Java exceptions, manipulate strings effectively, and implement multithreaded programming techniques.	**K3**
CO4	Develop Java applications that integrate event handling, Swing-based graphical user interfaces, and JDBC database connectivity to create robust and user-friendly software solutions.	**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	3									2
CO2	3	3	3									2
CO3	3	3	3		2							2
CO4	3	3	3		2							2
CO5	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	Java: The Complete reference	Herbert Schildt	Tata McGraw Hill	8/e, 2011.
2	Java How to Program, Early Objects	Paul Deitel, Harvey Deitel	Pearson	11/e, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Java Programming	Y. Daniel Liang	Pearson	7/e, 2013
2	Programming JAVA a Primer	Balagurusamy E	Tata McGraw Hill	5/e, 2014
3	Core Java: An Integrated Approach	Nageswararao R	Dreamtech Press	2008
4	Java in A Nutshell	Flanagan D	O'Reilly	5/e, 2005

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_cs105
2	https://onlinecourses.nptel.ac.in/noc24_cs105
3	https://onlinecourses.nptel.ac.in/noc24_cs105
4	https://onlinecourses.nptel.ac.in/noc24_cs105

SEMESTER 4

JAVA PROGRAMMING AND APPLICATION DEVELOPMENT

Course Code	PEERT 415	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)	UCEST105: Algorithmic Thinking with Python GYEST204: Programming in C	Course Type	Theory

Course Objectives:

1. Understand and apply foundational object-oriented programming concepts in Java, including classes, objects, inheritance, polymorphism, encapsulation, and abstraction.
2. Design and implement Java applications that leverage OOP principles to achieve modularity, reusability, and scalability in software development.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Object-Oriented concepts, Introduction to Java - Java programming and Runtime Environment, Development Platforms- Java Virtual Machine (JVM), Java compiler, Bytecode, Java Buzzwords, Java program structure, Comments. Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, 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
2	Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Introduction to Methods, Constructors, this Keyword, Method Overloading, Using Objects as Parameters, Returning Objects. Static	9

	Members, Final Variables, Inner Classes. Inheritance - Super Class, Sub Class, The Keyword super, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, using final with Inheritance. Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.	
3	Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw, throws and finally. Java Library - String Handling – String Constructors, String Length, Special String Operations -Character Extraction, String Comparison, Searching Strings, Modifying Strings. Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.	9
4	Event handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces. Swings fundamentals-Swing Controls, Components and Containers, Swing Packages, Event Handling in Swings, Swing Layout Managers, Exploring Swings –JFrame, JLabel, Swing Buttons, JText Field. Java Database Connectivity (JDBC) - JDBC overview, Creating and Executing Queries – create table, delete, insert, select.	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

Assignment: 20 Marks

Students should design and implement a real-world application using object-oriented programming principles, evaluate and refine their class structures and relationships, provide a conclusion on the effectiveness of their design, and demonstrate the functionality of their application using Java.

Criteria for evaluation:

1. ***Problem Definition (K4 - 4 points)***
   1. *Clearly defines the real-world problem.*
   2. *Examine and identifies relevant contextual factors (constraints, resources, objectives).*
2. ***Problem Analysis (K4 - 4 points)***
   1. *Break-down and presents a well-reasoned solution approach.*
   2. *Compare and justify the proposed solutions with evidence and logical reasoning.*
3. ***Evaluate (K5 - 4 points)***
   1. *Thoroughly evaluate the proposed solutions.*
   2. *Compares trade-offs, advantages, and disadvantages.*
   3. *Considers feasibility, scalability, and practical implications.*
4. ***Implementation (K5 - 4 points)***
   1. *Select the most feasible solution by implementing the proposed solutions.*
   2. *Successfully translates the chosen solution into code.*
   3. *Demonstrates proficiency in coding practices (readability, efficiency, error handling).*
5. ***Conclusion (K4- 2 points, K5 – 2 points)***
   1. *Summarizes findings and insights. State which solution is most appropriate for the problem.* ***(K4)***
   2. *Reflects critical thinking and informed decision-making.* ***(K5)***

Scoring:

1. ***Accomplished (4 points)****: Exceptional analysis, clear implementation, and depth of understanding.*
2. ***Competent (3 points)****: Solid performance with minor areas for improvement.*
3. ***Developing (2 points)****: Adequate effort but lacks depth or clarity.*
4. ***Minimal (1 point)****: Incomplete or significantly flawed.*

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	Understand and apply fundamental Java programming concepts, including the runtime environment, primitive data types, operators, and control statements, to develop efficient and well-structured Java applications.	Apply
CO2	Apply key object-oriented programming principles in Java, leveraging packages and interfaces effectively to design and implement Java applications.	Analysis
CO3	Confidently handle Java exceptions, manipulate strings effectively, and implement multithreaded programming techniques.	Apply
CO4	Develop Java applications that integrate event handling, Swing-based graphical user interfaces, and JDBC database connectivity to create robust and user-friendly software solutions.	Analysis
CO5	Evaluate any real-world problem and propose a solution using the concepts learned in this course.	Evaluate

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							2
CO4	3	3	3		2							2
CO5	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	Java: The Complete reference	Herbert Schildt	Tata McGraw Hill	8/e, 2011.
2	Java How to Program, Early Objects	Paul Deitel, Harvey Deitel	Pearson	11/e, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Java Programming	Y. Daniel Liang	Pearson	7/e, 2013
2	Programming JAVA a Primer	Balagurusamy E	Tata McGraw Hill	5/e, 2014
3	Core Java: An Integrated Approach	Nageswararao R	Dreamtech Press	2008
4	Java in A Nutshell	Flanagan D	O'Reilly	5/e, 2005

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105191/
2	https://archive.nptel.ac.in/courses/106/105/106105191/
3	https://archive.nptel.ac.in/courses/106/105/106105191/
4	https://archive.nptel.ac.in/courses/106/105/106105191/

SEMESTER S3/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 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	6

	Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	
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: 40 marks , ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/Case Study/ Microproject	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	7^{TH} 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,	**6**

	Gendered technologies & innovations**, Ethical values and practices in connection with gender -** equity, diversity & gender justice, **Gender policy and women/transgender empowerment initiatives.**	
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 ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	**6**
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	**6**

	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.	

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.
7	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

COMPUTER NETWORKING LAB

Course Code	**PCERL407**	**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)	GBEST204	**Course Type**	Lab

Course Objectives:

1. To analyze and implement various network communication and flow control protocols.
2. To simulate network congestion control and routing mechanisms alongside studying traffic analysis to develop skills in identifying and mitigating network congestion issues in diverse network environments...

Expt. No.	**Experiments**
1	Familiarize and understand basics of network configuration files, networking commands and the functioning of system calls used for network programming in Linux.*
2	Implement client-server communication using socket programming and TCP as transport layer protocol*
3	Implement client-server communication using socket programming and UDP as transport layer protocol*
4	Implement the framing methods employed in Data link layer.* a. Bit stuffing Character stuffing
5	Simulate sliding window flow control protocols.* a. Stop and Wait b. Go back N Selective Repeat
6	Implement and simulate algorithm for Distance Vector Routing protocol.*
7	Implement Simple Mail Transfer Protocol.
8	Implement File Transfer Protocol.*

9	Understanding the Wireshark tool.*
10	Implement congestion control using a leaky bucket algorithm.*
11	Study of NS2 simulator*
12	Design and configure a network with multiple subnets with wired and wireless LANs using required network devices. Configure commonly used services in the network.

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	Familiarize the fundamentals of networking commands, configuration files and the use of system calls for network programming.	**K2**
CO2	Implement and interpret client-server communication through socket programming, employing TCP and UDP as transport layer protocols.	**K3**
CO3	Implement simulation of sliding window flow control protocols routing protocols and framing methods using programmatic approach.	**K3**
CO4	Implement and simulate file transfer protocols and congestion control algorithms for networking	**K3**
CO5	Familiarize network configuration tools for configuring network with multiple subnets.	**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
CO2	3		2	2	2				2			2
CO3	3		2	2	2				2			2
CO4	3		2	2	2				2			2
CO5	3		2	2					2			2

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 Networks	Andrew S. Tanenbaum	PHI (Prentice Hall India)	4/e,2008
2	Data Communication and Networking	Behrouz A Forouzan	Tata McGraw Hill	4/e,2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Networking and the Internet	Fred Halsall	Addison-Wesley.	5/e,2005
2	James F. Kurose, Keith W. Ross	Computer Networking: A Top-Down Approach	Pearson Education	6/e,2012
3	TCP/IP Sockets in C	Michael J Donahoo	Morgan Kaufmann Publishers	2/e
4	Hands-On Network Programming with C	Lewis Van Winkle	Packt Publishing	2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106105183
2	https://nptel.ac.in/courses/106106091
3	https://onlinecourses.swayam2.ac.in/cec21_cs04/preview
4	https://onlinecourses.nptel.ac.in/noc22_cs19/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 S4

INTEGRATED CIRCUITS LAB

Course Code	**PCERL 408**	**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)	PBERT 304:Electronic Devices and Circuits	**Course Type**	Lab

Course Objectives:

1. To impart ability to handle the various electronic instruments and trouble shoot circuits.
2. To gain hands-on experience in designing electronic circuits using integrated circuits, transistors and diodes.

Expt. No.	Experiments
1	Measurement of current, voltage, frequency and phase shift of signal in a RC network using oscilloscope.
2	Rectifier circuits with and without C filter.
3	Clipping and clamping circuits using diodes.
4	RC coupled amplifier using BJT in CE Configuration-Measurement of gain, BW and plotting of frequency response.
5	Op-amp circuits – Design and set up of inverting and non-inverting amplifier
6	Op-amps circuits – adder, integrator, and differentiator.
7	Precision rectifier using Op-amps.
8	Phase shift oscillator and Wien's Bridge oscillator using Op-amps.
9	Waveform generation– Square, triangular and saw tooth waveform generation using Op-amps.
10	Basic comparator and Schmitt trigger circuits using Op-amp
11	Astable and Monostable circuits using 555 IC.
12	D/A Converters - R-2R ladder circuit.

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	Use the various electronic instruments for conducting experiments	Apply
CO2	Design and develop various electronic circuits using diodes.	Apply
CO3	Design and implement amplifier and oscillator circuits using BJT	Apply
CO4	Design and implement basic circuits using IC (OPAMP and 555 timers).	Apply

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			
CO2	3	3	3						3			
CO3	3	3	3						3			
CO4	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	Electronic Devices and Circuit Theory	R E Boylstead and L Nashelsky	Pearson Education	11/e, 2015
2	Pulse, digital and Switching Waveforms,	Millman and Taub	Tata McGraw Hill	2007
3	Opamps and Linear Integrated circuits	Coughlin & Driscoll	Prentice Hall	6/e, 2009
4	Linear Integrated Circuits,	Choudhury R.,	New Age International Publishers	4/e, 2017

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	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 5

ELECTRONICS & COMPUTER ENGINEERING

SEMESTER S5

DIGITAL SIGNAL PROCESSING

Course Code	PCERT 501	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 understand the various design techniques and realization methods of FIR and IIR filters.
2. To describe signals mathematically and understand how to perform mathematical operations on signals.
3. To understand the analytical tools such as Discrete Time Fourier Transforms, Discrete Fourier Transforms, Fast Fourier Transforms and Z-Transforms required for digital signal processing.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Signals, Systems and Digital Signal Processing:** Continuous and Discrete Time Signals, Generation of Discrete Time Signals – Sampling, Elementary Discrete Time Signals. Classification of signals (Continuous and Discrete) - Periodic and Non-Periodic Signals, Energy and Power Signals, Even and odd signals. Operations on Signals (Continuous and Discrete) - Shifting, Folding, Scaling. Discrete Time Systems-Properties of Discrete Time Systems-Linearity, Time invariance, Causality, Stability. Linear Time Invariant (LTI) Systems – Convolution sum, Impulse response. Difference Equation representation of LTI Systems. Z-transform-Properties of Z-transform, Inverse Z-transform, System Transfer function. Basic Elements of Digital Signal Processing (DSP) System, Typical DSP applications.	11
2	**Frequency Domain Representation of Discrete-Time Signals:** Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT)-	10

	Properties. Circular convolution and its relationship with linear convolution; Relationship between DTFT and DFT Efficient Computation of DFT: Fast Fourier Transform (FFT) Algorithms- Radix-2 Decimation in Time (DIT) and Decimation in Frequency (DIF) FFT Algorithms, IDFT computation using Radix-2 FFT Algorithms	
3	**Design of Digital Filters:** Classification of Digital filters: FIR Filter, IIR Filter. Types of filters-LPF, HPF, BPF, BSF Design of FIR Filters: Linear Phase FIR filters-Symmetric and Anti-symmetric FIR Filters, Gibbs Phenomenon, Design of linear phase FIR filters using Window method (Rectangular, Hamming and Hanning). Design of IIR Digital Filters: Analog Filters (Butterworth), Analog Butterworth Prototype LPF filter design, IIR Filter Design using Impulse Invariance, and Bilinear Transformation, Frequency Transformations in the Analog domain (LPF and HPF only)	**11**
4	**Realization of Digital Filters:** Structures for the realization of Discrete Time Systems: Block diagram and signal flow graph representations of filters. FIR Filter Structures: Linear Phase realization, Direct Form, Cascade Form. IIR Filter Structures: Direct Form, Cascade Form and Parallel Form. **DSP architecture:** Introduction to TMS320C67xx digital signal processor, Functional Block Diagram and Description. Finite word length effects in DSP systems: Introduction (analysis not required), fixed-point and floating- point DSP arithmetic, ADC quantization noise, Round-off error	**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	Summarize the fundamental concepts of discrete-time signals, systems, digital signal processing and obtain the transfer function of system using Z-transform.	**K2**
CO2	Illustrate the fundamental concepts of DFT and compute DFT and IDFT.	**K2**
CO3	Design FIR filters and IIR filters for the given specifications.	**K3**
CO4	Realize the various FIR and IIR filter structures for given the system function	**K2**
CO5	Explain the architecture ofTMS320C67xxDSPprocessorandthe finite word length effects in DSP 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	2	2	1									2
CO2	2	3	3									2
CO3	2	3	3									2
CO4	2	2	2									2
CO5	2	1	1									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 Signal Processing	Proakis J. G. and Manolakis D. G.	Pearson Education	4/e, 2007
2	Discrete-Time Signal Processing	Alan V Oppenheim, Ronald W. Schafer	Pearson Education	3/e, 2014
3	Digital Signal Processing: A Computer Based Approach	Mitra S. K.	McGraw Hill	4/e, 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: A Practical Approach	Ifeachor E.C. and Jervis B. W	Pearson Education	2/e,2009
2	Understanding Digital Signal Processing	Lyons, Richard G.	Pearson Education	3/e,2004
3	Digital Signal Processing	Salivahanan S	McGraw - Hill Education	4/e,2019
4	DSP applications using C and the TMS320C6x DSK.	Chassaing, Rulph	John Wiley & Sons	2003
5	Digital Signal Processing	Vinay K. Ing1e, John G. Proakis	Thomson	2004

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc21_ee28/preview
2	https://nptel.ac.in/courses/117105134
3	https://nptel.ac.in/courses/117102060
4	https://onlinecourses.nptel.ac.in/noc22_ee99/preview

SEMESTER S5

THEORY OF COMPUTATION

Course Code	PCERT 502	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. Design and implement Java applications that leverage OOP principles to achieve modularity, reusability, and scalability in software development.
2. Understand and apply foundational object-oriented programming concepts in Java, including classes, objects, inheritance, polymorphism, encapsulation, and abstraction.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to formal language theory – Alphabets, Strings, Concatenation of strings, Languages. Regular Languages - Deterministic Finite State Automata (DFA), Nondeterministic Finite State Automata (NFA), Equivalence of DFA and NFA (Proof not required), Regular Grammar (RG), Equivalence of RGs and DFA (Proof not required).	11
2	Regular Expression (RE), Equivalence of REs and DFA (proof not required), Pumping Lemma for regular languages. Closure Properties of Regular Languages, DFA state minimization (Myhill-Nerode Theorem). Applications of MNT	11
3	Context Free Grammar (CFG), derivation trees and ambiguity. Nondeterministic Pushdown Automata (PDA), Deterministic Pushdown Automata (DPDA). Pumping Lemma for Context-Free Languages (Proof not required), Closure Properties of Context Free Languages.	11

4	Context Sensitive Languages - Context Sensitive Grammar (CSG), Linear Bounded Automata. Turing Machines - Standard Turing Machine, Robustness, Recursive and Recursively Enumerable Languages. Chomsky classification of formal languages.	**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 and analyze deterministic and nondeterministic finite automata and understand their equivalence with regular grammars.	**K2**
CO2	Apply regular expressions, finite automata, the pumping lemma, closure properties, and the Myhill-Nerode Theorem for DFA minimization.	**K3**
CO3	Understand and apply context-free grammars, derivation trees, and ambiguity resolution, along with the design and analysis of nondeterministic and deterministic pushdown automata, the pumping lemma, and closure properties of context-free languages.	**K3**
CO4	Understand and apply context-sensitive grammars, linear bounded automata, standard Turing machines, and the classification of formal languages, including recursive and recursively enumerable languages.	**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									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	Automata and Computability	Dexter C. Kozen	Springer	2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Automata Theory, Languages, and Computation	John E Hopcroft, Rajeev Motwani and Jeffrey D Ullman,	Pearson Education	3/e, 2008
2	Introduction To Theory of Computation	Michael Sipser,	Cengage Publishers	2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/104/106104148/
2	https://archive.nptel.ac.in/courses/106/104/106104148/
3	https://archive.nptel.ac.in/courses/106/104/106104148/
4	https://archive.nptel.ac.in/courses/106/104/106104148/

SEMESTER S5

MICROCONTROLLERS AND INTERFACING

Course Code	**PCERT 503**	**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)	PCERT 402 Computer Organization and Architecture	**Course Type**	Core

Course Objectives:

1. To introduce the students to the architectural features of microcontrollers, capabilities of microcontroller and their utilisation.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**8051 Microcontroller:** Introduction, comparison of Microprocessor and microcontroller, Evolution of microcontrollers from 4-bit to 32-bit, Selection of microcontrollers, Applications of microcontrollers. 8051 Architecture-Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.	**9**
2	Addressing modes and accessing memory using various addressing modes, instruction set: Arithmetic, Logical, Simple bit, jump, loop and call instructions, Stack, Stack and Subroutine instructions. Assembly language program examples	**9**
3	Timers and Counters, Interrupts, interfacing seven segment displays, displaying information on an LCD, control of a stepper Motor, ADC, DAC. 8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming to transmit a message and to receive data serially.	**9**

4	ARM processor fundamentals – Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions, Architecture Revisions. Introduction to ARM family, ARM7 register architecture, ARM programmer's model. Raspberry pi 4 board - Introduction and brief description.	**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 features of various microcontroller	**K2**
CO2	Write and execute assembly language programs for given application	**K3**
CO3	Interface microcontroller with hardware for given application	**K3**
CO4	Able to understand architecture of the ARM 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	2										
CO2	3	3	3									
CO3	3	3	3	3	2							
CO4	3	2										

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 Gillespie Mazidi and Rollin D. McKinlay	Pearson	**2e, 2007**
2	The 8051 Microcontroller	Kenneth J. Ayala	Cengage	**3e, 2007**
3	ARM System - on-chip Architecture	Steve Furber	Pearson Education	**2e, 2001**
4	ARM System Developer's guide	Andrew N. Sloss, Dominic Symes, Chris Wright	Morgan Kaufman	**2004**
5	Microcontrollers: Architecture, Programming, Interfacing and System Design	Raj Kamal	Pearson Education	**2005**

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The 8051 Microcontroller Based Embedded Systems	Manish K Patel	McGraw Hill	**2014**

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/105/108105102/
2	https://archive.nptel.ac.in/courses/108/105/108105102/
3	https://archive.nptel.ac.in/courses/108/105/108105102/
4	https://archive.nptel.ac.in/courses/108/105/108105102/

SEMESTER S5

DATABASE MANAGEMENT SYSTEMS

Course Code	**PBERT504**	**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)		**Course Type**	Theory

Course Objectives:

1. Gain a comprehensive understanding of database fundamentals, including the architecture, languages, and classification of database management systems (DBMS).
2. Develop skills in designing and implementing databases using the Entity-Relationship (ER) model and relational model, including translating ER diagrams into relational schema and performing normalization.
3. Acquire knowledge of database concepts such as transaction processing, concurrency control, recovery mechanisms, and the characteristics and types of NoSQL databases.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of Database - Introduction and applications of DBMS, Purpose of database, View of Data, Database Languages, Database architecture and Classification, Database users and Administrators. ER model - Entity Sets, Relationship Sets, Attributes, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams. Introduction to Relational Model - Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Algebra, Synthesizing ER diagram to relational schema.	**10**
2	Introduction to Structured Query Language (SQL) - Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Views, assertions, Triggers.	**9**

3	Relational Database Design - Different anomalies in designing a database, the idea of normalization, Functional dependency, Armstrong's Axioms (proofs not required), Closures and their computation, Equivalence of Functional Dependencies (FD), Minimal Cover (proofs not required). First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce Codd Normal Form (BCNF).	**8**
4	Transaction Processing Concepts - overview of concurrency control, Transaction Model, Significance of concurrency Control & Recovery, Transaction States, System Log, Desirable Properties of transactions. Serial schedules, Concurrent and Serializable Schedules, Conflict equivalence and conflict serializability, Recoverable and cascade-less schedules, Locking, Two-phase locking and its variations. Log-based recovery, check-pointing. NoSQL Databases - Introduction, properties of NoSQL Databases, types of No SQL Databases.	**9**

Course Assessment Method

(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	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 =16 marks)**	• 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 3 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	Comprehend and exemplify the fundamental nature and characteristics of database systems, and model real-world scenarios using Entity-Relationship diagrams.	Apply
CO2	Develop and execute efficient queries to create, manage, and retrieve data in relational databases.	Apply
CO3	Demonstrate the features of Normalization in database applications.	Apply
CO4	Discuss and compare the aspects of Concurrency Control and Recovery in Database systems.	Apply
CO5	Explain various types of NoSQL databases.	Understand

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	2								3
CO2	2	3	3	2								3
CO3	2	3	3	2								3
CO4	2	3	3							1		3
CO5	1	1	1		2					1		3

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Database Systems: Models, Languages, Design and Application Programming	Elmasri R. and S. Navathe	Pearson Education	6/e, 2013
2	Database System Concepts	Sliberschatz A., H. F. Korth and S. Sudarshan	McGraw Hil	6/e, 2011

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	NoSQL Data Models: Trends and Challenge	**Olivier Pivert (Editor)**	Wiley	2018
2	NoSQL for Dummies	Adam Fowler	John Wiley & Sons	**2015**

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106105175
2	https://www.coursera.org/learn/sql-data-science
3	https://www.udemy.com/course/database-normalization-simplified
4	https://archive.nptel.ac.in/courses/106/104/106104135/

SEMESTER S5

WIRELESS SENSOR NETWORKS

Course Code	PEERT 521	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	4/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand the fundamentals of wireless sensor networks and its applications.
2. To study the various protocols at various layers.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction and Overview of Wireless Sensor Networks: Background of Sensor Network Technology – Application of Sensor Networks-Basic overview of the technology- Basic Sensor Network Architectural Elements-Survey of Sensor Networks - Applications of Sensor Networks: Introduction-Background-Range of Applications-Examples of Category 2 WSN Applications- Examples of Category 1 WSN Applications-Taxonomy of WSN Technology.	9
2	Basic Wireless Sensor Technology: Introduction-Sensor Node Technology-Sensor Taxonomy. WN Operating Environment- WN Trends -Wireless Transmission Technology and Systems: Radio Technology Primer-Propagation and Propagation Impairments- Available Wireless Technologies-Campus Applications- MAN/WAN Applications.	9
3	Medium Access Control Protocols for Wireless Sensor Networks: Introduction- BackgroundFundamentals of MAC Protocols-Performance Requirements-Common Protocols-MAC Protocols for WSNs-Sensor-MAC Case Study-IEEE 802.15.4 LR –WPANs Standard Case Study-PHY Layer-	9

	MAC Layer.	
4	Routing Protocols for Wireless Sensor Networks: Data Dissemination and Gathering-Routing Challenges and Design Issues in Wireless Sensor Networks-Routing Strategies in Wireless Sensor Networks- Transport Control Protocols for Wireless Sensor Networks: Traditional Transport Control Protocols- Transport Protocol Design Issues- Examples of Existing Transport Control Protocols-Performance of Transport Control Protocols-Middleware for Wireless Sensor Networks : WSN Middleware Principles-Middleware Architecture-Existing Middleware.	**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 overview of wireless sensor networks and wireless sensor node architectures.	**K2**
CO2	Discuss the basic Wireless Sensor Technology and its applications.	**K2**
CO3	Explain the MAC protocols developed for WSN.	**K2**
CO4	Describe the infrastructure, topology, routing, Challenges and Design Issues for wireless sensor networks	**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	2		2		
CO2	3	2	1			2	2	1				2
CO3	2	2	1		1	1				2		1
CO4	2	2	1			1	1	1		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	Wireless Sensor Networks: Technology, Protocols, and Applications	Kazem Sohraby, Daniel Minoli and Taieb Znati	John Wiley & Sons	2007

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Protocols and Architectures for Wireless Sensor Networks	Holger Karl and Andreas Willig	John Wiley & Sons	2007
2	Handbook of Sensor Networks:Compact Wireless and Wire Sensing System	Mohammad Ilyas and Imad MahGoub	CRC Press	2005

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106/105/106105160/
2	https://onlinecourses.swayam2.ac.in/arp19_ap52/preview
3	https://cse.iitkgp.ac.in/~smisra/course/wasn.html
4	https://youtu.be/ycaz99NogS4?si=TemMsONNFER22HeQ, https://youtu.be/PssAY3wgQqE?si=qRTYWduHXZRb4-6-

SEMESTER S5

CMOS VLSI DESIGN

Course Code	**PEERT 522**	**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 basic MOS inverter and its characteristics
2. To outline the performance parameters of CMOS circuits
3. To discuss the various combinational and sequential CMOS circuits
4. To explain the static and dynamic logic circuits

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	The MOS Inverter: Principle, Depletion and enhancement load inverters. The basic CMOS inverter, logic threshold, Noise margins, and Dynamic behaviour. Propagation Delay, Power Consumption, Latch-up in CMOS circuits, Tristate inverter, Bi CMOS inverter. Performance parameters: Static, dynamic and short circuit power dissipations; Propagation delay; Power delay product	**9**
2	Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design –Realizing Boolean expressions using NMOS gates and CMOS gates, AOI and OAI gates. Sequential MOS Logic Circuits: Behaviour of bi-stable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.	**9**

3	Static Logic Circuits: Pseudo-NMOS – Full complementary CMOS, Ratioed logic, Pass Transistor Logic Pass Transistor Logic (PTL) families: DPTL, CPTL - DCVS, CMOS transmission gates, Designing with Transmission gates	**9**
4	Dynamic pass transistor circuits, Dynamic CMOS transmission gate logic High performance Dynamic CMOS circuits, N-P Dynamic logic - Domino logic - NORA logic - TSPC logic - Multiple output Domino logic - Dynamic NORA	**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 CMOS Inverter characteristics	**K3**
CO2	Explain various combinational and sequential circuits	**K2**
CO3	Explain static logic circuits	**K2**
CO4	Explain dynamic logic circuits	**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		2	2							2
CO2	2	3			2							2
CO3	2	3		2	2							2
CO4	2	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	CMOS Digital Integrated Circuits-Analysis and Design	Sung- Mo- Kang, Yusuf Leblebici	TATA McGraw-Hill	3e, 2003
2	CMOS VLSI Design, a Circuits and Systems Perspective	Neil H. E. Weste, David Money Harris	PEARSON	4e, 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital Integrated Circuits- A Design Perspective	J.M. Rabaey, A. Chandrakasan and B. Nikolic	PHI	**2e, 2016**
2	CMOS Logic Circuit Design	John P. Uyemura	Springer India Pvt. Ltd	**2005**

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1,2,3,4	https://archive.nptel.ac.in/courses/108/107/108107129/

SEMESTER S5

SENSORS AND ACTUATORS

Course Code	PCECT523	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 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 FlowSensors, Electromagnetic FlowSensors. 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 =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 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	Understand the working principles of smart sensors	**K2**
CO4	Understand the basic idea of Actuator Fundamentals and 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	2006
2	Mechatronic systems, Sensors and Actuators Fundamentals and Modelling	Robert H. Bishop	Taylor & Francis Group	2007
3	Process Control Instrumentation Technology	Curtis D. Johnson	Pearson/Prentice Hall	2006
4	Sensors and Transducers	D. Patranabis	PHI Learning	2004

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

CLOUD COMPUTING

Course Code	**PEERT524**	**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. Understand Cloud Computing Fundamentals.
2. Explore Cloud Technologies and Platforms.
3. Apply Cloud Solutions and Ensure Security.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Traditional computing- Limitations. Overview of Computing Paradigms- Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. NIST reference Model-Basic terminology and concepts. Cloud characteristics, benefits and challenges, Roles and Boundaries. Cloud delivery (service) models-Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), XaaS (Anything-as-a-service) - Cloud deployment models- Public cloud, Community cloud, Private cloud, Hybrid cloud.	**8**
2	Introduction to virtualization-Virtualizing physical computing resources, Virtual Machines (Machine virtualization), non-virtualized v/s virtualized machine environments. Types of VMs- process VM v/s system VM, Emulation, interpretation and binary translation. Hardware-level virtualization- Hypervisors/VMM. Types of Hypervisors. Full Virtualization, Para- Virtualization, Hardware-assisted virtualization, OS level virtualization. Basics of Network Virtualization, Storage Virtualization and Desktop Virtualization, Pros and cons of virtualization.	**8**

3	Broadband networks and internet architecture- Internet Service Providers (ISPs), Data center technology, Web technology, Multitenant technology, Service technology. Resource provisioning techniques-static and dynamic provisioning. Open-source software platforms for private cloud-OpenStack, Cloud Stack, Basics of Eucalyptus, Open Nebula, Nimbus. Cloud Programming- Parallel Computing and Programming Paradigms. Map Reduce – Hadoop Library from Apache, HDFS, Pig Latin High Level Languages, Apache Spark.	**8**
4	Basic terms and concepts in security- Threat agents, Cloud security threats/risks, Trust. Operating system security-Virtual machine security-Security of virtualization- Security Risks Posed by Shared Images, Security Risks Posed by Management OS. Infrastructure security- Network Level Security, Host Level Security, Application level security, Security of the Physical Systems. Identity & Access Management- Access Control. **Amazon Web Services (AWS)**:- AWS ecosystem- Computing services, Amazon machine images, Elastic Compute Cloud (EC2), Advanced compute services. Storage services-Simple Storage System (Amazon S3), Elastic Block Store (Amazon EBS). **Google Cloud Platform**:- IaaS Offerings: Compute Engine (GCE), Cloud Storage, PaaS Offerings: Google App Engine (GAE), Storage services, Application services, Compute services, Database Services, SaaS Offerings: Gmail, Docs, Google Drive. **Microsoft Azure:** Azure Platform Architecture, Hyper-V, Azure Virtual Machine, Compute services, Storage services.	**12**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	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 =16 marks)**	• 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 3 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	Explain the various cloud computing models and services.	**K2**
CO2	Demonstrate the significance of implementing virtualization techniques.	**K2**
CO3	Explain different cloud enabling technologies and compare private cloud platforms	**K2**
CO4	Apply appropriate cloud programming methods to solve big data problems	**K3**
CO5	Describe the need for security mechanisms in cloud and compare the different popular cloud computing platforms	**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	2	2	3									3
CO3	3											3
CO4	2	2	3	3	2							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	Cloud Computing Concepts, Technology &Architecture	Thomas, E., Zaigham M., Ricardo P	Prentice Hall	2013
2	Mastering cloud computing: foundations and applications programming	Buyya, R., Vecchiola, C., & Selvi, S. T.	Morgan Kaufmann	2017
3	Cloud computing	Bhowmik, S	Cambridge University Press	2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Cloud computing: theory and practice	Marinescu, D. C	Morgan Kaufmann	2017
2	Cloud computing: Principles and paradigms	Buyya, R., Broberg, J., & Goscinski, A. M	John Wiley & Sons.	2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105167/
2	https://onlinecourses.nptel.ac.in/noc23_cs90/preview
3	https://onlinecourses.nptel.ac.in/noc22_cs18/preview
4	https://archive.nptel.ac.in/courses/106/105/106105167/

SEMESTER S5

PYTHON BASICS FOR MACHINE LEARNING

Course Code	**PEERT526**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	2:1:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	UCEST105	**Course Type**	Theory

Course Objectives:

1. To provide foundational Python programming skills and data manipulation techniques.
2. Enabling learners to handle data, create visualizations, and apply basic machine learning algorithms using Python.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Programming Environment and Python Basics:** Getting Started with Python Programming - interactive shell, Editing, Saving, and Running a script. How python works? Using editors - IDLE, Jupyter. Basic coding skills - Working with data types, Numeric data types and Character sets, Strings, Keywords, Variables and Assignment statement, Operators, Expressions. Type conversions, Comments in the program. Input, Processing, and Output. Formatting text for output.	8
2	**Building Python Programs:** Data representation: List, tuple, Sets, Dictionary. Work with dates and times. Control statements - Selection structure (if-else, switch-case), Iteration with for/while loop, Testing the control statements. Functions - Hiding redundancy and complexity, Arguments and return values, Variable scopes and parameter passing, Named arguments, Main function, Working with recursion, Lambda functions.	9

3	**Object Oriented Programming:** Design with classes - Objects and Classes, Methods, Instance Variables, Constructor, Accessors and Mutators. Structuring classes with Inheritance and Polymorphism. Abstract Classes, Interfaces. Exceptions - Handle a single exception, handle multiple exceptions.	9
4	**Data Processing:** The *os* and *sys* modules. Introduction to file I/O - Reading and writing text files, Manipulating binary files. NumPy - Basics, Creating arrays, Arithmetic, Slicing, Matrix Operations, Random numbers. Plotting and visualization. Working with CSV files. Pandas - Reading, Manipulating, and Processing Data. Introduction to Micro service using Flask.	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 =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	Write, test and debug Python programs	**K3**
CO2	Illustrate uses of conditional, and iterative statements in Python programs	**K3**
CO3	Develop programs by utilizing the modules Lists, Tuples, Sets and Dictionaries in Python	**K3**
CO4	Implement Object Oriented programs with exception handling	**K3**
CO5	Write programs in Python to process data stored in files by utilizing the modules Numpy, Pandas	**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	3		3							3
CO2	3	3	3		3							3
CO3	3	3	3	2	3							3
CO4	3	3	3	2	3							3
CO5	3	3	3	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	Fundamentals of Python : First Programs	Kenneth A Lambert.	Cengage Publishing	2/e, 2016
2	Python for Data Analysis	Wes McKinney	Shroff / O'Reilly Publishers	2/e, 2017
3	Flask: Building Python web services	Jack Stouffer, Shalabh Aggarwal, Gareth Dwyer	PACKT Publishing Limited	2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Learn Python 3 The Hard Way	Zed A Shaw	Addison-Wesley	2017
2	Think Python: How to Think Like a Computer Scientist	Allen B. Downey	Schroff	2/e, 2016
3	Python Programming	Michael Urban and Joel Murach	Shroff/Murach	2016
4	Python Essential Reference	David M.Baezly	Addison-Wesley Professional	4/e, 2009
5	Python for Informatics: Exploring Information	Charles Severance	CreateSpace Independent Publishing Platform	2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.swayam2.ac.in/cec22_cs20/preview
2	https://onlinecourses.nptel.ac.in/noc22_cs32/preview
3	https://onlinecourses.nptel.ac.in/noc19_cs52/preview

SEMESTER S5

COMPUTATIONAL FUNDAMENTALS FOR MACHINE LEARNING

Course Code	**PEERT525**	**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. The purpose of this course is to introduce mathematical foundations of basic Machine Learning concepts among learners, on which Machine Learning systems are built.
2. This course helps the learners to understand the mathematical principles in Machine Learning and aid in the creation of new Machine Learning solutions, understand & debug existing ones, and learn about the inherent assumptions & limitations of the current methodologies.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	LINEAR ALGEBRA: Systems of Linear Equations – Matrices, Solving Systems of Linear Equations. Vector Spaces –Vector Spaces, Linear Independence, Basis and Rank. Linear Mappings – Matrix Representation of Linear Mappings, Basis Change, Image and Kernel. OPTIMIZATION: Optimization Using Gradient Descent - Gradient Descent with Momentum, Stochastic Gradient Descent. Constrained Optimization and Lagrange Multipliers - Convex Optimization - Linear Programming - Quadratic Programming.	12
2	ANALYTIC GEOMETRY, MATRIX DECOMPOSITIONS: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Orthogonal Projections – Projection into One Dimensional Subspaces, Projection onto General Subspaces, Gram-	8

	Schmidt Orthogonalization. Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation.	
3	VECTOR CALCULUS: Differentiation of Univariate Functions - Partial Differentiation and Gradients, Gradients of Vector Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients. Back propagation and Automatic Differentiation – Gradients in Deep Network, Automatic Differentiation. Higher Order DerivativesLinearization and Multivariate Taylor Series.	**8**
4	Probability and Distributions: Construction of a Probability Space - Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem. Summary Statistics and Independence – Gaussian Distribution - Conjugacy and the Exponential Family - Change of Variables/Inverse Transform.	**8**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal exam	Evaluate	Analyse	Total
5	**15**	**10**	**10**	**40**

Assignment: 20 Marks

Students should evaluate and analyze a real-world problem, assess the proposed solutions, provide a conclusion on which solution is most appropriate for the problem.

Criteria for evaluation:

1. ***Problem Definition (K4 - 4 points)***
    a. *Clearly defines the real-world problem.*
    b. *Examine and identifies relevant contextual factors (constraints, resources, objectives).*
2. ***Problem Analysis (K4 - 4 points)***
    a. *Break-down and presents a well-reasoned solution approach.*
    b. *Compare and justify the proposed solutions with evidence and logical reasoning.*
3. ***Evaluate (K5 - 4 points)***
    a. *Thoroughly evaluate the proposed solutions.*

b. *Compares trade-offs, advantages, and disadvantages.*

c. *Considers feasibility, scalability, and practical implications.*

4. ***Implementation (K5 - 4 points)***

a. *Select the most feasible solution by implementing the proposed solutions.*

b. *Successfully translates the chosen solution into code.*

c. *Demonstrates proficiency in coding practices (readability, efficiency, error handling).*

5. ***Conclusion (K4- 2 points, K5 – 2 points)***

a. *Summarizes findings and insights. State which solution is most appropriate for the problem.* ***(K4)***

b. *Reflects critical thinking and informed decision-making.* ***(K5)***

Scoring:

1. ***Accomplished (4 points)****: Exceptional analysis, clear implementation, and depth of understanding.*
2. ***Competent (3 points)****: Solid performance with minor areas for improvement.*
3. ***Developing (2 points)****: Adequate effort but lacks depth or clarity.*
4. ***Minimal (1 point)****: Incomplete or significantly flawed.*

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	Make use of the concepts, rules and results about linear equations, matrix algebra, vector spaces, eigenvalues & eigenvectors and orthogonality & diagonalization to solve computational problems.	Apply
CO2	Perform calculus operations on functions of several variables and matrices, including partial derivatives and gradients.	Apply
CO3	Utilize the concepts, rules and results about probability, random variables, additive & multiplicative rules, conditional probability, probability distributions and Bayes' theorem to find solutions of computational problems.	Apply
CO4	Train Machine Learning Models using unconstrained and constrained optimization methods.	Evaluate

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**	**3**	**3**									**3**
CO3	**3**	**3**	**3**	**3**								**3**
CO4	**3**	**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	Mathematics for Machine Learning	Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong	Cambridge University Press	2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Linear Algebra and Its Applications	Gilbert Strang	Cengage India Private Limited	4e/2014
2	Linear Algebra Done Right	Axler, Sheldon	Springer	2015
3	Introduction to Applied Linear Algebra	Stephen Boyd and Lieven Vandenberghe	Cambridge University Press	2018
4	Convex Optimization	Stephen Boyd and Lieven Vandenberghe	Cambridge University Press	2004
5	Pattern Recognition and Machine Learning	Christopher M Bishop	Springer	2009
6	Learning with Kernels – Support Vector Machines, Regularization, Optimization, and Beyond	Bernhard Scholkopf and Smola, Alexander J Smola	MIT Press	2002
7	Information Theory, Inference, and Learning Algorithms	David J. C MacKay	Cambridge University Press	2003
8	Machine Learning: A Probabilistic Perspective	Kevin P Murphy	MIT Press	2012
9	The Nature of Statistical Learning Theory	Vladimir N Vapnik	Springer	2000

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106139/

SEMESTER: S5

DIGITAL SIGNAL PROCESSING LABORATORY

Course Code	**PCERL 507**	**CIE Marks**	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	**ESE Marks (Internal only)**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	PCERT 501 Digital Signal Processing GYEST 204 Programming in C	**Course Type**	Lab

Course Objectives:

1. Simulate DSP algorithms using MATLAB/PYTHON/OCTAVE/SCILAB
2. Perform real time DSP computing on development boards

Expt. No.	**Experiments**
	PART-A **Experiments based on MATLAB/PYTHON/SCILAB/OCTAVE** **(7 experiments are mandatory**
1	Generation of Waveforms (Continuous and Discrete).
2	Time and Frequency Response of LTI systems (First and second order).
3	Linear Convolution, Circular Convolution and Linear Convolution using Circular Convolution.
4	To find the DFT and IDFT for the given input sequence.
5	Linear convolution using DFT.
6	To find FFT and IFFT for the given input sequence.
7	FIR and IIR filter design using Filter Design Toolbox.
8	FIR Filter (Low-pass, High-pass and Band-pass) design (Window method).
9	IIR Filter (Low-pass, High-pass) design (Butterworth).
	Part -B

	Experiments on Digital Signal Processor/ DSP kits (3 experiments are mandatory)
1.	Generation of sine wave and standard test signals.
2.	Convolution: Linear and Circular.
3.	Real time FFT of the signal using a real-time input signal.
4.	Real Time FIR Filter implementation (Low-pass, High-pass) using a real-time input Signal

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	Simulate digital signals.	**K2**
CO2	Understand LTI systems and its properties	**K2**
CO3	Simulate efficient DFT algorithms and digital filters	**K2**
CO4	Familiarize the DSP hardware and interface with computer.	**K2**
CO5	Understand the spectrum of real time signals.	**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		3				3			1
CO2	3	3	3		3				3			1
CO3	3	3	3		3				3			1
CO4	3	3	3		3				3			1
CO5	3	3	3		3				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, A Practical approach	Sanjit K. Mitra	Tata McGraw Hill Publishing Company Limited	2005
2	*Digital signal processing using MATLAB*.	Ingle, Vinay K., and John G. Proakis	Brooks/Cole Publishing Co.,	1999
3	*Think DSP: digital signal processing in Python*.	Downey, Allen	O'Reilly Media, Inc.	2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Signal Processing Principles, Algorithms, Applications	John G Proakis, G. Manolakis,	Prentice Hall India Private Limited, Fourth Edition	2007
2	Discrete time Signal Processing	Allen V. Oppenheim, Ronald W. Schafer	Prentice Hall India Private Limited, Fifth Edition	200
3	DSP applications using C and the TMS320C6x DSK.	Chassaing, Rulph	John Wiley & Sons	2003

Video Links (NPTEL, SWAYAM…)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc19_ee50/preview
2	https://onlinecourses.nptel.ac.in/noc21_ee20/preview
3	https://onlinecourses.nptel.ac.in/noc22_ee62/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

DATABASE MANAGEMENT SYSTEMS LAB

Course Code	PCERL508	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)	PBERT504 Database Management Systems	Course Type	Lab

Course Objectives:

1. Enable students to design, create, and manage databases using practical tools.
2. Equip students with the skills to write and execute SQL queries for various database operations.
3. Introduce students to NoSQL databases and Big Data technologies like MongoDB for handling large datasets

Details of Experiment

Expt. No	Experiment
1	Design a database schema for an application with ER diagram from a problem description
2	Creation, modification, configuration, and deletion of databases using UI and SQL Commands
3	Creation of database schema - DDL (create tables, set constraints, enforce relationships, create indices, delete and modify tables)
4	Database initialization - Data insert, Data import to a database
5	Practice SQL commands for DML (insertion, updating, altering, deletion of data, and viewing/querying records based on condition in databases)
6	Implementation of built-in functions in RDBMS
7	Implementation of various aggregate functions in SQL
8	Implementation of Order By, Group By & Having clause
9	Implementation of set operators nested queries, and join queries
10	Practice of SQL TCL commands like Rollback, Commit, Save point
11	Practice of SQL DCL commands for granting and revoking user privileges

12	Practice of SQL commands for creation of views and assertions
13	Implementation of various control structures like IF-THEN, IF-THEN-ELSE, IF-THEN-ELSIF, CASE, WHILE using PL/SQL
14	Creation of Procedures, Triggers and Functions
15	Creation of Packages
16	Creation of Cursors
17	Familiarization of NoSQL Databases and CRUD operations
18	Design a database application using any front-end tool for any problem selected. The application constructed should have five or more tables

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	Design database schema for a given real world problem-domain using standard design and modeling approaches.	**K3**
CO2	Construct queries using SQL for database creation, interaction, modification, and updation.	**K3**
CO3	Design and implement triggers and cursors.	**K3**
CO4	Implement procedures, functions, and control structures using PL/SQL**.**	**K3**
CO5	Perform CRUD operations in NoSQL Databases.	**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			2		2		2
CO2	3	2	3		3			2		2		2
CO3	3	2	2	2	2			2		2		2
CO4	3	2	2	2	2			2		2		2
CO5	3	2	2		2			2		2		2

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	Database Systems: Models, Languages, Design and Application Programming	Elmasri R. and S. Navathe	Pearson Education	6/e, 2013
2	Database System Concepts	Sliberschatz A, H.F.Korth and Sudarshan	McGraw Hill	6/e, 2011

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	NoSQL Data Models: Trends and Challenge	Wiley		2018
2	NoSQL for Dummies	John Wiley & Sons		2015

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://nptel.ac.in/courses/106105175
2	https://www.coursera.org/learn/sql-data-science
3	https://www.udemy.com/course/database-normalization-simplified
4	https://archive.nptel.ac.in/courses/106/104/106104135/

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 & COMPUTER ENGINEERING

SEMESTER S6

OPERATING SYSTEMS

Course Code	**PCERT601**	**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)	GYEST204, PCCST302	**Course Type**	PC

Course Objectives:

1. Gain a comprehensive understanding of the basic functionalities, structure and components of modern operating systems.
2. Gain proficiency in tasks such as process creation, synchronization, and deadlock handling.
3. Understand the trade-offs involved in choosing between different scheduling algorithms, memory management strategies, and file system structures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** Operating system overview – Operations, Functions, Service – System calls, Types – Operating System structure - Simple structure, Layered approach, Microkernel, Modules– System boot process. **Processes** - Process states, Process control block, threads, scheduling, Operations on processes - process creation and termination – Inter-process communication - shared memory systems, Message passing systems.	11
2	**Process Scheduling** – Basic concepts- Scheduling criteria -scheduling algorithms- First come First Served, Shortest Job First, Priority scheduling, Round robin scheduling. **Deadlocks:** Necessary conditions, Resource allocation graphs, Deadlock prevention, Deadlock avoidance – Banker's algorithms, Deadlock detection, Recovery from deadlock.	12

3	**Process synchronization-** Race conditions – Critical section problem – Peterson's solution, Synchronization hardware, Mutex Locks, Semaphores, Classic Synchronization problems - Producer Consumer, Dining Philosophers and Readers-Writers.	**9**
4	**Memory Management:** Concept of address spaces, Swapping, Contiguous memory allocation, fixed and variable partitions, Segmentation, Paging. Virtual memory, Demand paging, Page replacement algorithms. **File System:** File concept - Attributes, Operations, types, structure – Access methods, Protection. File-system implementation, Directory implementation. Allocation methods. **Storage Management:** Magnetic disks, Solid-state disks, Disk Structure, Disk scheduling, Disk formatting.	**12**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	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 relevance, structure and functions of Operating Systems in computingdevices along with the concepts of process management mechanisms employed in Operating Systems.(**Cognitive knowledge: Understand**)	**K2**
CO2	Illustrate the mechanisms for process scheduling and deadlock handling. (**Cognitive knowledge: Apply**)	**K3**
CO3	Explain the tools and mechanisms for process synchronization in Operating Systems (**Cognitive knowledge: Understand**)	**K2**
CO4	Elaborate on memory management and storage management techniques in Operating Systems. **(Cognitive knowledge: Apply)**	**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	-	1
CO2	3	3	3	3	-	-	-	-	-	2	-	2
CO3	3	3	2	2	-	-	-	-	-	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	Operating System Concepts	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne,	Wiley India	9th Edition, 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Operating Systems	Andrew S Tanenbaum,	Prentice Hall	4th Edition, 2015
2	Operating systems	William Stallings,	Pearson, Global Edition	6th Edition, 2015.
3	Operating Systems	Garry Nutt, Nabendu Chaki, Sarmistha Neogy,	Pearson Education.	3rd Edition
4	Operating Systems	D.M.Dhamdhere,	Tata McGraw Hill	2nd Edition, 2011.
5	Operating Systems	Sibsankar Haldar, Alex A Aravind,	Pearson Education	2010

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105214/
2	https://nptel.ac.in/courses/106106144
3	https://onlinecourses.nptel.ac.in/noc20_cs04/preview
4	https://nptel.ac.in/courses/106105214

SEMESTER S6

DATA COMMUNICATION AND NETWORKING

Course Code	**PCERT602**	**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)	PCERT403	**Course Type**	Theory

Course Objectives:

1. To analyze data transmission methods, error control mechanisms, and congestion management techniques in networking.
2. To understand the fundamental principles of data communication and networking protocols, including OSI and TCP/IP architectures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	A data communication model-data communication - data communications networking - protocol architecture - the need for a protocol architecture - a simple protocol architecture - OSI – TCP/IP protocol architecture. Data transmission - Concepts and terminology - Analog and Digital data transmission-Transmission Impairments – channel capacity	8
2	Digital data, Digital signals & analog signals – analog data, digital signals and analog signals. Asynchronous and synchronous transmission -Types of Error -Error Detection -Error Correction. Data link Control -Flow control-Error Control-HDLC.	8
3	FDM – Synchronous TDM – statistical TDM – Asymmetric DSL – xDSL. Circuit Switching and packet switching: switching networks - circuit switching networks - circuit switching concepts - control signaling - soft switch architecture-Packet switching principles-X.25-Frame Relay. Routing in Switched Networks: routing in circuit switched network – routing in packet switched network – least cost algorithms.	10

4	Effect of congestion - Congestion control - Traffic management - Congestion control in packet switching networks - Frame Relay congestion control. Local Area Network: LAN protocol architecture – bridges – layer2 and layer3 switches. High speed LANs: the emergence of High-speed LAN's – Ethernet – token ring – fibre channel. Transport protocol: connection-oriented transport protocol mechanisms - TCP – TCP – congestion control - UDP.	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 =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 data communication and networking using the layered concept, Open System Interconnect (OSI) and the TCP/IP Model. (Cognitive Knowledge: Understand)	**K2**
CO2	Illustrate various types of encoding techniques and error detection methods used in networks. (Cognitive Knowledge: Understand)	**K2**
CO3	Use the concept of multiplexing, switching and routing in networks. (Cognitive Knowledge: Apply)	**K3**
CO4	Discuss the working principles of LAN and the concepts behind congestion in networks. (Cognitive Knowledge: Understand)	**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	3	1	2								1
CO2	2	2	3									2
CO3	2	3	2	1								2
CO4	2	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	Data and Computer Communication	William Stallings	Pearson Education	9/e, 2013
2	Computer Networks	Andrew S. Tanenbaum	PHI (Prentice Hall India)	5/e, 2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Communication and Networking	Behrouz A Forouzan	Tata McGraw Hill	5/e,2013
2	Computer Networks – A Systems Approach	Larry L Peterson and Bruce S Dave	Morgan Kaufmann.	5/e,2011
3	Computer Networking and the Internet	Fred Halsall	Addison-Wesley.	5/e,2005

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106105183
2	https://nptel.ac.in/courses/106105082
3	https://nptel.ac.in/courses/117105148
4	https://onlinecourses.nptel.ac.in/noc22_ee61/preview

SEMESTER S6
NETWORK AND LINEAR CONTROL SYSTEMS

Course Code	**PEERT631**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	2:1:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. This course aims to develop the skills for mathematical modelling and analysis of linear control systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Electrical Circuits** Circuit concept – Types of elements - source transformation-voltage - current relationship for passive elements. Network reduction techniques: series, parallel, series parallel, examples, time and frequency domain analysis of RLC circuits. **Introduction to control systems** Basic components of a control system, types of control systems, examples of control systems, effect of feedback systems, Laplace Transforms, transfer function, modelling of electrical networks, block diagram reduction, signal flow graphs.	11
2	**Modelling of mechanical systems** Translational and rotational systems, transfer function for typical mechanical systems, analogous systems–force voltage & force-current analogy, impulse response and its relation with transfer function	7
3	**Time domain analysis of feedback control systems** Transient and steady-state response, standard test signals, type and order of systems, concept of poles and zeros, time response of first and second order systems to unit impulse and step input, time domain specifications, Steady-state response, steady state error, static and dynamic error coefficients.	9

4	**Stability of linear control systems** Concept of stability, methods of determining stability, Routh's Hurwitz criterion, Root locus - construction of root locus, effect of addition of poles and zeros on root locus. Frequency response analysis: Frequency domain specifications, stability from Bode plots, relative stability, gain margin and phase margin, introduction to lead, lag and lead-lag compensating networks (excluding design).	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	Analysis and modelling of mechanical systems using translational and rotational systems, along with the understanding of force voltage & force-current analogy.	**K3**
CO2	Implementing techniques to ensure the stability of linear control systems; using the Routh's Hurwitz criterion, Root locus method and frequency response analysis.	**K3**
CO3	Understand and model control systems using Laplace Transforms and transfer functions to analyze electrical networks and control systems structures.	**K3**
CO4	Apply poles and zeros concept, analyze first and second order systems, and compute static and dynamic error coefficients within time domain analysis of feedback control 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	3									
CO2	3	3	3									
CO3	3	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	Network Analysis and Synthesis	Ravish R. Singh	McGraw Hill Education	2/e, 2019
2	Automatic Control Systems	Farid Golnaraghi, Benjamin C. Kuo	Wiley India	9/e, 2014
3	Control Systems	M. Gopal	McGraw Hill Education India	4/e, 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Control System Engineering	Norman S. Nise	Wiley India	5/e, 2015
2	Modern Control Systems	Richard C Dorf and Robert H. Bishop	Pearson Education	13/e, 2016

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/108/104/108104139/
2	https://nptel.ac.in/courses/107106081
3	https://nptel.ac.in/courses/107106081
4	https://nptel.ac.in/courses/107106081

SEMESTER S6

MICRO-ELECTRO-MECHANICAL SYSTEMS

Course Code	**PEERT632**	**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)	Nil	**Course Type**	PE

Course Objectives:

1. Acquire a thorough understanding of MEMS products, microfabrication evolution, and multidisciplinary applications including micro sensors and actuators.
2. Gain proficiency in MEMS material selection, fabrication techniques, and microsystem packaging design considerations.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	MEMS and Microsystems: Typical MEMS and microsystem products – Evolution of Microfabrication - Microsystem and microelectronics - Multidisciplinary nature of MEMS – Applications of Microsystems in Automotive Industry - Principles and examples of Micro sensors and micro actuators – micro accelerometer, Micro grippers, micro motors, micro valves, micro pumps.	9
2	Actuation and Sensing techniques: Actuation using Thermal forces, Actuation using Shape Memory Alloys, Actuation using Piezoelectric crystals, actuation using Electrostatic forces; Microsensors - Acoustic wave sensors, Biomedical sensors and biosensors, chemical sensors, pressure sensors, optical sensors - microfluidics.	8
3	Engineering science for Microsystem design - Atomic structure of Matter - Ions & ionization - Molecular Theory of matter & Intermolecular forces - Doping of semiconductors - Diffusion process - Electrochemistry - Quantum physics. Materials for MEMS and Microsystems - Substrate and wafer -	9

	Silicon as substrate Material - Silicon compounds - Silicon peizoresistors - Gallium Arsenide - Quartz - Peizoelectric crystals - Polymers.	
4	Overview of Microsystem fabrication – Photolithography – Ion implantation- Diffusion – Oxidation – Chemical vapour deposition – Etching. Overview of Micro manufacturing – Bulk micro manufacturing, Surface micro machining , LIGA process. Micro system Packaging: general considerations in packaging design – Levels of Micro system packaging.	**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 basic concepts of MEMS and microsystem products.	**K2**
CO2	Understand the working principles of micro sensors and actuators.	**K2**
CO3	Identify the typical materials used for fabrication of micro systems.	**K2**
CO4	Illustrate the various methods in microsystem fabrication and micro manufacturing.	**K2**

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

CO-PO Mapping Table:

	PO31	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										3
CO2	3	2										3
CO3	3	2	1									3
CO4	3	2	1									3

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	MEMS and Microsystems Design, Manufacture and Nanoscale Engineering	Tai-Ran Hsu,	Wiley	2^{nd} , 2020
2	Foundations of MEMS	Chang Liu	Pearson	2^{nd} , 2012
3	Microsystem Design	Stephen D Senturia	Springer	3^{rd}, 2013

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Silicon VLSI Technology	James D Plummer	Prentice Hall	4^{th}, 2012
2	MEMS	Nitaigur Premchand Mahalik	Tata Mc Graw Hill	2013
3	Micro and Nano Fabrication: Tools and Processes	Hans H. Gatzen	Springer	2015

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	NPTEL course : "MEMS & Microsystems" by Prof. Santiram Kal, Video Lecture No: 5, MEMS materials https://archive.nptel.ac.in/courses/117/105/117105082/
2	NPTEL course: "MEMS & Microsystems" by Prof. Santiram Kal, Video Lecture No: 13, Surface & Quartz Micromachining. https://archive.nptel.ac.in/courses/117/105/117105082/

SEMESTER S6

FOUNDATIONS OF DATA SCIENCE

Course Code	**PEERT 633**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	4/3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To understand the data science fundamentals and process.
2. To learn to describe the data for the data science process.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Data Science**: Facets of data – structured, unstructured-semi structured data & patterns, Importance of data Science - History of Data Science -Need for Data Science, Steps in Data Science Process, Components of Data Science, Tools and skills needed - Differences between AI, ML, DL, Data Science & Data Analytics, Real world applications of data science-Simple case study based on real life applications such as - Market research case, tracking disease outbreaks, business predictions, (for example, Rating a product design).	7
2	**Data Preprocessing:** Need to preprocess the data- Major Tasks in Data Preprocessing, Data cleaning - Missing Values Noisy Data- Data Cleaning as a Process, Data Integration, Data Reduction, Data Transformation and Data Discretization	8
3	**Classification Models:** Classification - Basic Concepts, K-Nearest-Neighbour Classifiers, Decision Tree Induction (ID3 algorithm), Naïve Bayesian Classification, Support Vector Machines	8
4	**Mining Frequent Patterns, Associations, and Correlations:** Basic Concepts Frequent Itemset - Apriori Algorithm - Generating Association Rules from Frequent Itemsets **Clustering:** Partitioning methods- k-Means clustering, Hierarchical	9

	Methods- Agglomerative versus Divisive Hierarchical Clustering- Distance Measures in Algorithmic Methods, Density-Based Methods -DBSCAN	

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 basic principles and concepts of data science.	**K2**
CO2	Pre-process and explore datasets to extract meaningful insights.	**K3**
CO3	Illustrate the concepts of classification methods	**K3**
CO4	Perform association mining and analyze clusters using different methods	**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	3	-	-	3	-	-	-	-	-	-	2
CO2	3	2	1	3	2	-	-	-	-	-	-	3
CO3	3	2	2	2	2	-	-	-	-	-	-	3
CO4	3	2	1	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	Fundamentals of Data Science	Sanjeev J. Wagh, Manisha S. Bhende, and Anuradha D. Thakare	CRC press	1e, 2022
2	Data mining Concepts and Techniques	Jiawei Han, Michelin Kamber, Jian Pei	Morgan Kaufmann Publishers	3e, 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Data Mining Techniques	Arun K. Pujari	Universities Press	2001
2	Data Science for Business	Foster Provost, Tom Fawcett	O'Reilly Media	1e, 2013

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106179/ https://www.youtube.com/watch?v=XohgKT13FKY
2	https://archive.nptel.ac.in/courses/106/105/106105174/
3	https://archive.nptel.ac.in/courses/106/105/106105174/ https://www.youtube.com/playlist?list=PLw5h0DiJ-9PCn4shW4X43FSjEqdBwc1Cn
4	https://archive.nptel.ac.in/courses/106/105/106105174/

SEMESTER S6

COMPILER DESIGN

Course Code	PEERT634	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)	PCERT502	Course Type	Theory

Course Objectives:

1. To understand the structure and functionality of compilers, including lexical and syntax analysis, parsing techniques, and code optimization strategies.
2. To learn about implementing various phases of a compiler, from lexical analysis to code generation.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Analysis of the source program - Analysis and synthesis phases, Phases of a compiler. Lexical Analysis - Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens.	9
2	Role of the Syntax Analyser. Review of Context Free Grammars -Derivation and Parse Trees. Basic parsing approaches - Eliminating left recursion, left factoring. Top-Down Parsing - Recursive Descent parsing, Predictive Parsing,LL(1) Grammars.	9
3	Handle Pruning. Shift Reduce parsing. LR parsing - Constructing SLR, LALR and canonical LR parsing tables. Syntax directed translation - Syntax directed definitions, S-attributed definitions, L-attributed definitions, Storage organization, Storage-allocation strategies.	9
4	Intermediate code generation- Intermediate languages, Graphical representations, Three-Address code, Quadruples, Triples. Code Optimization - Principal sources of optimization, Local and global optimizations. Code generation - Issues in the design of a code generator, Target Language, A simple code generator.	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 phases in the compilation process (lexical analysis, syntax analysis, semantic analysis, intermediate code generation, code optimization, and code generation) and model a lexical analyzer.	**K3**
CO2	Describe the role of the syntax analyzer, review context-free grammars, and apply basic parsing approaches including top-down parsing techniques and LL (1) grammars.	**K3**
CO3	Illustrate handle pruning, shift-reduce parsing, LR parsing with SLR, LALR, and canonical LR tables, and apply syntax-directed translation concepts.	**K3**
CO4	demonstrate intermediate code generation techniques, including intermediate languages and three-address code, as well as discuss code optimization strategies and the issues involved in code generation and design.	**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	1	3							3
CO2	3	3	3	2	3							3
CO3	3	3	3	2	3							3
CO4	3	3	3	1								3

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Compilers – Principles Techniques and Tools	Aho A.V., Ravi Sethi and D. Ullman.	Addison Wesley	2006

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	System Programming and Operating Systems	D.M.Dhamdhere	Tata McGraw Hill & Company	1996
2	Compiler Construction – Principles and Practice	Kenneth C. Louden	Cengage Learning Indian Edition	2006
3	The Theory and Practice of Compiler Writing	Tremblay and Sorenson	Tata McGraw Hill& Company	1984

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105190/
2	https://archive.nptel.ac.in/courses/106/105/106105190/
3	https://archive.nptel.ac.in/courses/106/105/106105190/
4	https://archive.nptel.ac.in/courses/106/105/106105190/

SEMESTER 6

ALGORITHM ANALYSIS & DESIGN

Course Code	**PEERT636**	**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)	PCERT302	**Course Type**	Theory

Course Objectives:

1. To introduce the concepts of Algorithm Analysis, Time Complexity, Space Complexity.
2. To discuss various Algorithm Design Strategies with proper illustrative examples.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Characteristics of Algorithms, Criteria for Analysing Algorithms, Time and Space Complexity - Best, Worst and Average Case Complexities, Asymptotic Notations - Big-Oh (O), Big- Omega (Ω), Big-Theta (Θ), Little-oh (o) and Little- Omega (ω) and their properties. Analysis of Recursive Algorithms: Recurrence Equations, Solving Recurrence Equations – Iteration Method, Recursion Tree Method, Substitution method and Master's Theorem (Proof not required).	**9**
2	Self-Balancing Tree - AVL Trees (Insertion and deletion operations with all rotations in detail, algorithms not expected); DFS and BFS traversals - Analysis, Strongly Connected Components of a Directed graph, Topological Sorting.	**9**
3	The Control Abstraction of Divide and Conquer- 2-way Merge sort, Strassen's Algorithm for Matrix Multiplication-Analysis. The Control Abstraction of Greedy Strategy- Fractional Knapsack Problem, Minimum Cost Spanning Tree Computation- Kruskal's Algorithms - Analysis, Single Source Shortest Path Algorithm - Dijkstra's Algorithm-Analysis.	**9**
4	The Control Abstraction- The Optimality Principle- Matrix Chain Multiplication-Analysis, All Pairs Shortest Path Algorithm - Floyd-Warshall Algorithm-Analysis. The Control Abstraction of Back Tracking – The N	**9**

	Queen's Problem. Branch and Bound Algorithm for Travelling Salesman Problem. Introduction to Complexity Theory - Tractable and Intractable Problems, Complexity Classes – P, NP, NP- Hard and NP-Complete Classes	

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	Evaluate the efficiency of algorithms using asymptotic notations, solve recurrence relations for recursive algorithms, and apply these concepts to optimize algorithmic solutions.	**K3**
CO2	Implement AVL trees, perform DFS and BFS traversals, analyze strongly connected components of directed graphs, and apply topological sorting.	**K3**
CO3	Implement divide and conquer algorithms, apply greedy strategies, and evaluate shortest path solutions.	**K3**
CO4	Apply dynamic programming, backtracking, and branch and bound techniques, and understand complexity theory concepts.	**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	3	2	2								2
CO2	2	3	2	2								1
CO3	1	2	2	2								2
CO4	2	3	3	2								3

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Algorithms	Ellis Horowitz, SartajSahni, Sanguthevar Rajasekaran	Universities Press	2007
2	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein	MIT Press	2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Design and Analysis of Computer Algorithms	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman	Pearson Education	1999
2	Introduction to the Design and Analysis of Algorithms	Anany Levitin,	Pearson	3/e, 2011
3	Fundamentals ofAlgorithmics	Gilles Brassard, Paul Bratley	Pearson Education	1995

Video Links (NPTEL, SWAYAM…)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/106/106106131/
2	https://archive.nptel.ac.in/courses/106/106/106106131/
3	https://archive.nptel.ac.in/courses/106/106/106106131/
4	https://archive.nptel.ac.in/courses/106/106/106106131/

SEMESTER S6

DESIGN AND ANALYSIS OF ALGORITHMS

Course Code	PEERT 635	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 the concepts of Algorithm Analysis, Time Complexity, Space Complexity.
2. To discuss various Algorithm Design Strategies with proper illustrative examples.
3. To introduce Complexity Theory.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Algorithm - Analysis Time and Space Complexity Elementary operations and Computation of Time Complexity Best, worst and Average Case Complexities- Complexity Calculation of simple algorithms. Recurrence Equations - Solution of Recurrence Equations – Iteration Method and Recursion Tree Methods.	6
2	Master's Theorem (Proof not required) – examples, Asymptotic Notations and their properties- Application of Asymptotic Notations in Algorithm Analysis- Common Complexity Functions. AVL Trees – rotations, Red-Black Trees insertion and deletion (Techniques only; algorithms not expected). B-Trees – insertion and deletion operations. Sets- Union and find operations on disjoint sets.	8

3	Graphs – DFS and BFS traversals, complexity, Spanning trees – Minimum Cost Spanning Trees, single source shortest path algorithms, Topological sorting, strongly connected components. Divide and Conquer - The Control Abstraction, 2-way Merge sort, Strassen's Matrix Multiplication, Analysis. Dynamic Programming - The control Abstraction- The Optimality Principle- Optimal matrix multiplication, Bellman-Ford Algorithm. Analysis, Comparison of Divide and Conquer and Dynamic Programming strategies.	10
4	Greedy Strategy - The Control Abstraction- the Fractional Knapsack Problem, Minimal Cost Spanning Tree Computation- Prim's Algorithm – Kruskal's Algorithm Back Tracking -The Control Abstraction – The N Queen's Problem, 0/1 Knapsack Problem Branch and Bound: Travelling Salesman Problem. Introduction to Complexity Theory - Tractable and Intractable Problems- The P and NP Classes- Polynomial Time Reductions - The NP- Hard and NP-Complete Classes.	12

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

Assignment: 20 Marks

Students should design and implement a real-world application using object-oriented programming principles, evaluate and refine their class structures and relationships, provide a conclusion on the effectiveness of their design, and demonstrate the functionality of their application using Java.

<u>Criteria for evaluation:</u>

1. ***Problem Definition (K4 - 4 points)***
   . *Clearly defines the real-world problem.*
   a. *Examine and identifies relevant contextual factors (constraints, resources, objectives).*

2. ***Problem Analysis (K4 - 4 points)***

   - *Break-down and presents a well-reasoned solution approach.*
   - *Compare and justify the proposed solutions with evidence and logical reasoning.*

2. ***Evaluate (K5 - 4 points)***

   - *Thoroughly evaluate the proposed solutions.*
   - *Compares trade-offs, advantages, and disadvantages.*
   - *Considers feasibility, scalability, and practical implications.*

2. ***Implementation (K5 - 4 points)***

   - *Select the most feasible solution by implementing the proposed solutions.*
   - *Successfully translates the chosen solution into code.*
   - *Demonstrates proficiency in coding practices (readability, efficiency, error handling).*

2. ***Conclusion (K4- 2 points, K5 – 2 points)***

   - *Summarizes findings and insights. State which solution is most appropriate for the problem.* ***(K4)***
   - *Reflects critical thinking and informed decision-making.* ***(K5)***

Scoring:

1. ***Accomplished (4 points)****: Exceptional analysis, clear implementation, and depth of understanding.*
2. ***Competent (3 points)****: Solid performance with minor areas for improvement.*
3. ***Developing (2 points)****: Adequate effort but lacks depth or clarity.*
4. ***Minimal (1 point)****: Incomplete or significantly flawed.*

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 any given algorithm and express its time and space complexities in asymptotic notations.	**K4**
CO2	Derive recurrence equations and solve it using Iteration, Recurrence Tree, Substitution and Master's Method to compute time complexity of algorithms.	**K3**
CO3	Analyze and compare the functionality and applications of various graph traversal algorithms, and critically evaluate the structure and performance of advanced data structures	**K4**
CO4	Demonstrate Divide-and-conquer, Greedy Strategy, Dynamic programming, Branch-and Bound and Backtracking algorithm design techniques.	**K3**
CO5	Classify a problem as computationally tractable or intractable, and discuss strategies to address intractability.	**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	3	2	2								2
CO2	2	3	2	2								1
CO3	1	2	2	2								2
CO4	2	3	3	2								3
CO5	1	2		3								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	Computer Algorithms	Ellis Horowitz, SartajSahni, Sanguthevar Rajasekaran	Universities Press	2007
2	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein	MIT Press	2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Design and Analysis of Computer Algorithms	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman	Pearson Education	1999
2	Introduction to the Design and Analysis of Algorithms	Anany Levitin	Pearson	3/e, 2011
3	Fundamentals of Algorithmics	Gilles Brassard, Paul Bratley	Pearson Education	1995
4	Foundations of Algorithms using C++ Psuedocode	Richard E. Neapolitan, Kumarss Naimipour	Jones and Bartlett Publishers, Inc	2/e, 1997

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106131/
2	https://archive.nptel.ac.in/courses/106/106/106106131/
3	https://archive.nptel.ac.in/courses/106/106/106106131/
4	https://archive.nptel.ac.in/courses/106/106/106106131/

SEMESTER S6

EMBEDDED SYSTEMS AND IOT

Course Code	PBERT 604	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)	None	**Course Type**	Theory

Course Objectives:

1. To give students a thorough understanding of designing embedded and internet of things systems for a range of applications
2. Expertise in the design and analysis of IOT and embedded systems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Embedded Systems and IoT** **Introduction to Embedded Systems:-** Desirable features and general characteristics of Embedded Systems -Comparison: Microcontroller Vs Microprocessors - Model of Embedded Systems. **Introduction to IoT:-** Evolution and enabling technologies of IoT - Complex Interdependence of Technologies - IoT Networking Components and Addressing Strategies. **Basics of Networking:-** Network Types and Layered Network Models - Addressing and TCP/IP Transport Layer. **Project Task:** Create a basic embedded system using a microcontroller, establish simple networking, and demonstrate data transfer over the network.	9
2	**Embedded Systems & IoT - Sensors, Actuators, and Processing** **Sensors:-** Sensor Characteristics, Sensorial Deviations, and Sensing Types - Sensing Considerations.	9

	Actuators:- Actuator Types and Characteristics. **IoT Processing:-** IoT Processing Topologies and Types - Data Format and Importance of Processing in IoT - Device Design and Selection Considerations - Processing Offloading. **Project Task:** Develop an IoT device integrating sensors and actuators with processing capabilities.	
3	**IoT Connectivity and Communication Technologies** **IoT Connectivity Technologies:-** Overview of IEEE 802.15.4, Zigbee, ISA100.11A, Wireless HART, RFID, NFC, Z-Wave, Weightless, LoRa, NB-IoT, Wi-Fi, Bluetooth. **IoT Communication Technologies:-** Infrastructure Protocols - Discovery Protocols - Data Protocols - Identification Protocols - Device Management - Semantic Protocols. **Project Task:** Implement connectivity and communication protocols for an IoT device.	**9**
4	**Developing IoT Applications with Arduino/NodeMCU** **Arduino Platform:-** Hardware features and Arduino IDE - Interfacing LEDs, switches, and LCDs **NodeMCU Platform:-** Hardware features and programming with Arduino IDE - Interfacing sensors and actuators with NodeMCU. **Introduction to Raspberry Pi** - Raspberry Pi hardware details - installing OS in Raspberry Pi **IoT Physical Servers and Cloud Offerings:-** Overview of AWS IoT, Microsoft Azure IoT, and Blynk. **Project Task:** Build comprehensive IoT applications using various platforms.	**9**

Suggestion on Project Topics

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	Understand the basics of embedded systems, IoT and networking.	**K2**
CO2	Illustrate various sensors and actuators for embedded systems and IoT.	**K2**
CO3	Apply the understanding of IoT requirements and constrains to select the suitable IoT connectivity and communication technologies for specific IoT applications.	**K3**
CO4	Illustrate various IoT physical servers and cloud offerings.	**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	2				2							3
CO3	2		2	2	2							3
CO4	2											3

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to IoT	Sudip Misra, Anandarup Mukherjee, Arijit Roy	Cambridge University Press	First edition, 2021
2	Arduino Cookbook: Recipes to Begin, Expand, and Enhance Your Projects	Michael Margolis	O'Reilly Media	3rd edition, 2020
3	Internet Of Things With Raspberry Pi And Arduino	Rajesh Singh, Anita Gehlot, Lovi Raj Gupta,Bhupendra Singh, and Mahendra Swain	CRC press	1st Edition, 2019
4	NodeMCU ESP8266 Communication Methods and Protocols _ Programming with Arduino IDE	Manoj R. Thakur	Amazon Media EU S.à r.l.	2018

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 Hands-On approach	Arshdeep Bahga, Vijay Madisetti		
2	https://docs.aws.amazon.com/whitepapers/latest/aws-overview/introduction.html			
3	https://azure.microsoft.com/en-us/explore			
4	https://docs.blynk.io/en/			

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/128108016
2	https://nptel.ac.in/courses/128108016
3	https://nptel.ac.in/courses/128108016
4	https://nptel.ac.in/courses/128108016

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

BASICS OF ANAOLG AND DIGITAL COMMUNICATION

Course Code	OEERT 611	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 main components and principles of analog and digital communication systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction, Elements of communication systems, Amplitude modulation (AM), Double-side band suppressed carrier (DSB-SC) modulation Single sideband modulation (SSB) – spectrum, power, efficiency of all the three variants. (Study of only tone modulation in DSB-SC, AM, and SSB.) Amplitude-modulator implementations –balanced modulator. AM demodulators -. Envelope detector.	9
2	Frequency modulation – modulation index, frequency deviation, average power, spectrum of tone modulated FM, bandwidth of FM, Narrow band FM and wide-band FM. FM generation: Varactor diode modulator, Armstrongs method. FM demodulation – slope detection.	9
3	Elements of digital communication system. Sources, channels and receivers. Sampling theorem. Sampling and reconstruction. Pulse code modulation. Sampling, quantization and encoding. Differential PCM, adaptive PCM, Delta modulator and adaptive delta modulator. Issues in delta modulation. Slope overload.	9

4	Digital modulation schemes. Baseband BPSK system and the signal constellation. BPSK transmitter and receiver. Base band QPSK system and Signal constellations. Plots of BER Vs SNR (Analysis not required). QPSK transmitter and receiver. Quadrature amplitude modulation.	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 main components in analog and digital communication systems.	**K2**
CO2	Understand the different analog modulation schemes.	**K2**
CO3	Illustrate the main principles of pulse code modulation.	**K2**
CO4	Understand different digital modulation schemes.	**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
CO2	3	2										3
CO3	3			2								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	Electronic Communication Systems	Kennedy, Davis	TATA McGraw-Hill	Fourth Edition
2	Electronic Communication Systems – Fundamentals through Advanced	Wayne Tomasi	Pearson	Fifth edition
3	Communication Systems	Simon Haykin	Wiley	Fourth edition

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Digital and Analog Communication Systems	Leon W. Couch	Prentice Hall	Eighth edition
2	Digital Communications: Fundamentals and Applications	Sklar	Pearson.	Third edition

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/S8Jod9AtpN4
2	https://youtu.be/jqJpbPseX2c
3	https://youtu.be/l_SqkcP6hZ4
4	https://youtu.be/ZW1glqkIgcw?si=zJ_ijYp7t6uh9WHx

SEMESTER S6

ROBOTICS AND AUTOMATION

Course Code	OEERT 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 Type	Open Elective I

Course Objectives:

1. Aims to provide students with a comprehensive understanding of robotics and their wide-ranging applications.
2. Aims to provide students with a detailed understanding of sensor and actuator technologies in robotics.
3. Aims to equip students with a thorough understanding of robotic configurations, and the classification, selection, and design of end effectors and their operational criteria.
4. Aims to provide students with a comprehensive understanding of robotic coordinate systems, transformations, and control techniques.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction To Robotics:** Definitions- Robots, Robotics; Types of Robots- Manipulators, Mobile Robots-wheeled & Legged Robots, Aerial Robots; Anatomy of a robotic manipulator-wrist configurations, links, joints, open kinematic vs closed kinematic chain; degrees of freedom; Robot Applications- medical, mining, space, defence, security, domestic, entertainment, Industrial Applications-Material handling, welding, Spray painting, Machining.	9
2	**Sensors and Actuators:** Sensor classification- touch, force, proximity, vision sensors. Internal sensors-Position sensors, velocity sensors, acceleration sensors, Force	9

	sensors; External sensors-contact type, noncontact type; Vision - Elements of vision sensor, image acquisition, image processing; Selection of sensors. Actuators for robots- classification-Electric, Hydraulic, Pneumatic actuators; their advantages and disadvantages; Electric actuators- Stepper motors, DC motors, DC servo motors, AC motors, Hydraulic actuators- Components and typical circuit, advantages and disadvantages; Pneumatic Actuators- Components and typical circuit, advantages and disadvantages.	
3	**Robotic configurations and End effectors:** Robot configurations-PPP, RPP, RRP, RRR; features of SCARA, PUMA Robots; Robot considerations for an application- number of axes, work volume, capacity & speed, stroke &reach, Repeatability, Precision and Accuracy, Operating environment, point to point control or continuous path control. Classification of End effectors - mechanical grippers, special tools, Magnetic grippers, Vacuum grippers, adhesive grippers, Active and passive grippers, selection and design considerations of grippers in robot.	**9**
4	**Kinematics and Control of Robots:** Robot Coordinate Systems- Matrix representation of a point, vector, frame and a rigid body in space, Representation of transformations-translation, Fundamental and composite rotations, homogeneous transformations, combined transformations, D-H representation. Control Techniques- Transfer function and state space representation, Performance and stability of feedback control, PID control of a single link manipulator, selection of PID controller gains.	**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
10	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	Familiarise with anatomy, specifications and applications of Robots.	**K2**
CO2	Choose the appropriate sensors and actuators for robots.	**K2**
CO3	Choose appropriate Robotic configuration and gripper for a particular application.	**K2**
CO4	Obtain kinematic model of robotic manipulators and design the controller for robotic manipulators	**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	1										3
CO2	2	1										3
CO3	2	1										3
CO4	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	Introduction to Robotics	S. K. Saha,	Tata McGraw Hill Education Pvt. Ltd.,	2nd Edition, 2008
2	Fundamentals of robotics – Analysis and control	Robert. J. Schilling	Dorling Kindersley (India) Pvt Ltd	2006.
3	Introduction to Robotics: Mechanics and Control	John J. Craig,	Pearson Publishers	3rd Edition, 2008
4	Introduction to Robotics: Analysis, Systems, Applications	Saeed B. Niku	Wiely Publishers	3rd Edition, 2020
5	Robotics and Control	R K Mittal and I J Nagrath,	Tata McGraw Hill, New Delhi	1st Edition, 2003
6	Introduction to measurements and Instrumentation	Arun K Ghosh	PHI Learning	4th Edition, 2012
7	Control Systems Engineering	I.J Nagrath & M. Gopal	New Age International Publishers	7th Edition, 2021

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Robot Modeling and Control	Mark W. Spong, Seth Hutchinson, M. Vidyasagar	Wiley (India),	2nd Edition 2020.
2	Fundamentals of Robotics	D.K. Pratihar	Narosa Publishing House, New-Delhi	1st Edition, 2017
3	Robotics	K.S. Fu, R.C. Gonzalez, C.S.G. Lee	McGraw-Hill Book Company	1987
4	Robotics Technology and Flexible Automation, Second Edition,	S. R. Deb	McGraw Hill Education (India) Private Limited	2nd Edition 2010.
5	Control Systems	Les Fenical	Cenage Learning India Pvt. Ltd.	2nd Edition 2011.
6	Robotics: A Very Short Introduction	Alan Winfield	Oxford University Press	2012

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Robotics, Prof. D. K Pratihar, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc24_me88/preview Industrial Robotics: Theories for implementation, Prof. Arun Dayal Udai IIT (ISM Dhanbad) https://onlinecourses.nptel.ac.in/noc24_me117/preview
2	Robotics, Prof. D. K Pratihar, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc24_me88/preview Industrial Robotics: Theories for implementation, Prof. Arun Dayal Udai IIT (ISM Dhanbad) https://onlinecourses.nptel.ac.in/noc24_me117/preview
3	Robotics, Prof. D. K Pratihar, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc24_me88/preview Industrial Robotics: Theories for implementation, Prof. Arun Dayal Udai IIT (ISM Dhanbad) https://onlinecourses.nptel.ac.in/noc24_me117/preview
4	Robotics, Prof. D. K Pratihar, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc24_me88/preview Industrial Robotics: Theories for implementation, Prof. Arun Dayal Udai IIT (ISM Dhanbad) https://onlinecourses.nptel.ac.in/noc24_me117/preview

SEMESTER SN6

OBJECT ORIENTED CONCEPTS

Course Code	**OEERT613**	**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)	GBEST204	**Course Type**	Theory

Course Objectives:

1. Understand and apply foundational object-oriented programming concepts in Java, including classes, objects, inheritance, polymorphism, encapsulation, and abstraction.
2. Design and implement Java applications that leverage OOP principles to achieve modularity, reusability, and scalability in software development

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Object-Oriented concepts, Introduction to Java - Java programming and Runtime Environment, Development Platforms- Java Virtual Machine (JVM), Java compiler, Bytecode, Java Buzzwords, Java program structure, Comments.Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, 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**
2	Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Introduction to Methods, Constructors, this Keyword, Method Overloading, Using Objects as Parameters, Returning Objects. Static Members, Final Variables, Inner Classes.Inheritance - Super Class, Sub Class, The Keyword super, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, using final with Inheritance.Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.	**9**

3	Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw, throws and finally. Java Library - String Handling – String Constructors, String Length, Special String Operations -Character Extraction, String Comparison, Searching Strings, Modifying Strings.Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.	**9**
4	Event handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces.Swings fundamentals-Swing Controls, Components and Containers, Swing Packages, Event Handling in Swings, Swing Layout Managers, Exploring Swings –JFrame, JLabel , Swing Buttons, JText Field.Java Database Connectivity (JDBC) - JDBC overview, Creating and Executing Queries – create table, delete, insert, select.	**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	Understand and apply fundamental Java programming concepts, including the runtime environment, primitive data types, operators, and control statements, to develop efficient and well-structured Java applications.	**K2**
CO2	Apply key object-oriented programming principles in Java, leveraging packages and interfaces effectively to design and implement Java applications.	**K3**
CO3	Confidently handle Java exceptions, manipulate strings effectively, and implement multithreaded programming techniques.	**K3**
CO4	Develop Java applications that integrate event handling, Swing-based graphical user interfaces, and JDBC database connectivity to create robust and user-friendly software solutions.	**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									2
CO2	3	3	3									2
CO3	3	3	3		2							2
CO4	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	Java: The Complete reference	Herbert Schildt	Tata McGraw Hill	8/e, 2011
2	Java How to Program, Early Objects	Paul Deitel, Harvey Deitel	Pearson	11/e, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Java Programming	Y. Daniel Liang	Pearson	7/e, 2013
2	Programming JAVA a Primer	Balagurusamy E	Tata McGraw Hill	5/e, 2014
3	Core Java: An Integrated Approach	Nageswararao R	Dreamtech Press	2008
4	Java in A Nutshell	Flanagan D	O'Reilly	5/e,2005

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105191/
2	https://archive.nptel.ac.in/courses/106/105/106105191/
3	https://archive.nptel.ac.in/courses/106/105/106105191/
4	https://archive.nptel.ac.in/courses/106/105/106105191/

SEMESTER S6

INTERNET OF THINGS

Course Code	**OEERT614**	**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 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 technology – features, LoRaWAN architecture, 6LoWPAN – features, protocol stack, Narrow Band (NB- IoT) – features, applications, Sigfox – features, applications	9
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	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 S6

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Course Code	OEERT615	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 basic principles that drive complex real world intelligence applications.
2. To introduce and discuss the basic concepts of AI Techniques and Learning.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Artificial Intelligence:** What is Artificial Intelligence(AI)? The Foundations of AI, History of AI, Applications of AI. Intelligent Agents, Types of agents and their environments, goodbehavior: The concept of rationality, nature of Environments, Structure of Agents. Examples of practical agents.	9
2	**Problem Solving:** Solving Problems by searching-Problem solving Agents, Example problems, Searching for solutions, Uninformed search strategies-Depth First Search (DFS) and Breadth First Search (BFS), Informed search strategies- Greedy Search, A* Search, AO* Search, Hill Climbing Algorithm, Heuristic functions.	9
3	**Adversarial search:** Games, Optimal decisions in games, The Minimax algorithm, Alpha-Beta pruning. Constraint Satisfaction Problems – Defining CSP, Constraint Propagation- inference in CSPs, Backtracking search for CSPs, Structure of CSP problems.	9
4	**Knowledge Representation and Reasoning:** First Order Predicate Logic – Syntax and Semantics of First Order Logic, Knowledge representation in	9

	First Order Logic. Inference in First Order Logic – Unification and Lifting, Forward chaining, Backward chaining, Resolution. **Basic concepts of Machine Learning:** Learning from Examples – Forms of Learning, Supervised Learning/Unsupervised Learning.	

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 subdivisions. **(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 intelligent systems and their architecture.	**K2**
CO2	Illustrate uninformed and informed search techniques for problem solving in intelligent systems.	**K2**
CO3	Solve Constraint Satisfaction Problems using search techniques.	**K3**
CO4	Represent AI domain knowledge using logic systems and use inference techniques for reasoning in intelligent systems.	**K3**
CO5	Illustrate different types of learning techniques used in intelligent 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											
CO2	3	3	3									3
CO3	3	3	3	2								3
CO4	3	3	3	2								3
CO5	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	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Prentice Hall	3/e, 2010
2	Artificial Intelligence	E Rich, K Knight,	Tata McGraw Hill	3/e, 2009
3	Artificial Intelligence-Structures and Strategies for Complex Problem Solving	GeorgeF.Luger	Pearson Education	4/e, 2002

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Artificial Intelligence - A New Synthesis	Nilsson N.J	Harcourt Asia Pvt. Ltd.	1998
2	Artificial intelligence, A modern approach	Stuart Jonathan Russell, Peter Norvig	Pearson Education	3/e, 2010
3	Artificial Intelligence and Machine Learning	Chandra SS And Hareendran S	PHI Learning	2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	An Introduction to Artificial Intelligence - Course (nptel.ac.in) https://onlinecourses.nptel.ac.in/noc22_cs56/preview
2	Fundamentals of Artificial Intelligence - Course (nptel.ac.in) https://onlinecourses.nptel.ac.in/noc22_ge29/preview
3	Artificial Intelligence - Course (swayam2.ac.in) https://onlinecourses.swayam2.ac.in/cec21_cs08/preview

SEMESTER S6

EMBEDDED SYSTEMS AND IoT LAB

Course Code	**PCERL 607**	**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)	PBERT 604	**Course Type**	Lab

Course Objectives:

1. To provide students a lot of hands-on experience designing different embedded systems and exposing them to the tools needed to make them Internet of Things devices.

Details of Experiment

Expt. No	Experiment
Part A: Arduino based embedded system	
1	Implement an arduino based system to detect when something is moved, tilted, or shaken.
2	Implement temperature control system by controlling a fan, if the temperature exceeds a limit. (Use arduino as control board)
3	Use Arduino to read the key presses on matrix keypad and display the pressed key on an LCD display.
4	Use Arduino to monitor one or more voltages and take some action when the voltage rises or falls below a threshold. For example, you want to flash an LED to indicate a low battery level—perhaps to start flashing when the voltage drops below a warning threshold and increasing in urgency as the voltage drops further.
5	Use Arduino to measure voltages greater than 5 volts. For example, you want to display the voltage of a 9V battery and trigger an alarm LED when the voltage falls below a certain level.
Part B: NodeMCU based systems	
6	Installing the Arduino IDE for the ESP8266 and connecting the module to your Wi-Fi network.
7	Reading data from a digital sensor connected to a digital pin of ESP8266.

8	Configuring the ESP8266 module and controlling an LED connected to it, from anywhere in the world; using MQTT.
9	Controlling the lock from the cloud using Blynk and NodeMCU.
10	Sending an e-mail/SMS notification based on activity at sensor connected to NodeMCU; using IFTTT.
Part C: Raspberry Pi based systems	
11	Setting up Raspberry Pi by installing OS and obtaining static IP of Raspberry Pi.
12	Light an LED by reading status of a switch connected to GPIO of the board.
13	Install Arduino IDE on Raspberry Pi and control LED using LDR; in which both are connected to Digital IO pin of Arduino.
14	Realize a datalogger with ThingSpeak Server: capture the real-time data of any sensor by Raspberry Pi and upload to the cloud.
15	Implement a Home Appliance Control system using Raspberry Pi using Blynk App

**** Any four experiments are mandatory from each part.**

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	Implement interfacing of various sensors and actuators with Arduino.	**K3**
CO2	Implement interfacing of various sensors and actuators with Node MCU.	**K3**
CO3	Design and develop smart systems using Raspberry Pi.	**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				3		3	3
CO2	3	3	3	3	3				3		3	3
CO3	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	Arduino Cookbook_ Recipes to Begin, Expand, and Enhance Your Projects	Michael Margolis	O'Reilly Media	3e, 2020
2	Internet of Things with ESP8266-Packt Publishing	Marco Schwartz	Packt Publishing	2016
3	Internet Of things With Raspberry Pi and Arduino	Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain	CRC Press Taylor & Francis Group	2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to IoT	Misra, Mukherjee, Roy	Cambridge University Press	2021
2	NodeMCU ESP8266 Communication Methods and Protocols _ Programming with Arduino IDE	Manoj R. Thakur	Amazon Media EU S.à r.l	2018
3	Raspberry Pi and MQTT Essentials	Dhairya Parikh	Packt	2022
4	Electronics Projects with the ESP8266 and ESP32_ Building Web Pages, Applications, and WiFi Enabled Devices	Neil Cameron	Apress	2021

Video Links (NPTEL, SWAYAM…)	
Sl. No.	**Link ID**
1	https://archive.nptel.ac.in/courses/128/108/128108016/

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 & COMPUTER ENGINEERING

SEMESTER S7

IMAGE PROCESSING

Course Code	PEERT 741	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)	Linear Algebra	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	9

	Filters, Sharpening spatial Filters. 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	Understand 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	Understand the basic image segmentation techniques	**K3**
CO5	Analyze the filtering and restoration of images	**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 Education	4/e, 2019
2	Digital Image Processing	S Jayaraman, S Esakkirajan, T Veerakumar	Tata McGraw Hill Education	2009

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://archive.nptel.ac.in/courses/117/105/117105135
2	https://archive.nptel.ac.in/courses/106/105/106105216
3	https://nptel.ac.in/courses/117105079
4	https://nptel.ac.in/courses/106105032

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)		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.	10
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.	10

	Gated Recurrent Units (GRU), architectture and training.	
4	Introduction to Generative models: parameter estimation, Maximum Likelyhood Estimation. 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)	**9**

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://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

ROBOTICS AND AUTOMATION

Course Code	**PEERT743**	**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)	Engineering mathematics	**Course Type**	Theory

Course Objectives:

1. To understand the basics of robotics.
2. To gain insights into various sensors used with robots.
3. To understand the spatial descriptions and kinematics of robots.
4. To design controllers for robots

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Definition and Origin of Robotics. Robot Anatomy. Robot Specifications. Robot Characteristics –Accuracy, Precision, and Repeatability. Classification of Robots. Advantages and Disadvantages of Robots. Robot Structure - Types of Joints and End Effectors, Mechanisms and Manipulators.Common Kinematic Arrangements. Degree of Freedom. Robot Coordinates. Areas of Applicationfor Robots	9
2	Actuators: Types of Robotic Drive Systems and Actuators: Hydraulic, Pneumatic and Electric drives. Transmission: Gears, Timing Belts and Bearings. Parameters for selection of actuators. Specification. Areas of Application for: Stepper Motor & Servo Motor. Sensors: Types and Applications of Sensors in Robotics: Position, Displacement and VelocitySensors. Tactile Sensors for Contact and Proximity Assessment	9
3	Introduction to Kinematics: Positionand Orientation of Objects. Rotation. Euler Angles. Rigid Motion Representation using Homogenous Transformation Matrix. Kinematic Modelling:Translation and Rotation Representation,	9

	Coordinate Transformation, Forward and Inverse Kinematics. Forward Kinematics-Link Coordinates, Denavit-Hartenberg Representation,Application of DH Convention to Different Serial Kinematic Arrangements	
4	Basics of Control: Open Loop- Closed Loop, Transfer Functions, Control Laws: P, PD, PID, Linearand Non-linear Controls; Control Hardware and Interfacing; Embedded Systems: Microcontroller Architecture and Integration with Sensors, Actuators, 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	Attain a thorough understanding of different types of Robots and their applications	**K2**
CO2	Select appropriate sensors and actuators based on the robotic application	**K2**
CO3	Perform kinematic and dynamic analyses for robots	**K2**
CO4	Carry out the design and control of a simple robot.	**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									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	Industrial Robotics Technology, Programming and Applications	M.PGroover	McGraw-HillUSA	2e(SIE),2012
2	Introduction to Robotics	JohnCraig	Macmillan	4e,2022
3	Fundamentals of Robotics Analysis& Control	Robert J Shilling	PHI	2003
4	Introduction to Robotics	S.K. Saha	Tata McGraw Hill	2e,2014

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Robotics, Analysis, Control, Application	NikuS.B.,	John Wiley	Second Edition, 2000
2	Robot Dynamics and Control	Mark W. Spong, Seth Hutchinson, and M. Vidyasagar	Wiley	2008
3	Robotics, Fundamental concepts and analysis	AshitavaGhosal	OXFORD University Press	2006
4	Robot Analysis and Control	Asada, H., and J. J. Slotine.	New York, NY:Wiley,	1986
5	Robotic Engineering An Integrated Approach	Klafter, R.D., Chmielewski, T.A, Negin, M,	PHI	2007

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/107106090
2	https://nptel.ac.in/courses/112105249
3	https://nptel.ac.in/courses/112101098
4	https://nptel.ac.in/courses/112107289

SEMESTER S7

NANOELECTRONICS

Course Code	PEERT 744	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 challenges of scaling of devices to Nano-meter scales
2. 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 Nanoelectronic systems, characteristic lengths **Scaling and short channel effects-L**ength, Oxide layer thickness, tunneling, power density, non-uniform dopant concentration, threshold voltage scaling, hot electron effects, sub-threshold current, velocity saturation, DIBL, and channel length modulation.	9
2	**Novel MOS Devices and Performance Optimization** **Silicon-on-insulator devices--**FD SOI, PD SOI **Multiple gate MOSFETs--**Double gate MOSFETs, FinFETs, Nanowires	9

	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.	
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.	**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 **Hetero junctions** -Modulation-doped hetero junctions- SiGe strained heterostructures- MODFET- Resonant Tunnelling-Resonant Tunneling 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	**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 S7

BLOCKCHAIN TECHNOLOGIES

Course Code	PEERT 746	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)	Data structures, Operating systems.	Course Type	Theory

Course Objectives:

1. Illustrate the cryptographic building blocks of blockchain technology.
2. To understand the function of blockchains, understanding why/when it is better than a simple distributed database.
3. Summarize the classification of consensus algorithms.
4. Explain the use of smart contracts and its use cases.
5. Develop simple applications using Solidity language on Ethereum platform.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of Cryptography** Introduction to Cryptography, Symmetric cryptography – AES. Asymmetric cryptography – RSA. Elliptic curve cryptography, Digital signatures – RSA digital signature algorithms. Secure Hash Algorithms – SHA-256. Applications of cryptographic hash functions – Merkle trees, Distributed hash tables **Fundamentals of Blockchain Technology** Blockchain – Definition, architecture, elements of blockchain, benefits and limitations, types of blockchain.	9
2	**Consensus Algorithms** Consensus – definition, types, consensus in blockchain.	9

	Consensus Algorithms, Crash fault-tolerance (CFT) algorithms – Paxos, Raft. Byzantine faulttolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT), Proof of work (PoW), Proof of stake (PoS), Types of PoS **Bitcoin** 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	
3	**Smart Contracts and Use cases** Smart Contracts – Definition, Smart contract templates, Oracles, Types of oracles, Deploying smart contracts. Use cases of Blockchain technology – Government, Health care, Finance, Supply chain management. Blockchain and allied technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence.	9
4	**Ethereum and Solidity** 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	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

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 cryptography and block chain	**K2**
CO2	Analyse how the various consensus algorithms ensure security and reliability in blockchain networks.	**K4**
CO3	Learn about the concept of smart contracts and their applications.	**K2**
CO4	Identify and discuss potential applications of blockchain technology in various sectors	**K4**
CO5	Study real-world examples of successful blockchain implementations and their impact.	**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	2	2										2
CO2	2	2										2
CO3	2	2										2
CO4	2	2										2
CO5	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	Block Chain in Action	Bina Ramamurthy	Mnning Publication	First edition& 2020
2	Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain	Ritesh Modi	Packt Publication	First edition&2018.
4	Blockchain Technology: Concepts and Applications	Kumar Saurabh, Ashutosh Saxena	Wiley Publication	First Edition&2020 .

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Blockchain Demo (andersbrownworth.com)
2	Blockchain.com Explorer | BCH | ETH | BCH
3	Remix - Ethereum IDE
4	Ethereum Transactions Information | Etherscan

SEMESTER S7

NETWORK SECURITY

Course Code	PEERT 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 understand the fundamental concepts and importance of network security.
2. To learn and apply various cryptographic techniques for securing data.
3. To explore and analyze different network security protocols and their applications.
4. To identify and mitigate various network threats and vulnerabilities.
5. To examine advanced topics in network security, including intrusion detection systems, wireless security, and emerging security challenges.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of network security - Introduction to Network Security, Understanding Security: Confidentiality, Integrity, Availability (CIA Triad), Threats, Vulnerabilities, and Attacks: Types and Examples, Security Policies and Mechanisms, Network Security Technologies and Devices - Firewalls: Types, Configurations, and Best Practices, Intrusion Detection and Prevention Systems (IDS/IPS), Virtual Private Networks (VPNs): Concepts and Uses, Access Control and Authentication - Access Control Models: DAC, MAC, RBAC, Authentication Methods: Passwords, Biometrics, Two-Factor Authentication, Authorization and Accounting Concept	9
2	Cryptography and Secure Communications - Introduction to Cryptography, Symmetric Key Cryptography: Algorithms (AES, DES), Modes of Operation,	9

	Encryption and Decryption Processes, Asymmetric Cryptography and Key Management- Public Key Cryptography: RSA, Diffie-Hellman, Digital Signatures and Certificates, Public Key Infrastructure (PKI) and Key Management, Hash Functions and Message Authentication- Hash Functions: SHA, MD5 – Concepts and Applications, Message Authentication Codes (MAC) and HMAC, Secure Email: PGP and S/MIME	
3	Network Security Protocols and Applications Secure Network Protocols - Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Shell (SSH): Concepts and Uses, IP Security (IPsec): Architecture and Protocols, Web and Email Security, HTTP Security: HTTPS, Secure Cookies, and Content Security Policy, Email Security Threats and Solutions, Web Application Security: OWASP Top 10, Wireless and Mobile Security, Wireless Security Protocols: WEP, WPA, WPA2, WPA3, Mobile Device Security Challenges and Solutions, Bluetooth and Near Field Communication (NFC) Security	9
4	Advanced Topics in Network Security - Intrusion Detection and Prevention, Types of Intrusions and Attack Patterns, Host-based and Network-based IDS/IPS, Anomaly Detection and Signature-Based Detection, Types of Malware: Viruses, Worms, Trojans, Ransomware, Malware Detection and Removal Techniques, Threat Intelligence and Cybersecurity Frameworks Malware and Threat Analysis - Cloud Security: Challenges and Solutions, Emerging Trends and Future Directions - Internet of Things (IoT) Security Concerns, Artificial Intelligence and Machine Learning in Security, Blockchain Technology for Secure Transactions	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 may be done using following Software and Tools: (10 marks)

:

- Wireshark: For network traffic analysis.
- Nmap: For network scanning and vulnerability assessment.
- OpenSSL: For implementing and testing cryptographic functions.
- Snort: For intrusion detection and prevention.
- VirtualBox/VMware: For creating virtualized network environments.
- Kali Linux: A Linux distribution specialized for digital forensics and penetration testing.

1. Setting Up a Secure Network Environment Using Virtual Machines
2. Configuring a Basic Firewall and Monitoring Network Traffic
3. Implementing User Authentication and Access Control in a Network
4. Implementing Symmetric Encryption Using OpenSSL
5. Creating and Using Digital Certificates with OpenSSL
6. Generating and Verifying Hashes and Digital Signatures
7. Establishing Secure Connections Using SSH and TLS
8. Configuring HTTPS for a Web Server and Implementing Basic Web Security Measures
9. Securing a Wireless Network and Assessing Vulnerabilities
10. Setting Up and Configuring Snort IDS for Network Monitoring
11. Conducting Basic Malware Analysis in a Controlled Environment
12. Case Study Presentation on an Emerging Network Security Topic

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.
2. Innovation and Creativity (2 marks)
    - Introduces innovative ideas or unique approaches in the design and implementation.
    - Demonstrates creativity in solving problems or optimizing designs.
2. 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.
2. 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	Apply cryptographic techniques and protocols to secure network communications and ensure data confidentiality, integrity, and authenticity.	**K3**
CO2	Configure and manage network security devices and software, such as firewalls, IDS/IPS, and VPNs, to protect network infrastructures.	**K3**
CO3	Identify and respond to security incidents and network breaches by conducting threat analysis and implementing appropriate countermeasures.	**K2**
CO4	Evaluate emerging network security challenges and technologies, proposing solutions to complex security problems in modern network environments.	**K4**

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			3	3					3	3
CO2	3	2			3	3					3	3
CO3	3	2			3	3					3	3
CO4	3	2			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	Network Security Essentials: Applications and Standards	William Stallings	Pearson	7th Edition, 2022
2	Cryptography and Network Security: Principles and Practice	William Stallings	Pearson	8th Edition, 2023
3	Computer Security: Principles and Practice"	William Stallings and Lawrie Brown	Pearson	5th Edition, 2021

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	The Network Security Test Lab: A Step-by-Step Guide	Michael Gregg	Wiley	2nd Edition, 2022
2	Applied Network Security Monitoring: Collection, Detection, and Analysis	Chris Sanders and Jason Smith	Syngress	1st Edition, 2018
3	Hacking Exposed 7: Network Security Secrets and Solutions	Stuart McClure, Joel Scambray, and George Kurtz	McGraw-Hill Education	7th Edition, 2020

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106105031
2	https://onlinecourses.nptel.ac.in/noc22_cs90/preview

SEMESTER S7

WEB PROGRAMMING

Course Code	**PEERT 751**	**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. Learn how servers and web browsers communicate.
2. Learn how to use HTML elements to construct well-structured web pages.
3. Explore advanced CSS methods such as animations, transitions, and responsive design.
4. Learn how to write PHP scripts to handle form submissions and perform server-side processing.
5. Learn how to integrate HTML, CSS, PHP, and MySQL to create dynamic and interactive web applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**WWW:** Web Basics, URI's & URL, Search Engine Optimization (SEO), Analytics, Domain Names & Hosting, Ftp & Third party tools **HTML5:** Introduction to HTML5, Basic Structure for HTML, Basic HTML tags-Headings, Hyper Links, Images, Special Characters and Horizontal Rules, Lists, Tables, Forms, Internal Linking, Meta Elements, HTML5 Form Input Types, Input and Data List Elements, Autocomplete Attribute, Page Structure Elements, Multimedia-HTML5 Audio & video elements	8
2	Introduction to Stylesheets : Introduction to CSS-Basic syntax and structure-Inline, Internal and External Styles, Embedded Style Sheets, Conflict Resolution, Linking External Style Sheets-Exploring CSS Selectors-Properties, values, Positioning Elements: Absolute Positioning, Relative	7

	Positioning, Backgrounds,List Styles,Element Dimensions, Table Layouts-Box Model and Text Flow-div and span, Basics of Responsive CSS, Media port & Media Queries.	
3	JavaScript:Introduction, Examples of JavaScript in browser, Basic JavaScript Instructions: Statements, Comments, Variable, Data Types, Arrays, Expressions, Operators, Functions and Objects, Variable Scope, Object, Arrays are objects, Browser Object Model, DOM, Global Objects: String, Number, Math, Date. Decision Making and Loops: if statement, if…else statement, switch statement, Loops: Key Concepts, for loops, while loops, do while loops; DOM: Document Object Model (DOM),Working with DOM tree, Accessing Elements, Nodelists, Selecting Elements: Using Class Attribute, Tag Name, CSS Selector, repeating actions for an entire nodelist, Looping through a Nodelist, Traversing the DOM, Adding or Removing HTMLcontent, Update Text and Markup, Adding/Removing Elements, Event Handling: Different event types and ways to bind an event to an element: using DOM Event Handlers, using Event listeners, using Parameters with Event Listeners; the Event Object, Event Delegation, User Interface Events, Event Bubbling ECMAScript: Versions, Features, Introduction, Var Declarations and Hoisting, let declaration, Constant declaration, Function with default parameter values, Default parameter expressions, Unnamed parameters, the spread operator, arrow functions, object destructuring, array destructuring, sets and maps, Array.find(), Array.findIndex(), template strings, Javascript classes, callbacks, promises, async/await	10
4	**PHP**: Introduction, Building blocks of PHP, Variables, Data Types Simple PHP program, Converting between Data Types, Operators and Expressions, Flow Control functions, Control statements, Working with Functions, Initialising and Manipulating Arrays, Objects, String Comparisons,String processing with Regular Expression **Advanced PHP**: Form processing and Business Logic, Cookies, Sessions, MySQL Integration: Connecting to MySQL with PHP, Performing CREATE, DELETE, INSERT, SELECT and UPDATE operations on MySQL table, Working with MySQL data, Reading from Database Dynamic Content.	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 subdivisions. **(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	Comprehend the principles of the WWW and create web pages using HyperText Markup Language (HTML)	**K3**
CO2	Implement Cascading Style Sheet to apply style in HTML pages	**K3**
CO3	Add functionality to web pages by using Java Script	**K3**
CO4	Construct websites using advanced sever side programming tool PHP	**K3**
CO5	Use PHP to create dynamic web pages and perform MySQL database operations	**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	1	1	-	-	1	-	-	-	-	-	-	1
CO2	1	1	-	-	1	-	-	-	-	-	-	1
CO3	2	2	-	-	1	-	-	-	-	-	-	1
CO4	2	2	-	-	2	-	-	-	-	-	-	1
CO5	2	3	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	Internet and World Wide Web How To Program	Paul J. Deitel, Harvey M. Deitel, Abbey Deitel	Pearson Education	5th Edition, 2012
2	HTML and CSS: Design and	Jon Duckett	Wiley	2011

	Build Websites			
3	JavaScript and JQuery : Interactive Front–End Web Development	Jon Duckett	Wiley	2014
4	Understanding ECMAScript 6: The Definitive Guide for JavaScript Developers	Nicholas C. Zakas	William Pollock	2016
5	PHP, MySQL & JavaScript All in One	Julie C. Meloni	Pearson - Sams Publishing	5th edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Programming the World Wide Web	Robert W Sebesta	Pearson	8th Edition, 2015
2	PHP 6 and MySQL 5 for Dynamic Web Sites: Visual QuickPro Guide	Larry Ullman	Pearson	5th Edition, 2017
3	The Joy of PHP: A Beginner's Guide to Programming Interactive Web Applications with PHP and mySQL	Alan Forbes	Plum Island	6th Edition, 2020
4	Head First PHP & MySQL	Lynn Beighley & Michael Morrison	O'Reilly	1st Edition, 2009
5	PHP: A Beginner's Guide	Vikram Vaswani	McGraw-Hill Education	1st Edition, 2008
6	Learning PHP, MySQL, JavaScript, CSS & HTML5	Robin Nixon	O'Reilly	2nd Edition, 2012

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106106156/
2	https://www.php.net/
3	https://www.mysql.com/
4	https://www.w3schools.com/php/
5	https://www.w3schools.com/sql/

SEMESTER S7

LOW POWER VLSI

Course Code	**PEERT 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 Type**	Theory

Course Objectives:

1. Students will be able to understand the fundamental principles of power dissipation in digital integrated circuits and the impact of power consumption on modern VLSI design
2. Students will be able to explore various low power design techniques and methodologies for minimizing power consumption in digital circuits, such as voltage scaling, power gating, and clock gating.

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, Tunnelling 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	9

	dependency on input rise and fall time, Variation of short circuit 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 **Static Power Dissipation:** Sources of Leakage Power, Effects of V_{dd} and Vton speed, Constraints on Vt 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	Understand the Impact of Technology Scaling on Power Dissipation and Short Channel Effects	**K2**
CO2	Identify Different Sources of Power Dissipation in Digital ICs	**K2**
CO3	Apply Power Management Approaches in Digital ICs	**K3**
CO4	Utilize Clocked and Non-Clocked Design Styles and Adiabatic Switching for Power Management	**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	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 SenguptaLectures 47-51

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 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-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	**9**
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 mechanisms	**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	Understand 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, K5, K6**

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

CLIENT SERVER ARCHITECTURE

Course Code	**PEERT 754**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

Understand fundamental concepts of Web Services including

1. Client Server systems
2. system models of distributed systems
3. networks that distributed systems run on
4. communication protocols between processes in distributed systems
5. Middleware
6. Enterprise Application integration
7. Web Services Security

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction**: Introduction to Client/Server computing - Driving forces behind Client/ Server, Client/ Server development tools, Development of client/server systems, Client/Server security, Organizational Expectations, Improving performance of client/server applications, Single system image, Downsizing and Rightsizing, Advantages of client server computing, Applications of Client/Server.	**7**
2	**Client/ Server Application and Network**: Classification of Client/Server Systems- Two-Tier Computing, Middleware, Three-Tier Computing- Model View Controller (MVC), Principles behind Client/Server Systems. Client/Server Topologies. Existing Client/Server Architecture. Architecture for Business Information System..	**8**

	Client- Services, Request for services, RPC, Windows services, Print services, Remote boot services, other remote services, Utility Services **Server-** Detailed server functionality, Network operating system, Available platforms, Server operating system.	
3	**Client/ Server Systems Development**: Services and Support- System administration, Availability, Reliability, Scalability, Observability, Agility, Serviceability. Software Distribution, Performance, Network management. Remote Systems Management- RDP, Telnet, SSH, Security. LAN and Network Management issues, Training, Connectivity, Communication interface technology, Interprocess communication, Wide area network technologies, Network Acquisition, PC-level processing unit, X-terminals, Server hardware.	**8**
4	**Client/Server Technology and Web Services:** Web Services History. Web Server Technology- Web Server, Web Server Communication, Role of Java for Client/Server on Web. Web Services- MicroServices, APIs, API Gateway, Authentication of users/clients, Tokens/Keys for Authentication, Service Mesh, Message Queues, SaaS, Web Sockets.Client/Server/Browser – Server Technology, Client/Server Technology and Web Applications, Balanced Computing and the Server's Changing Role.	**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 =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 subdivisions. **(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 client/server systems and the driving force behind the development of client/server systems	**K2**
CO2	Outline the architecture and classifications of client/server systems	**K2**
CO3	Choose the appropriate client/server network services for a typical application	**K2**
CO4	Describe management services and issues in network	**K2**
CO5	Compare and summarize the web extensions and choose appropriate web services standards for an application	**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	1	1	-	-	-	-	-	-	-	-	-	1
CO2	1	1	-	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	1	-	-	-	-	-	-	1
CO4	2	-	-	-	-	-	-	-	-	-	-	1
CO5	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	Client/ Server Computing	Patrick Smith & Steave Guengerich	Sam Publishers	2nd Edition, 1994
2	Client/ Server Computing	Dawna Travis Dewire	Mc Graw Hill	1993
3	An Indroduction to Client/ Server Computing	Subash Chandra Yadhav, Sanjay Kumar Sigh	New Age International Publishers	1st Edition, 2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Guide to Client- Server Application & Architecture	Jerffrey D Schank	Novell Press	1994
2	Client/ Server Survival Guide	Robert Orfali , Dan Harkey , Jeri Edwards	Wiley Indian Edition	3rd Edition, 1996
3	Client/ Server Applications	W H Inman		
4	Client/ Server Computing	Dawna Travis Dewire	Mc Graw Hill	1993
5	Developing Client/ Server Application	W H Inman		

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/105/106105084/
2	https://www.geeksforgeeks.org/client-server-architecture-system-design/
3	https://intellipaat.com/blog/what-is-client-server-architecture/
4	https://www.tutorialspoint.com/client-server-computing
5	https://www.simplilearn.com/what-is-client-server-architecture-article

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	4/3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**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 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										
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	2^{nd} 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

NEURAL NETWORKS AND DEEP LEARNING

Course Code	PEERT 755	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2Hr.30 Min.
Prerequisites (if any)	None		Elective

Course Objectives:

1. To introduce the fundamental concepts of neural networks, including their structure, function, and basic training algorithms.
2. To provide an understanding of deep learning concepts, architectures, and key techniques for training deep neural networks.
3. To explore advanced neural network architectures and techniques, including optimization methods and regularization techniques.
4. To explore real-world applications of deep learning and discuss the latest trends and future directions in the field.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Neural Networks:** Overview of Artificial Neural Networks (ANNs), Biological Neurons vs. Artificial Neurons, Applications of Neural Networks, Neuron Model: Activation Functions (Sigmoid, ReLU, Tanh), Single-layer Perceptron: Theory and Implementation, Multi-layer Perceptrons (MLPs), Backpropagation Algorithm: Concepts and Mathematical Foundations	9
2	**Deep Learning Fundamentals:** Introduction to Deep Learning, Differences Between Shallow and Deep Networks, Convolutional Neural Networks (CNNs): Architecture and Applications, Pooling Layers and Feature Maps,	9

	Training Deep Networks: Vanishing and Exploding Gradients, Recurrent Neural Networks (RNNs): Architecture and Applications, Long Short-Term Memory (LSTM) Networks	
3	**Advanced Neural Network Architectures:** Autoencoders: Concept, Architecture, and Applications, Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs): Theory and Architecture, Applications of GANs in Image Generation and Data Augmentation, Optimization Techniques: Gradient Descent, Adam, RMSprop, Regularization Methods: Dropout, Batch Normalization	**9**
4	**Applications and Emerging Trends in Deep Learning:** Deep Learning in Computer Vision: Object Detection, Segmentation, Deep Learning in Natural Language Processing: Word Embeddings, Transformers, Deep Reinforcement Learning: Concepts and Applications, Emerging Trends: Federated Learning, Explainable AI,	**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 Software Tools: (10 marks)

Introduction to Neural Network Libraries (e.g., TensorFlow, Keras)

Building a Simple Perceptron Model

Implementing Backpropagation in a Neural Network

Implementing Deep Neural Networks with Keras

Building and Training a CNN for Image Classification

Implementing an RNN for Sequence Prediction

Implementing an Autoencoder for Data Compression

Implementing a Simple GAN for Image Generation

Applying Regularization Techniques to Improve Model Performance

Implementing a Transformer Model for Text Classification

2. 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.
2. Innovation and Creativity (2 marks)
    - Introduces innovative ideas or unique approaches in the design and implementation.
    - Demonstrates creativity in solving problems or optimizing designs.
2. 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.
2. 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 implement the basic structure and functioning of neural networks and apply the backpropagation algorithm for training.	**K3**
CO2	Demonstrate the ability to design, train, and evaluate deep neural network architectures, including Convolutional Neural Networks and Recurrent Neural Networks.	**K2**
CO3	Evaluate and apply advanced neural network architectures, including Autoencoders and Generative Adversarial Networks, to solve real-world problems, and optimize models using advanced techniques such as regularization and optimization algorithms.	**K4**
CO4	Synthesize knowledge of deep learning applications in fields like computer vision, natural language processing, and reinforcement learning.	**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			3	2					3	2
CO2	3	2			3	2					3	2
CO3	3	2			3	2					3	2
CO4	3	2			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	Deep Learning	Ian Goodfellow, Yoshua Bengio, and Aaron Courville	MIT Press	1st Edition, 2016
2	Deep Learning: A Practitioner's Approach	Adam Gibson and Josh Patterson	O'Reilly Media	1st Edition, 2020

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Neural Networks: A Comprehensive Foundation	Simon Haykin	Prentice Hall	2nd Edition, 1998
2	Deep Learning for Computer Vision	Rajalingappaa Shanmugamani	Packt Publishing	2nd Edition 2022
3	Neural Networks and Deep Learning: A Textbook	Charu C. Aggarwal	Springer	2nd Edition, 2024

Video Links (NPTEL, SWAYAM…)	
Module No.	Link ID
1	https://nptel.ac.in/courses/117105084
2	https://nptel.ac.in/courses/106106184
3	https://nptel.ac.in/courses/106106184
4	https://nptel.ac.in/courses/106106184

SEMESTER S7

SENSORS AND INSTRUMENTATION

Course Code	OEERT721	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. Students will be able to identify and differentiate between various types of sensors and their applications.
2. Students will learn about different measurement instruments.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to sensor based measurement systems: General concepts and terminology, sensor classification, Primary Sensors, material for sensors, micro sensor technology. Self-generating Sensors-Thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors.	8
2	Principles of Measurement: Static Characteristics, Error in Measurement, Types of Static Error. Multirange Ammeters, Multirange voltmeter. Digital Voltmeter: Ramp Technique, Dual slope integrating Type DVM, Direct Compensation type and Successive Approximations type DVM	8
3	Digital Multimeter: Digital Frequency Meter and Digital Measurement of Time, Function Generator. Bridges: Measurement of resistance: Wheatstone's Bridge, AC Bridges - Capacitance and Inductance Comparison bridge, Wien's bridge.	8

4	Transducers: Introduction, Electrical Transducer, Resistive Transducer, Resistive position Transducer, Resistance Wire Strain Gauges, Resistance Thermometer, Thermistor, LVDT. Instrumentation Amplifier using Transducer Bridge, Temperature indicators using Thermometer.	**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 Sensor Concepts and Classification	**K2**
CO2	Gain knowledge of self-generating sensors	**K2**
CO3	Understand the principles of measurement	**K3**
CO4	Understand the various types of transducers	**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							
CO2	3	2		2	2		1					
CO3	3	3		2	2							
CO4	3	3		2	2							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	Electronic Instrumentation & Measurements.	David A. Bell	Oxford University Press PHI	2ndEdition, 2006.
2	Modern Electronic Instrumentation and Measuring Techniques.	D. Helfrick and W.D. Cooper	Pearson	1stEdition, 2015,
3	Sensors and Signal Conditioning.	Ramon Pallas Areny, JohnG. Webster,	John Wiley and Sons	2ndEdition, 2000.
4	Electronic Instrumentation	H.S.Kalsi	Mc Graw Hill	3rd Edition, 2012

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. Doebelin	McGraw-Hill	7th edition 2019
2	Transducers and Instrumentation	D. V. S. Murty	PHI	2nd edition and 2008
3	Electronic Measurement and Instrumentation	K. Lal Kishore	Pearson	1st edition 2009
4	Electrical and Electronic Measurements and Instrumentation	A.K. Sawhney	Dhanpat and Rai	19th revised edition 2011

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc23_ee105/preview
2	https://onlinecourses.nptel.ac.in/noc21_ee107/preview

SEMESTER S7

BIOMEDICAL INSTRUMENTATION

Course Code	OEERT 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)	NIL	Course Type	Theory

Course Objectives:

1. To understand various bio potentials and its recording
2. To illustrate the working of various diagnostic equipment
3. To illustrate the working of various therapeutic equipment
4. To describe the imaging techniques used in clinical applications

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to human physiological system** Physiological systems of the body (brief discussion on Heart and cardio vascular system, Anatomy of nervous system, Physiology of respiratory systems) Problems encountered in biomedical measurements. Sources of bioelectric potentials – resting and action potentials -propagation of action potentials – bioelectric potentials example (ECG, EEG, EMG, ERG, EOG, EGG etc.)	9
2	**Bio potential electrodes, ECG and BP Measurement** Bio potential electrodes –basic theory – microelectrodes – skin surface electrodes – needle electrodes Instrumentation for clinical laboratory: Bio Potential amplifiers instrumentation amplifiers, isolation amplifiers, chopper amplifier Electro conduction system of the heart, Electro cardiograph –electrodes and	9

	leads – Einthoven triangle, ECG readout devices ECG machine – block diagram Measurement of blood pressure – direct and indirect measurement– oscillometric measurement –ultrasonic method.	
3	**Measurement EEG, EMG Respiratory Parametersand Therapeutic devices** Electro encephalogram –EEG measurement Electromyogram (EMG) – Nerve conduction velocity measurements- Respiratory parameters – Spiro meter, pneumograph. Therapeutic devices- Pacemakers – defibrillators-heart lung machine, haemodialysis -Surgical diathermy.	**9**
4	**Advances in Radiological Imaging and Electrical safety** X-rays- principles of generation, uses of X-rays- Basic principle of computed tomography, magnetic resonance imaging system and nuclear medicine system. Ultrasonic imaging system Electrical safety– physiological effects of electric current –shock hazards from electrical equipment –method of accident prevention, introduction to telemedicine	**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 understand the physiology of major systems of human body	**K2**
CO2	To understand various bio potentials and its recording	**K1**
CO3	To illustrate the working of various diagnostic equipment	**K2**
CO4	To illustrate the working of various therapeutic equipment	**K2**
CO5	To describe the imaging techniques used in clinical applications	**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										
CO2	3	3										
CO3	3	3										
CO4	3	3										
CO5	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	Biomedical Instrumentation Measurements	L. Cromwell, F. J. Weibell and L. A. Pfeiffer	Pearson education	2ndEdton1990
2	Handbook of Biomedical Instrumentation	R. S. Khandpur	Tata McGraw Hill	
3	Introduction to Biomedical Equipment Technology	J. J. Carr and J. M. Brown	Pearson Education	

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	J. G. Webster	John Wiley and Sons	
2	John Enderele , Susan Blanchard, Joseph Bronzino	Introduction to Biomedical Engg	Academic Press	
3	Welkovitz	Biomedical Instruments, Theory and Design	Elselvier	
4	Jerry L Prince, Jonathan M Links	Medical Imaging Signals & Systems	Pearson Education	

SEMESTER S7

EMBEDDED SYSTEM DESIGN AND APPLICATIONS

Course Code	**OEERT 723**	**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)	Microprocessors and Microcontrollers	**Course Type**	Theory

Course Objectives:

1. This course aims to introduce the design of embedded electronic systems and its applications.

SYLLABUS

Module No.	**Syllabus Description**	**Contact Hours**
1	Embedded System Components: Embedded Systems vs. General Computing Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components.	**9**
2	Embedded System Design Concepts: Characteristics of an Embedded System, Quality Attributes of Embedded Systems, Application-Specific Embedded System, Domain Specific Examples of Embedded System, Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Embedded Firmware Design Approaches, Embedded Firmware Development Languages.	**9**
3	Design and Development of Embedded Product: Embedded Hardware Design and Development, Embedded Firmware Design and Development: Embedded firmware Design Approaches, Embedded firmware Development Languages, Programming in Embedded ‘C’. Real Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types	**9**

	of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronisation, Device Drivers, How to choose an RTOS.	
4	Design and Development of Embedded Systems: Integration of Hardware & Firmware, Board Power up. The Embedded System Development Environment: Integrated Development Environment (IDE), Types of files generated on cross-compilation, Disassembler/Decompiler, Simulators, Emulators & Debugging, Target Hardware Debugging, Boundary Scan. Product Enclosure Design & Development: Product Enclosure Design Tools, Product Enclosure Development Techniques.	**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	Understanding of Embedded Systems Concepts, its classification and applications	**K2**
CO2	Understand application-specific embedded systems by familiarizing their characteristics, quality attributes, and hardware-software co-design principles.	**K2**
CO3	To understand the design concepts of embedded products, with proficiency in embedded hardware and firmware, real-time operating systems, and task management.	**K2**
CO4	Understand the skills to integrate hardware and firmware, utilize development environments and debugging tools, and design and develop product enclosures for embedded systems.	**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									1
CO2	3	3	3									2
CO3	3	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	Introduction to Embedded Systems,	Shibu K.V.	Tata McGraw Hill Education Private Limited, New Delhi	2nd Edition, 2017
2	Embedded Systems: Design, Programming and Applications	A K Ganguly	Alpha Science International Ltd	2014

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Embedded Systems, A Contemporary Design Tool	J. K. Peckol	Wiley Student edition	2009
2	Embedded System Design	Peter Marwedel	Springer	4th edition, 2022
3	Programming Embedded Systems in C and C++	Michael Barr	O'Reilly	1999
4	Embedded System Applications	C. Baron, J. Geffroy and G. Motet	Springer-Verlag New York Inc.	2010

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc23_cs54/preview
2	https://onlinecourses.nptel.ac.in/noc20_ee98/preview
3	http://www.digimat.in/nptel/courses/video/106105159/L01.html

SEMESTER 7

DIGITAL IMAGE PROCESSING

Course Code	**OEERT 724**	**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)	Linear Algebra	**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	**9**

	spatial Filters, Sharpening spatial Filters. 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	Understand 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	Understand the basic image segmentation techniques	**K3**
CO5	Analyze the filtering and restoration of images	**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 Education	4/e, 2019
2	Digital Image Processing	S Jayaraman, S Esakkirajan, T Veerakumar	Tata McGraw Hill Education	2009

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://archive.nptel.ac.in/courses/117/105/117105135
2	https://archive.nptel.ac.in/courses/106/105/106105216
3	https://nptel.ac.in/courses/117105079
4	https://nptel.ac.in/courses/106105032

SEMESTER S7

CONCEPTS IN MACHINE LEARNING

Course Code	**OEERT 725**	**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 concepts and algorithms in machine learning and the most popular supervised and unsupervised learning algorithms
2. To help the students provide machine learning-based solutions to real world problems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to ML** Machine Learning vs. Traditional Programming, Machine learning paradigms - supervised, semi-supervised, unsupervised, reinforcement learning. **Basics of parameter estimation** - maximum likelihood estimation (MLE) and maximum aposteriori estimation (MAP), Bayesian formulation. **Supervised Learning** Feature Representation and Problem Formulation, Role of loss functions and optimization **Regression** - Linear regression with one variable, Linear regression with multiple variables - solution using gradient descent algorithm and matrix method.	

2	**Classification** - Naïve Bayes, KNN **Generalisation and Overfitting** - Idea of overfitting, LASSO and RIDGE regularization, Idea of Training, Testing, Validation **Evaluation measures** – Classification - Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve(ROC), Area Under Curve (AUC). Regression - Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination.	
3	**Neural Networks (NN) -** Perceptron, Neural Network - Multilayer feed-forward network, Activation functions (Sigmoid, ReLU, Tanh), Back propagation algorithm. **Decision Trees** – Information Gain, Gain Ratio, ID3 algorithm	
4	**Unsupervised Learning** **Clustering** - Similarity measures, Hierarchical Clustering - Agglomerative Clustering, partitional clustering, K-means clustering **Dimensionality reduction** - Principal Component Analysis, Multidimensional scaling **Ensemble methods**- bagging, boosting **Resampling methods** - Bootstrapping, Cross Validation. Practical aspects - Bias-Variance trade-off.	

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 Machine Learning concepts and basic parameter estimation methods.	**K2**
CO2	Demonstrate supervised learning concepts (regression, classification).	**K3**
CO3	Illustrate the concepts of Multilayer neural network and Decision trees	**K3**
CO4	Describe unsupervised learning concepts and dimensionality reduction techniques	**K3**
CO5	Use appropriate performance measures to evaluate machine learning models	**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							3
CO2	3	3	3	3	3							3
CO3	3	3	3	3	3							3
CO4	3	3	3	3	3							3
CO5	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	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	2nd edition, 2010
2	Data Mining and Analysis: Fundamental Concepts and Algorithms	Mohammed J. Zaki and Wagner Meira	Cambridge University Press	First South Asia edition, 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Machine Learning	Tom Mitchell	McGraw-Hill	1997
2	Neural Networks for Pattern Recognition	Christopher Bishop	Oxford University Press	1995
3	Machine Learning: A Probabilistic Perspective	Kevin P Murphy	MIT Press	2012.
4	The Elements Of Statistical Learning	Trevor Hastie, Robert Tibshirani, Jerome Friedman	Springer	Second edition, 2007

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/fC7V8QsPBec?si=8kqBn-_7x1RG5V1J
2	https://youtu.be/g__LURKuIj4?si=Xj10NPfMfpQSOhVx
3	https://youtu.be/yG1nETGyW2E?si=ySlxpeWuFAUQBf7-
4	https://youtu.be/zop2zuwF_bc?si=W7TpSHLdi4rykva4

SEMESTER 8

ELECTRONICS & COMPUTER ENGINEERING

SEMESTER S8

PLC AND DATA ACQUISITION SYSTEM

Course Code	PEERT861	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)	Basics of analog and digital electronics	Course Type	Theory

Course Objectives:

1. To understand the fundamental of PLC
2. To develop programs using various functions available with PLC.
3. To understand various industrial applications of PLCs.
4. To understand the basics of data acquisition systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of PLC-PLC advantages and disadvantages- Architecture of PLC- Scan Cycles–Types of PLC- PLC Programming languages – Relay logic–Ladder logic–connecting PLC to computer PLC Troubleshooting and Maintenance.	9
2	Programming of Timers – ON delay, OFF delay, Retentive Timers – PLC Timer functions –Examples of timer function Industrial application. Programming Counters – Up/Down counter –Examples of counter function Industrial application. PLC Arithmetic Functions – PLC number Comparison function	9
3	PLC Program Control Instructions: Master Control -Reset - Skip – Jump and Move Instructions. Sequencer instructions - Types of PLC Analog modules and systems, PLC analog signal processing –Case study of Tank level control system, bottle filling system and Sequential switching of motors	9

4	Sampling theorem – Sampling and digitizing – Aliasing – Sample and hold circuit – Practical implementation of sampling and digitizing – Definition, design and need for data acquisition systems – Interfacing ADC and DAC with Microprocessor / Multiplexer - Multiplexed channel operation –Microprocessor/PC based acquisition systems.	**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	Understand the fundamental of PLC based systems	**K2**
CO2	Develop programs using various functions available with PLC.	**K3**
CO3	Understand various industrial applications of PLCs.	**K2**
CO4	Understand the basics of data acquisition systems.	**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
CO2	3	3	3									3
CO3	3	3										3
CO4	3	2	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	Programmable Logic Controllers	Petrezeulla	McGraw Hill	1989
2	Programmable logic controllers-principles and applications	John W.Webb& Ronald A.Reis	PHI	5e,2010
3	Process Control Instrumentation Technology	Curtis D. Johnson.	PH	8e,2005

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Programmable Logic Controllers	Hughes .T,	ISA Press	1989.
2	Data Converters,	G. B. Clayton	The Mac Millian Press Ltd.,	1982.
3	Linear Integrated circuits	D. Roy Choudhury and Shail B. Jain,	New age International Pvt. Ltd	2003.

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/108105063
2	https://nptel.ac.in/courses/108105088
3	https://nptel.ac.in/courses/112102011

SEMESTER S8

ELECTRONIC PRODUCT DESIGN

Course Code	**PEERT862**	**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 will help the students to understand the product development process for realization of the product.
2. The course will help the students to understand the packaging and modelling of electronic product

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Definition of a product, Product Classification, New Product development process. Product design methodology, Product planning, data collection, Creativity techniques. Electronic systems and needs Physical integration of circuits, packages, boards and full electronic systems	**9**
2	Introduction to concepts of reliability, nature of reliability problems in electronic equipment, series configuration, Parallel Configuration, Mixed Configuration, Methods of Solving Complex Systems, Mean Time to Failure (MTTF) and Mean Time between Failures (MTBF) of Systems. Maintainability, Availability Concepts, System Downtime, Mean Time to Repair (MTTR).	**9**
3	Packaging & Enclosures of Electronic System: Effect of environmental factors on electronic system (environmental specifications), nature of environment and safety measures. Packaging's influence and its factors.	**9**
4	Introduction to 3D Printers, Hierarchical Structure of Additive Manufacturing Processes, Integration of Additive Manufacturing in the	**9**

	Product Development Process, Rapid Prototyping, Rapid Tooling, Rapid manufacturing.	

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 basics of product development process	**K2**
CO2	Understand the reliability problems of electronic equipment	**K2**
CO3	Understand the packaging of electronic systems	**K2**
CO4	Understand the surface modelling and additive manufacturing methods in the product development	**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				2
CO2	3	2	2			2						2
CO3	3					2	3					2
CO4	3		2	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	Product Design and Manufacturing	A.K. Chitale, R.C. Gupta	Prentice, Hall of India	5th Edition January 2011
2	Reliability and Failure of Electronic Materials and Devices	Milton Ohring,Lucian Kasprzak	Academic Press Publication	2nd Edition - October 14, 2014
3	Introduction to Electronic Packaging: Unconventional Guide to Product Design	S.A Srinivasa Moorthy	Notion Press	1st edition 2020
4	Additive Manufacturing Technologies 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing	Ian Gibson, David Rosen, Brent Stucker	Springer verlang,Newyork	2nd edition 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electronic Product Design	V.S. Bagad	Technical Publications	4th edition 2016
2	Electronics product Design	V.B. Baru R.G. Kaduskar	New Delhi: Wiley India Pvt Ltd.	2nd edition 2014
3	Rapid Prototyping, Rapid Tooling and Reverse Engineering: From Biological Models to 3D Bioprinters	Kaushik Kumar,Divya Zindani,Paulo Davim	De Gruyter	5th edition,June2020
4	Reliability and Failure of Electronic Materials and Devices	Milton Ohring, Lucian Kasprzak	Academic Press	2nd edition,October 14, 2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/117/108/117108140/
2	https://archive.nptel.ac.in/courses/112/105/112105267/
3	https://nptel.ac.in/courses/112104230
4	https://archive.nptel.ac.in/courses/112/104/112104265/

SEMESTER S8

SYSTEM SOFTWARE

Course Code	PEERT 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 Type**	Theory

Course Objectives:

1. Students will be able to understand the basic concepts and use of system software and application software.
2. Students will understand the machine dependent and machine independent system software features and to design/implement system software.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Systems Programming – Background, System software and Application Software.System software-Basic Concepts of Assemblers, Loaders, Linkers, Macro processors, Text editorsSIC & SIC/XE Architecture and Programming.	9
2	Assemblers – Basic assembler directives, machine dependent assembler features, machine independent assembler features, Object code generation of SIC and SIC/XE. Assembler design options – one pass assembler, multi pass assembler	9
3	Loaders and Linkers - Basic loader functions, machine dependent loader features, machine independent loader features. Loader design options – linkage editors, dynamic linking, bootstrap loaders	9
4	Macro processors – Basic macro processor functions, machine dependent and machine independent macro processor features, Design options. Device drivers - Anatomy of a device driver, Character and block device drivers, General design of device drivers. Text Editors- Overview of Editing,	9

	User Interface, EditorStructure. Debuggers - Debugging Functions and Capabilities, Relationship with other parts of the system, Debugging Methods- By Induction, Deduction and Backtracking	

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 different System Software.	**K2**
CO2	Analyse machine architecture with its instruction sets and capable to do programming	**K3**
CO3	Identify machine dependent and independent features of system software	**K3**
CO4	Design algorithms for system software and analyse the effect of data structures.	**K3**
CO5	Understand the features of device drivers and editing & debugging tools.	**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									2
CO2	2	3	3									2
CO3	2	2	2									2
CO4	2	2	3									2
CO5	2	1	1		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	System Software: An Introduction to Systems Programming	Leland L. Beck	Pearson Education Asia	3/E

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Systems Programming and Operating Systems	D.M. Dhamdhere	Tata McGraw Hill	Second Revised Edition
2	Systems Programming	Donovan J. J	Tata McGraw Hill	2/e
3	System Software	J Nithyashri	Tata McGraw Hill	Second Edition
4	IBM PC Assembly Language and Programming	Peter Abel	Prentice Hall of India	Third Edition

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 –	**9**

	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	
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	Understand 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	Understand cryptography principles, including encryption, ciphers, symmetric and public key algorithms, RSA, Diffie Hellman, authentication, hash functions, and digital signatures.	**K2**
CO4	Understand 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	1	1	-	-	-	-	-	-	-	-	-	1
CO2	2	2	2	3	3	-	-	-	-	-	-	2
CO3	3	3	3	3	2	-	-	-	-	-	-	2
CO4	2	1	-	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	2005
2	Cryptography and Network Security Principles and Practice	William Stallings	Pearson Education Asia(6/e)	2012
3	Network Security Essentials	William Stallings	Pearson Education	4th Edition 2011
4	Fundamentals of Network Security	Eric Maiwald	Tata McGraw-Hill	4th Edition, 2013

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	(Indian Edition)
2	Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	Nina Godbole and Sunit Belpure	Wiley	Latest
3	Mark Stamp's Information Security Principles and Practice	Deven N. Shah	Wiley	Reprint 2012

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

CRYPTOGRAPHY AND NETWORK SECURITY

Course Code	**PEERT 866**	**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)	Discrete Mathematical Structures	**Course Type**	Theory

Course Objectives:

1. To introduce fundamental concepts of number theory
2. To understand the basics of symmetric and asymmetric cipher models.
3. To provide a better foundation in network security in today's internet environment.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Cryptography -** Security Goals, Security Services-Classification of Cryptosystems, Cryptanalytic attacks **Basics of Number Theory:** **Integer Arithmetic** -Divisibility – GCD, Linear Diophantine equation, **Modular Arithmetic** - Congruence - Addition and multiplicative inverse, Fermat's and Euler's Theorem - Chinese Remainder Theorem, Primitive roots, Quadratic congruences- quadratic residues, Legrende symbol.	**10**
2	**Algebraic structures:** groups, rings, Finite fields of the form GF(p) and GF(2^n), polynomial rings over finite field. **Symmetric Ciphers:** Ceaser cipher, Affine cipher, Playfair cipher, Hill cipher, Vigenere cipher etc. Modern Secret Key Ciphers - Substitution Box-Permutation Box-Product Ciphers. Data Encryption standard (DES), Advanced Encryption standard	**10**

	(AES). Cryptographic Hash Functions - Properties - SHA-512, Message Authentication Code, HMAC and CMAC	
3	**Public key cryptography:** One-way functions, RSA, Discrete Log, Diffie-Helman Key Exchange system, Digital Signature- Signing - Verification, Digital signature forgery- RSA Digital Signature Scheme -El Gamal Signature Scheme. Elliptic curves and elliptic curve cryptosystems	**8**
4	**Distribution of symmetric keys and Distribution of public keys** **Electronic Mail Security** -Pretty Good Privacy- PGP message format - Transmission and Reception of PGP Messages, **IP Security** Overview - IP Authentication Header - Encapsulating Security Payload - Distributed Denial of Service attacks, **Secure Electronic Transaction** – Payment Processing - Dual Signature, **Firewalls** - Firewall Design Principles.	**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 the concepts of number theory in designing crypto systems	**K3**
CO2	Design and analyze various symmetric key cryptosystems and hash functions.	**K3**
CO3	Design and Analyze various public key cryptosystems and digital signature schemes.	**K3**
CO4	Discuss various network security aspects, protocols to ensure Email Security and Network Security	**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	2									**2**
CO2	3	3	2									**2**
CO3	3	3	2									**2**
CO4	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	Cryptography and Network.Security	Behrouz A Forouzan &DebdeepMukhopadhyay	Tata McGraw Hill Education Pvt Ltd Publication	2/e, 2010.
2	Cryptography and Network security: Principles and Practice,	Stallings William	Pearson Education Asia,	7/e, 2017
3	A Course in Number Theory and Cryptography	Neal Koblitz:	Springer	2/e, 2012
4	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	Elementary Number Theory with Applications	Thomas Koshy	Elsevier India	2/e, 2007
2	Number Theory in Science and Communication	MR Schroeder	Springer	5/e, 2009
3	Cryptography: Theory and Practice	Douglas R. Stinson	Chapman and Hall/CRC	3/e, 2006
4	Guide to Elliptic Curve Cryptography	Hankerson, D.J., Menezes, A., Vanstone, S.A.	Springer	2004
5	Advanced Engineering Mathematics	Merle C. Potter, David C. Wiggert	Wiley	10/e, 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 S8

CYBER FORENSICS

Course Code	PEERT 865	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)		Course Type	Theory

Course Objectives:

1. To provide foundational knowledge of cyber forensics, including key concepts, terminology, and the role of forensics in cybersecurity.
2. To equip students with the knowledge and skills to use various forensic tools and techniques for data recovery, analysis, and investigation.
3. To understand the process of responding to cyber incidents, conducting thorough forensic analysis, and presenting findings.
4. To explore advanced topics, emerging trends, and the future landscape of cyber forensics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of Cyber Forensics, The Role of Cyber Forensics in Modern Cybersecurity, Understanding Digital Evidence, Types of Digital Evidence (Data at rest, in transit, etc.), Legal and Ethical Considerations in Cyber Forensics, Cyber Forensics Process: Identification, Preservation, Collection, Examination, Analysis, and Presentation, Chain of Custody and Documentation	9
2	Overview of Forensic Tools (FTK, EnCase, Autopsy, etc.), File Systems and Their Forensic Relevance (FAT32, NTFS, etc.), Data Recovery Techniques, Imaging and Cloning Digital Evidence, Network Forensics: Capturing and Analyzing Network Traffic, Introduction to Mobile Device Forensics	9
3	Incident Response Lifecycle: Preparation, Detection, Containment, Eradication, Recovery, The Role of Forensics in Incident Response,	9

	Analyzing Malware: Static and Dynamic Analysis Techniques, Memory Forensics: Capturing and Analyzing Volatile Data, Forensic Reporting: Writing and Presenting Findings, Legal and Regulatory Compliance in Incident Response	
4	Cloud Forensics: Challenges and Techniques, IoT Forensics: Investigating Smart Devices, AI and Machine Learning in Cyber Forensics, Cyber Forensics in Blockchain and Cryptocurrency Investigations, Future of Cyber Forensics: Predictive Forensics and Beyond, Career Paths in Cyber Forensics: Skills and Certifications	**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 Forensic Tools: (10 marks)

Case Studies: Real-world applications of cyber forensics

Exploring Digital Evidence in a Controlled Environment

Hands-on: Creating and Maintaining a Chain of Custody

Hands-on: Creating Forensic Images and Recovering Deleted Data

Analyzing Network Traffic with Wireshark

Simulating a Cyber Incident: Initial Response

Analyzing a Malicious File: Tools and Techniques

Writing a Forensic Report: Key Components and Best Practices

Exploring Cloud Forensics Tools

Analyzing Blockchain Transactions for Forensic Purposes

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.
2. Innovation and Creativity (2 marks)
    - Introduces innovative ideas or unique approaches in the design and implementation.
    - Demonstrates creativity in solving problems or optimizing designs.
2. 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.
2. 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	Evaluate the principles and methodologies of cyber forensics, including the identification and classification of digital evidence, and will assess the legal and ethical implications of forensic investigations.	**K4**
CO2	demonstrate advanced proficiency in the application of forensic tools, performing complex data recovery, forensic imaging, and evidence analysis, and will critically evaluate the effectiveness of various forensic techniques in different scenarios.	**K2**
CO3	Develop and implement comprehensive incident response strategies, utilizing forensic analysis to interpret and correlate complex data, and will evaluate the effectiveness of different approaches in incident response and forensic reporting.	**K3**
CO4	Synthesize knowledge of emerging technologies in cyber forensics, such as cloud and IoT forensics, to design and execute innovative forensic investigations, critically analyzing challenges and proposing solutions to overcome them.	**K4**

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			3	2					3	2
CO2	3	2			3	2					3	2
CO3	3	2			3	2					3	2
CO4	3	2			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	Digital Forensics and Incident Response: Incident Response Techniques and Procedures to Respond to Modern Cyber Threats	Gerard Johansen	Packt Publishing	2nd edition, 2020
2	The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics	John Sammons	Syngress	2nd edition, 2014

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Guide to Computer Forensics and Investigations	Bill Nelson, Amelia Phillips, and Christopher Steuart	Cengage Learning	6th edition, 2016
2	Computer Forensics: Cybercriminals, Laws, and Evidence	Marjie T. Britz	Pearson	3rd edition, 2013
3	Incident Response & Computer Forensics	Jason T. Luttgens, Matthew Pepe, and Kevin Mandia	McGraw-Hill Education	3rd edition, 2014
4	Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet	Eoghan Casey	Academic Press	3rd edition, 2011

SEMESTER S8

BIOMEDICAL SIGNAL PROCESSING

Course Code	**OEERT 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 Type**	Theory

Course Objectives:

1. To make students understand the sources, types & characteristics of different noises and artifacts present in biomedical signals.
2. To make students able to design time domain and frequency domain filters for noise and artifact removal from biomedical signals.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Biomedical Signals-Action Potential and Its Generation, Origin and Waveform Characteristics of Basic Biomedical Signals Like: Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Objectives of Biomedical Signal Analysis, Difficulties in Biomedical Signal Analysis, Computer-Aided Diagnosis.	9
2	Removal of Noise and Artifacts from Biomedical Signal- Random and Structured Noise, Physiological Interference, Stationary and Nonstationary Processes, Noises and Artifacts Present in ECG, Time and Frequency Domain Filtering.	9
3	EEG Signal Processing and Event Detection in Biomedical Signals- EEG Signal and Its Characteristics, EEG Analysis, Linear Prediction Theory, Autoregressive Method, Sleep EEG, Application of Adaptive Filter for Noise Cancellation in ECG and EEG Signals; Detection of P, Q, R, S and T Waves in ECG, EEG Rhythms, Waves and Transients, Detection of Waves and Transients, Correlation Analysis Ad Coherence Analysis of EEG Channels.	9

4	Speech production model, inverse filtering techniques for extraction of vocal tract parameters, glottal inverse filtering; electroglottograpic signals; signal processing techniques for detection of pathologies in speech production system. Medical imaging techniques: CT scan, ultrasound, NMR and PET.	**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 sources of biopotential generation and to familiarize students with different types of biomedical signals in the human body.	**K1**
CO2	Design time domain and frequency domain filters for noise and artifact removal from biomedical signals.	**K3**
CO3	Analyse ECG, EEG, EMG and PCG signals using data acquisition, data reduction methods.	**K4**
CO4	Analyse speech signals and medical imaging techniques.	**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	3	2		3					2	
CO2	3	3	3	2		3					2	
CO3	3	3	3	2		3					2	
CO4	3	3	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	Biomedical signal analysis	Rangayyan, R.M.	John Wiley & Sons	2015 (Vol. 33)
2	Biomedical signal processing: principles and techniques.	Reddy, D.C.	McGraw-Hill	2005.
3	Biomedical Signal Processing	W. J. Tompkins	Prentice Hall	1995
4	Biomedical Signal Processing and Signal Modelling	E.N. Bruce	John Wiley and Sons,	2001
5	Digital Processing of speech signals	L. Rabinar	Prentice Hall,	1978.

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Advanced Methods and Tools for ECG Data Analysis.,	Clifford, G., F. Azuajae, and P. McSharry	Norwood, MA: Artech House	2006. ISBN: 9871580539661.
2	Discrete-Time Speech Signal Processing: Principles and Practice. Upper Saddle River, NJ:	Quatieri, T. F.	Prentice-Hall,	2001. ISBN: 9780132429429.
3	Medical Imaging Systems. Upper Saddle River, NJ:	Macovski, A.	Prentice Hall,	1983. ISBN: 9780135726853
4	Biomedical Signal Analysis	Rangaraj M Rangayyan	IEEE Press	2001

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	.http://www.biomedicahelp.altervista.org › Segnali
2	https://www.digimat.in/nptel/courses/video/108105101/L12.html

SEMESTER S8

HYBRID AND ELECTRIC VEHICLES

Course Code	**OEERT 832**	**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 fundamental concepts of electric and hybrid and vehicles, drive trains, electrical machines used, energy storage devices and charging systems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction to Hybrid Electric Vehicles**: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. **Conventional Vehicles**: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.	**9**
2	**Hybrid Electric Drive-trains**: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. **Electric Drive-trains:** Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis	**9**
3	**Electric Propulsion unit:** Introduction to electric components used in hybrid and electric vehicles **DC Drives:** Review of Separately excited DC Motor control – Speed and torque equations **PMSM Drives:** PMSM motor basics.	**9**

	Energy Storage: Introduction to energy storage requirements in Hybrid and Electric Vehicles- Battery based energy storage systems, Battery Management System, Types of battery- Fuel Cell based energy storage systems- Super capacitors- Hybridization of different energy storage devices	
4	**Sizing the drive system:** Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, rating of the power electronic components **Vehicle Communication:** Need & requirements, Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies	**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 fundamentals of Conventional, Electric and Hybrid EV	**K2**
CO2	Describe different configurations of electric and hybrid electric drive trains	**K2**
CO3	Discuss the propulsion unit, DC and PMSM drives used for electric and hybrid vehicles	**K3**
CO4	Selection and sizing of drive systems for EV	**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										
CO2	3	2										
CO3	3	2										
CO4	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	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Hussein	CRC Press	2e, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Electric Vehicle Technology Explained	James Larminie, John Lowry	Wiley	2e, 2012
2	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design,	Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi.	CRC Press	1e, 2004
3	Hybrid Electric Vehicles – Principles and applications with practical perspectives	Chris Mi, M A Masrur, D W Gao	Wiley	2011
4	Autonomous vehicle technology: A guide for policymakers,	Anderson JM, Nidhi K, Stanley KD, Sorensen P, Samaras C, Oluwatola OA	Rand Corporation	2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.swayam2.ac.in/nou24_ec10/

SEMESTER S8

FUNDAMENTALS OF COMPUTER NETWORKS

Course Code	**OEERT 833**	**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 make students understand the fundamentals of computer networks, TCP/IP and OSI models and their different layers.
2. To make students analyse the various layers of OSI Model and its protocols.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	INTRODUCTION: Introduction to computer networks, network hardware, network software, internet protocols and standards, Reference models -OSI and TCP/IP and its different layers, Connection oriented networks - X.25 THE PHYSICAL LAYER: Theoretical basis for communication, analog and digital signals, guided transmission media- twisted pairs, coaxial cable, fiber optics, wireless transmission.	9
2	THE DATA LINK LAYER: Design issues, error detection and correction, elementary data link protocols, sliding window protocols, HDLC THE MEDIUM ACCESS SUBLAYER: Channel allocation problem, multiple access protocols-Ethernet, Wireless LAN, Data Link Layer switching.	9
3	THE NETWORK LAYER: Network layer -various functions and design issues, adaptive and non-adaptive routing algorithms, Congestion control algorithms-leaky bucket and token bucket algorithms.	9

	Internetworking, the network layer in the internet (IPv4 and IPv6), Quality of Service. THE TRANSPORT LAYER: Transport service, elements of transport protocol, Simple Transport Protocol, Internet transport layer protocols: UDP and TCP protocols.	
4	THE APPLICATION LAYER: Domain name system, DNS in internet, electronic mail, World Wide Web: architectural overview, dynamic web document and http, network security APPLICATION LAYER PROTOCOLS: Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol.	**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	Understand the basic computer network technology, OSI and TCP/IP reference models and physical layer transmission methods.	**K2**
CO2	Analyse the design issue problems of data link layer and its protocols; channel allocation problems in medium access control layer and its protocols.	**K4**
CO3	Understand the functions of network layer and transport layer and its associated protocols.	**K2**
CO4	Understand the essentials of application layer in computer networking.	**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
CO2	3		3									1
CO3	3		3									1
CO4	3	2	3	2	2	1			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	Computer Networks	Andrew. S. Tanenbaum	Pearson Education, India.	5th edition, 2010
2	Data Communication and Networking	Behrouz A. Forouzan	Mc Graw-Hill, 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	Computer Networking: A top down approach,	Kurose, Ross	Pearson Education, India. 2.	4th Edition 2010
2	An Engineering Approach to Computer Networks-,	S.Keshav	Pearson Education India. 2.	2nd Edition, 2019
3	Data and Computer Communications	William Stallings	PHI	5th edition, 2005

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/106106091
2	https://www.nptelvideos.com/course.php?id=393

SEMESTER S8

CLOUD COMPUTING AND APPLICATIONS

Course Code	**OEERT 834**	**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)	Operating System and Networking	**Course Type**	Theory

Course Objectives:

1. Understand the fundamentals and architecture of cloud computing, including delivery and deployment models.
2. Develop knowledge and skills in cloud security, SLA management, and risk assessment.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Cloud Computing Fundamentals: What is Cloud Computing, Essential Characteristics, Architectural Influences Cloud delivery models, The SPI Framework, Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS), Cloud deployment models, Public Clouds, Community Clouds, Private clouds, Hybrid clouds.	**9**
2	Understanding cloud architecture- Exploring cloud computing stack. Using virtualization technologies, Load balancing and virtualization, Understanding hypervisors, Understanding machine imaging. Cloud storage- Cloud storage providers, Cloud Computing with the Titans– Google, Amazon. Accessing the cloud: Platforms, Web applications, Web APIs.	**9**
3	Virtual Machines and Containers, Serverless Computing, Using and Managing Containers:-Container Basics, Docker and the Hub. Agents and Microservices: Microservices and Container Resource Managers, Managing Identity in a swarm, A simple Microservices Example, Amazon EC2 Container Service, Google's Kubernetes.	**9**

4	SLA Management in Cloud Computing-Types of SLA, Life cycle of SLA, SLA management in cloud. Cloud Information Security Objectives, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements. Privacy and Compliance Risks, Threats to Infrastructure Data and Access Control, Cloud Service Provider Risks. Cloud computing Security Architecture- architecture considerations, identity management and access control	**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 principles of cloud computing.	**K2**
CO2	Explain the technologies used in cloud computing and virtualization.	**K2**
CO3	Describe cloud computing and microservices.	**K2**
CO4	Describe cloud management and cloud security features.	**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	1	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2
CO4	3	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	Cloud Security -A Comprehensive Guide to Secure Cloud Computing	Ronald L Krutz and Russell Dean Vines	Wiley Publishing, Inc.	2010
2	Cloud Computing Bible	Barrie Sosinsky	Wiley Publishing	2011
3	Cloud Computing: A Practical Approach	Anthony T. Velte Toby J. Velte, Robert Elsenpeter	The McGraw-Hill	2010
4	Cloud Computing for Science and Engineering https://cloud4scieng.org/chapters/	Ian Foster and Dennis B.Gannon	The MIT Press	2017
5	Cloud Computing: Principles and Paradigms	Rajkumar Buyya, James Broberg and Andrzej M. Goscinski	Wiley Publishing	2011

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Distributed and Cloud Computing: From parallel processing to Internet ofThings	Kai Hwang, Geoffrey C. Fox, Jack K.Dongarra	Morgen Kauffmann	2013
2	Getting Started with Kubernetes: 2nd Edition	Jonathan Baier	Packt publishers	2nd, 2015

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://en.wikipedia.org/wiki/Cloud_computing https://nptel.ac.in/courses/106105167
2	https://nptel.ac.in/courses/106105167
3	https://nptel.ac.in/courses/106105167
4	https://nptel.ac.in/courses/106105167

SEMESTER S8

INTRODUCTION TO DEEP LEARNING

Course Code	**OEERT 835**	**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 basic concepts in machine learning
2. To introduce the idea of artificial neural networks and their architecture
3. To introduce techniques used for training artificial neural networks
4. To enable design of an artificial neural network for classification
5. To enable design and deployment of deep learning models for machine learning problems

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Key components - Data, models, objective functions, optimization algorithms, Learning algorithms. Supervised learning- regression, classification, tagging, web search, page ranking, recommender systems, sequence learning, Unsupervised learning, Reinforcement learning, Historical Trends in Deep Learning. Other Concepts - overfitting, underfitting, hyperparameters and validation sets, estimators, bias and variance.	**10**
2	Neural Networks –Perceptron, Gradient Descent solution for Perceptron, Multilayer perceptron, activation functions, architecture design, chain rule, back propagation, gradient based learning. Introduction to optimization– Gradient based optimization, linear least squares. Stochastic gradient descent, Building ML algorithms and challenges	**10**

3	Convolutional Neural Networks – convolution operation, motivation, pooling, Convolution and Pooling as an infinitely strong prior, variants of convolution functions, structured outputs, data types, efficient convolution algorithms.	**8**
4	Recurrent neural networks – Computational graphs, RNN design, encoder – decoder sequence to sequence architectures, deep recurrent networks, recursive neural networks, modern RNNs LSTM and GRU, Practical use cases for RNNs. Applications – computer vision, speech recognition, natural language processing. Autoencoders, Representation learning, Boltzmann Machines, Deep belief networks.	**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 =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 subdivisions. **(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 basic concepts in machine learning.	**K2**
CO2	Illustrate the validation process of machine learning models using hyper-parameters and validation sets.	**K2**
CO3	Demonstrate the concept of the feed forward neural network and its training process.	**K3**
CO4	Build CNN and Recurrent Neural Network (RNN) models for different use cases.	**K3**
CO5	Use different neural network/deep learning models for practical applications.	**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	1	1	-	-	-	-	-	-	-	-	-	1
CO2	1	1	-	-	-	-	-	-	-	-	-	1
CO3	2	3	2	2	-	-	-	-	-	-	-	1
CO4	3	2	2	3	-	-	-	-	-	-	-	1
CO5	2	3	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	Deep Learning.	Ian Goodfellow. Yoshua Bengio and Aaron Courville.	MIT Press	2016.
2	Dive deep into machine learning	Astan Zhang and Zachary and Alexander semola	Cambridge university press https://d2l.ai/	2019
3	Neural Networks and Deep Learning: A Textbook	Charu C. Aggarwal.	Springer	. 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Practical Convolutional Neural Networks	Mohit Sewak, Md. Rezaul Karim, Pradeep Pujari	Packt Publishing Ltd	1st edition, 2018
2	Hands-On Deep Learning Algorithms with Python	Sudharsan Ravichandran	Packt Publishing Ltd.	1st edition, 2019
3	Deep Learning with Python	Francois Chollet	Manning Publications Co	2nd edition, 2018
4	Generative Deep Learning	David Foster	OReilly	2022
5	Hands-on Machine learning with Sc-kit Learn Keras and Tensorflow	Aurelien Geron	Oreilly	Second edition 2019
6	Neural Networks for deep learning	Michael Nielsen	http://neuralnetworksanddeeplearning.com/	2019

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.cse.iitm.ac.in/~miteshk/CS6910.html
2	https://www.deeplearningbook.org/contents/convnets.html
3	https://wiki.pathmind.com/lstm http://colah.github.io/posts/2015-08-Understanding-LSTMs/
4	https://jalammar.github.io/illustrated-transformer/ Jay Almar