Curriculum Structure for B. Tech. Electronics and Telecommunication Engineering Programme

(In light of NEP 2020)

NCrF Level 6

(NEP_Version II)

For students admitted in 2023-24 onwards

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

Near Kathora Naka, Amravati, Maharashtra

PIN 444604

www.gcoea.ac.in

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Structure for B. Tech. Programme in light of NEP 2020

For students admitted in 2023-24 onwards

Key Features of Curriculum

1. Multiple entry and exit option after every year.
2. Provision for Open Electives (OE), Vocational and Skill Enhancement Courses (VSE), Ability Enhancement Courses (AE), Indian Knowledge System (IKS), Value Education Courses (VE), Co-Curricular Courses (CC) in addition to program core courses.
3. Mandatory internship of one semester.
4. Credits for Value education courses, Ability Enhancement Courses, Co-Curricular Curricular Activities.
5. Mandatory Non-Credit Courses.
6. Interdisciplinary and multidisciplinary education through single and double minors and open electives.
7. Skill based courses and multiple exit level.
8. Provision for learning in online mode through Swayam / NPTEL etc courses
9. Provision for B.Tech. Honours with Research degree through research project.
10. Opportunity for learner to choose courses of their interest in all disciplines.

11. Provision of Skill Based Courses and internship/Field project/mini projects for exit options at each level.

12. Flexibility for all types of learners i.e. Good, Normal and Exit

Good Students	Normal Students	Exit
B. Tech. Major with Multidisciplinary Minor	B. Tech. Major with Multidisciplinary Minor	Additional 08 credits in the form of skill-based courses / labs, internship, mini projects shall be offered in 8 weeks.
B. Tech. Honors and Multidisciplinary Minor	--	
B. Tech. Honors with Research and Multidisciplinary Minor	--	
B. Tech. with Double Minor (Multidisciplinary and Specialization Minor)	--	

Credit Distribution for each year and Exit Option

`NCrFLevel	Year / Semester	Exit Option	Credits	Additional Credits for exit students	Total Credits
4.5	Semester I & II	U. G. Certificate	43	08	51
5.0	Semester III & IV	U. G. Diploma	84	08	92
5.5	Semester V & VI	B. Vocational/B.Sc. Engg.	127	08	135
6.0	Semester VII & VIII	B. Tech. Major with Multidisciplinary Minor	167	--	167
		B. Tech. Honors and Multidisciplinary Minor	167+18=185	--	185
		B. Tech. Honors with Research and Multidisciplinary Minor	167+18=185	--	185
		B. Tech. with Double Minor (Multidisciplinary and Specialization Minor)	167+18=185	--	185

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Course Category-wise Credit Distribution

Course Category	As per NEP GR	GCOEA Credits	CC	As per NEP GR	GCOEA Credits
BSC/ESC	30	30	BS	14-18	15
			ES	16--12	15
Program Courses	64-76	67	PC	44-56	48
			PE	20	19
Multidisciplinary Courses	22	22	MM	14	14
			OE	8	8
Skill Courses	8	8	VSE	8	8
Humanities, Social Science & Management (HSSM)	14	14	AE	4	4
			EM	4	4
			IKS	2	2
			VE	4	4
Experiential Courses	22	22	RM	4	4
			FP	2	2
			PR	4	4
			IN/OJT	12	12
Liberal Learning Courses	4	4	CC	4	4
Total Credits	**160-176**	**167**		**160-176**	**167**

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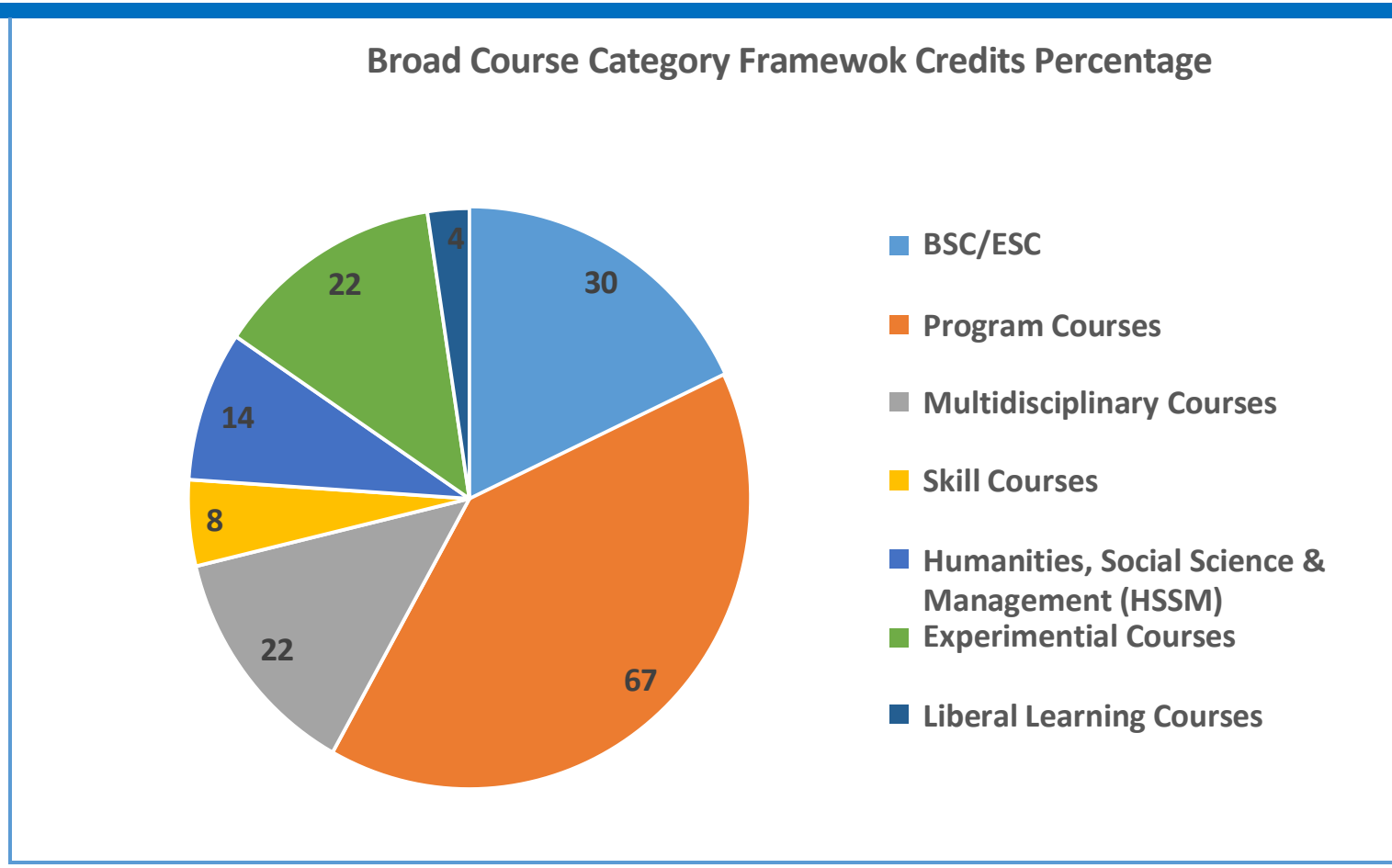
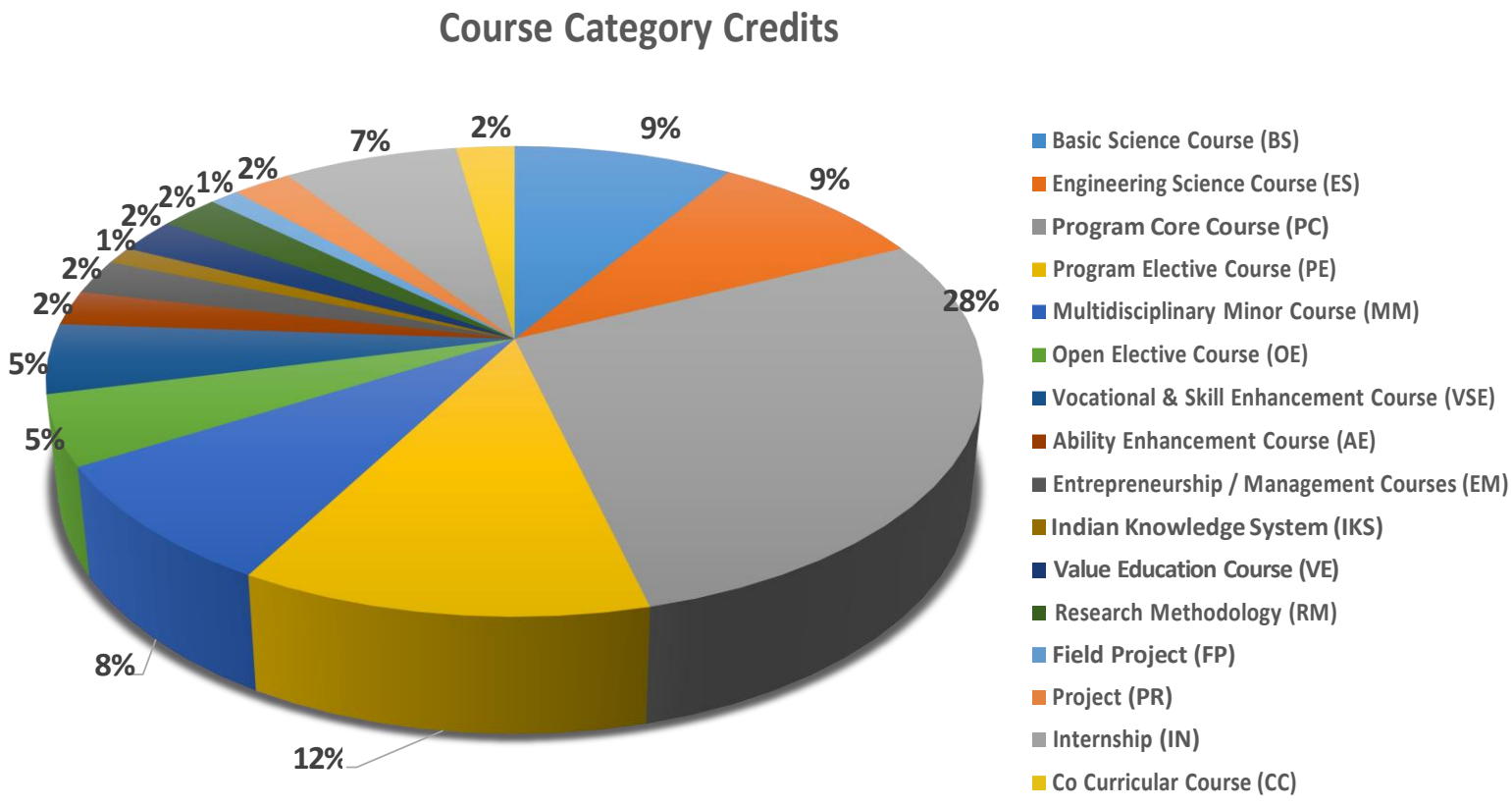

Broad Course Category Framewok Credits Percentage
30
67
22
8
14
22
4
BSC/ESC
Program Courses
Multidisciplinary Courses
Skill Courses
Humanities, Social Science & Management (HSSM)
Experimental Courses
Liberal Learning Courses



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Semester-wise Credit Distribution

Sr. No.	SEM	I	II	III	IV	V	VI	VII	VIII	Total Credits	NEP Requirement
1	Basic Science Course (BS)	8	7	3						18	14-18
2	Engineering Science Course (ES)	8	4							12	16-12
3	Program Core Course (PC)		6	10	14	9	6	3		47	44-56
4	Program Elective Course (PE)					5	8	7		20	20
5	Multidisciplinary Minor Course (MM)			3	3	3	3	2		14	14
6	Open Elective Course (OE)				3	3		2		8	8
7	Vocational & Skill Enhancement Course (VSE)			2	2	1	1	2		8	8
8	Ability Enhancement Course (AE)	1	3							4	4
9	Entrepreneurship / Management Courses (EM)			1					3	4	4
10	Indian Knowledge System (IKS)	2								2	2
11	Value Education Course (VE)	2	2							4	4
12	Research Methodology (RM)								4	4	4
13	Field Project (FP)						2			2	2
14	Project (PR)							4		4	4
15	Internship (IN)								12	12	12
16	Co-Curricular Course (CC)				2	2				4	4
	Total Credits	**21**	**22**	**19**	**23**	**23**	**20**	**20**	**19**	**167**	**160-176**

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General Instructions:

(1) 10% content of syllabus of each theory course shall be completed by the students with self-study. The 10% portion of each course (for self-study) shall be declared by the concerned course-coordinator at the beginning of teaching of the course.

(2) Student can complete **any Course** or programme elective courses PE1 to PE5 in "online" mode, offered through SWAYAM/ NPTEL portal or equivalent platform which provides Evaluation mechanism with the permission of Departmental Faculty Board (DFB). In this case –

(i) Students can register and complete these online courses any time after beginning of third semester, however, the student must successfully complete and pass the course, and submit the score card/certificate before declaration of result of respective semester in which the course is being offered.

(ii) In case, if a student registers for a course in online mode but fails in the course, the student will have to register for the course offered by the institute in respective semester as per curriculum. In this case, the student will have to appear for all the examinations (CT1/CT2, TA, ICA, ESE etc) of the course, and successfully complete the course.

(3) In eighth semester, the students have to complete mandatory internship of one semester in the company/ organization approved by the DFB.

(4) In eighth semester during internship, the students have to complete the theory courses in any one of the two modes:

(i) **Online courses** offered through SWAYAM/ NPTEL or equivalent platform which provides Evaluation mechanism with the permission of DFB: In this case, students can register and complete these online courses any time after beginning of third semester and complete the course and submit the score card/ certificate before declaration of result of eighth semester.
In case if a student registers for a course in online mode but fails in the course, the student will have to register for the course offered by the institute as per curriculum. In this case, the student will have to appear for all the examinations (CT1/CT2, TA, ICA, ESE etc) of the course personally as per the schedule declared by the institute, and successfully complete the course.

(ii) **Self-study mode:** In this case the student will have to study the course offered by the institute of his/her own. The student shall appear for all the college assessments/ examinations (CT1/CT2, TA and ESE) personally as per the schedule declared by the institute and successfully complete the course.

(5) In addition to program specific courses, the students have to complete vocational skill courses, internship, field projects connected to **major degree**.

(6) Exit Option:

The exit option at the end of each year will be available to students after even semester. e. 2^{nd} semester, 4^{th} semester &6^{th} semester and will commence from AY 2024-25 for UG Certificate, AY 2025-26 for UG Diploma, AY 2026-27 for B. Voc./B. Sc. Engineering degree.

(7) Students opting for exit at any level (after odd semesters or even semester) will have to earn additional eight credits before exit in skill based vocational courses and internship/apprenticeship/mini project to make them eligible to get UG certificate / UG Diploma or B. Voc./B. Sc. Engineering degree as per eligibility.

(8) Re Entry and Lateral Entry: Students opting for exit at any level after even semester, will have the option to re-enter the programme from where they left off in odd semesters within **four years of exit.** There shall be a gap of at least **one year** between exit and re-entry to UG programme.

(9) Students opting for exit after odd semester, i.e. 1^{st}, 3^{rd}, 5^{th} or 7^{th} semester will have the option to re-enter the programme from where they left off in even semesters only. There shall be a gap of at least **one year** between exit and re-entry to UG programme.

(10) Maximum period for completion of B. Tech. programme:

The student has to complete the degree programme within the stipulated **maximum period of eight years** from the date of admission to first year UG. The maximum duration of the programme includes the period of exit, withdrawal, absence and different kinds of leaves permissible to a student but it shall exclude the period of rustication of the student from the institute. However, genuine cases on confirmation of valid reasons may be referred to Academic Council for extending this limit by **additional one year**.

(11) Eligibility for admission to the UG Bachelor's Degree with Honours/ Research/Double Minor:

Students with minimum **CGPA of 7.5** without backlog courses at the end of fourth semester and should have earned from 1 to 4 Sem total mentioned credits are eligible for admission to the UG Bachelor's Degree with Honours/ Research/ Double Minor. Courses under this category must be completed in online mode through SWAYAM/ NPTEL or equivalent platform which provides evaluation mechanism. Credits/Marks Obtained under this category are directly mapped to mention teaching evaluation scheme. At the time of registration, if mention course is not available on SWAYAM/ NPTEL or equivalent platform , then DFB will provide available alternative/equivalent course.

Multiple exits: Following options are available for multiple exists:

Option	NCrF Level	Qualification Title	Additional credit requirement	Bridge courses
Exit-1	4.5	One year UG certificate course in Engg/Tech	8	2 Month Internship **OR** Online Two skill courses at ITI Level from NSQF/ESSC/ANY Other agency which provides certification / Evaluation @ **OR** Technical Project
Exit-2	5.0	Two year UG Diploma I Engg/Tech	8	2 Month Internship **OR** Online Two skill courses at Diploma Level from NSQF/ESSC/ANY Other agency which provides certification / Evaluation @ **OR** Technical Project
Exit-3	5.5	Three year Bachelor Degree in Vocation (B.Voc) or B.Sc. (Engg./Tech)	8	2 Month Internship **OR** Online Two skill courses at Degree Level from NSQF/ESSC/ANY Other agency which provides certification / Evaluation @ **OR** Technical Project

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SEMESTER –III														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
											Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
BS	SH1301D	Transforms and Linear Algebra	3			3	15	15	10	60			100	3
MM1	ET1315/16	Multidisciplinary Minor 1	3			3	15	15	10	60			100	3
PC	ET1301	Electronic Devices & Circuits	3			3	15	15	10	60			100	3
PC	ET1302	Signals and Systems	3			3	15	15	10	60			100	3
PC	ET1303	Digital Electronics	3			3	15	15	10	60			100	3
PC	ET1304	Electronic Devices & Circuits Lab			2	2					25	25	50	1
VSE	ET1305	Signals and Systems Lab			2	2					25	25	50	1
VSE	ET1306	Digital Electronics Lab			2	2					50		50	1
EM	ET1310	IDEA Lab			2	2					50		50	1
Total			**15**		**8**	**23**	**75**	**75**	**50**	**300**	**150**	**50**	**700**	**19**

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SEMESTER –IV														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM2	ET1415 /16	Multidisciplinary Minor 2	3			3	15	15	10	60			100	3
PC	ET1401	Analog Communication	3			3	15	15	10	60			100	3
PC	ET1402	Analog Circuits	3			3	15	15	10	60			100	3
PC	ET1403	Microprocessors and Microcontrollers	3			3	15	15	10	60			100	3
PC	ET1404	Control System	3			3	15	15	10	60			100	3
OE1	SH1401	Open Elective 1	3			3	15	15	10	60			100	3
PC	ET1405	Analog Communication Lab			2	2					25	25	50	1
VSE	ET1406	Analog Circuits Lab			2	2					25	25	50	1
VSE	ET1407	Microprocessors and Microcontrollers Lab			2	2					50		50	1
CC1	SH1402	Co-curricular Course			4	4			20				20	2
Total			**18**		**10**	**28**	**90**	**90**	**80**	**360**	**100**	**50**	**770**	**23**

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Co-Curricular Course:: Active Participation in Activities such as: Sports, Tech-fest, College Club Activity, University level /college level cultural activities, Drama, painting ,annual day, department student's association/IE/ISTE, paper presentation, foreign language certificate, NCC etc. **Co-Curricular Course Activities minimum hours:** 2 hours per week or 24 hours, Teaching Load: 01 Hr. /Week.

EXIT CRITERIA FOR U. G. DIPLOMA														
Category	Course Code	Name of the Course @	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
EX2	ET1411	Introduction to Embedded System Design			8	8					50		50	4
EX2	ET1412	Learn the Art and Science of PCB Design with Eagle			8	8					50		50	4
OR														
EX2	ET1413	Internship / Technical Project			16	16					100 @		100	8

@ Based on seminar, Internship Report, Internship/ Project evaluation

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SEMESTER –V														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
								Theory			**Practical**		**Total**	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM3	ET1515/16	Multidisciplinary Minor-3	3			3	15	15	10	60			100	3
PC	ET1501	Electromagnetic Waves	3			3	15	15	10	60			100	3
PC	ET1502	Digital Communication	3			3	15	15	10	60			100	3
PC	ET1503	Digital Signal Processing	3			3	15	15	10	60			100	3
PE1	ET1504	Program Elective 1	3			3	15	15	10	60			100	3
OE2	SH1501	Open Elective 2	3			3	15	15	10	60			100	3
PE	ET1505	Digital Communication Lab			2	2					25	25	50	1
VSE	ET1506	Digital Signal Processing Lab			2	2					25	25	50	1
PE2	ET1507	Laboratory-1			2	2					50		50	1
CC2	SH1502	Co-curricular Course			4	4			20				20	2
MNC2	SH1503	Soft Skills	2			2			20				20	0
Total			**20**	**0**	**10**	**30**	**90**	**90**	**100**	**360**	**100**	**50**	**790**	**23**

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Co-Curricular Course:: Active Participation in Activities such as: Sports, Tech-fest, College Club Activity, University level /college level cultural activities, annual day, department student's association/IE/ISTE, paper presentation, foreign language certificate, NCC etc. **Co-Curricular Course Activities minimum hours:** 2 hours per week or 24 hours, Teaching Load: 01 Hr. /Week.

ADDITIONAL CRITERIA FOR HONORS

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	CT1	CT2	TA	ESE	ICA	ESE		
PEH1	ET1521	Program Elective for Honors 1 (Swayam/MOOCS/NPTEL/ Online) from Basket	3				15	15	10	60			100	3
PEH2	ET1522	Program Elective for Honors 2 (Swayam/MOOCS/NPTEL/ Online) from Basket	3				15	15	10	60			100	3
	Total		6				30	30	20	120			200	**6**

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PER1	ET1531	Research Project Stage 1	08	08					100		100	4	08	08

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ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MN1	ET1541	Minor Track Course 1 From Basket	3				15	15	10	60			100	3
MN2	ET1542	Minor Track Course 2 From Basket	3				15	15	10	60			100	3
	Total		6				30	30	20	120			200	6

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SEMESTER –VI														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM3	ET1615/16	Multidisciplinary Minor 3	3			3	15	15	10	60			100	3
PC	ET1601	Embedded Systems	3			3	15	15	10	60			100	3
PC	ET1602	CMOS Design	3			3	15	15	10	60			100	3
PE3	ET1603	Program Elective 2	3			3	15	15	10	60			100	3
PE4	ET1604	Program Elective 3	3	1		4	15	15	10	60			100	4
VSE	ET1605	Embedded Systems Lab			2	2					25	25	50	1
PE5	ET1606	CMOS Design Lab			2	2					25	25	50	1
FP	ET1607	Laboratory-2/Minor Project			4	4					50		50	2
MNC3	ET1608	MATLAB Fundamentals	2			2	15	15	20				50	0
MNC4	SH1601	NCC/NSS	0			0			20				20	0
Total			**17**	**1**	**8**	**26**	**90**	**90**	**90**	**300**	**100**	**50**	**720**	**20**

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EXIT CRITERIA FOR EXIT CRITERIA FOR B. VOC.

Category	Course Code	Name of the Course @	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
EX3	ET1611	PC Hardware & Computer Networking			8	8					50		50	4
EX3	ET1612	IoT System			8	8					50		50	4
OR														
EX3	ET1613	Internship / Technical Project			16	16					100@		100	8

@ Based on seminar, Internship Report, Internship/ Project evaluation

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ADDITIONAL CRITERIA FOR HONORS

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PEH3	ET1621	Program Elective for Honors 3 (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10	60			100	3
PEH4	ET1622	Program Elective for Honors 4 (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10	60			100	3
	Total						30	30	20	120			200	**6**

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PER2	ET1631	Research Project Stage 2			12	12					100	100	200	6

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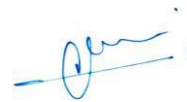
ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)															
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme								Credits
							Theory				Practical		Total		
			Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	CT1	CT2	TA	ESE	ICA	ESE			
MN3	ET1641	Minor Track Course 3 From Basket	3				15	15	10	60			100		3
MN4	ET1642	Minor Track Course 4 From Basket	3				15	15	10	60			100		3
	Total		6				30	30	20	120			200		6





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SEMESTER –VII

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM5	ET1715/16	Multidisciplinary Minor 5	3			3	15	15	10	60			100	2
PC	ET1701	Digital System Design	3			3	15	15	10	60			100	3
PE6	ET1702	Program Elective 4	3	1		4	15	15	10	60			100	4
PE7	ET1703	Program Elective 5	3			3	15	15	10	60			100	3
OE3	SH1701	Open Elective 3	2			2	15	15	10	60			100	2
VSE	ET1704	Laboratory – 3			2	2					50		50	1
VSE	ET1705	Laboratory – 4			2	2					50		50	1
PR	ET1706	Project			8	8					50	50	100	4
MNC5	ET1707	Raspberry Pi / Arduino interfacing with MATLAB	2			2	15	15	20				50	0
Total			**16**	**1**	**12**	**29**	**90**	**90**	**80**	**300**	**150**	**50**	**750**	**20**

Note: Project Guide Teaching load: 8 hrs/week

Students can register for the elective in seventh semester .Courses will be of completely student's choice but approved by DFB of concerned department and should be **at least of 12 weeks** including tutorials, which will be considered as **4 credit course**.

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Students can register and complete online courses for Multidisciplinary Minor 4 any time after completion of semester IV, however, the student must successfully complete and pass the course, and submit the score card/certificate before declaration of result of VII th semester.

ADDITIONAL CRITERIA FOR HONORS

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT2	TA	ESE	ICA	ESE			
PEH5	ET1721	Program Elective for Honors 1 (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10	60			100	3
PEH6	ET1722	Program Elective for Honors 2 (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10	60			100	3
	Total						30	30	20	120			200	**6**

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PER3	ET1731	Research Project Stage 3			16	16					100	200	300	8

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ADDITIONAL CRITERIA FOR DOUBLE MINOR (SPECIALIZATION)														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MN5	ET1741	Minor Track Course 5 From Basket	3				15	15	10	60			100	3
MN6	ET1741	Minor Track Course 6 From Basket	3				15	15	10	60			100	3
	Total		6				30	30	20	120			200	6

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SEMESTER –VIII

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
								Theory			Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE	Total	
RM	SH1801	Research Methodology (Online through SWAYAM/NPTEL)	4			4	15	15	10	60			100	4
EM2	ET1801	Entrepreneurship Management Course	3			3	15	15	10	60			100	3
IN	ET1802	Internship (Online reviews - one in each month)									100	200	300	12
		Total	7			7	30	30	20	120	100	200	500	19

Note: Internship Guide Teaching load: 4 hrs/week

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LIST OF PROGRAM ELECTIVES					
Area	**PE1 ET1504**	**PE2 ET1603**	**PE3 ET1604**	**PE4 ET1702**	**PE5 ET1704**
Electronic Design	EDT with HDL	MEMS	VLSI Design	Mixed Signal VLSI	VLSI Verification and Testing
Communication Engineering	Antenna and Wave Propagation	Information Theory and Coding Techniques	Optical Communication	Satellite Communication	Wireless and Mobile Communication
Signal Processing	Engineering Transforms	Multirate DSP	Adaptive Signal Processing	Image and Video Processing	Audio Processing
Computer Vision	Fuzzy Logic and Neural Networks	Soft Computing	Machine Learning	Pattern Recognition	Artificial Intelligence
Competitive Examination	Network Analysis	Control System	Analog and Digital Systems	Communication Engineering	Transmission Lines and Waveguides

SWAYAM/NPTEL etc. portal. Courses for PE1 to PE5 should be related to concerned vertical approved by DFB and should be **at least of 12 weeks** including tutorials.

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LIST OF MULTIDICIPLINARY MINOR COURSES:

Sr No.	Offering Department	Name of Programme /Minor Course	Students from Department who can register
1	CSE	Data Science	CE,ME,EE,ENTC,INST
		Artificial Intelligence	CE,ME,EE,ENTC,INSTR
2	IT	Machine Learning	CE,ME,EE,ENTC,INST
		Software Engineering	CE,ME,EE,ENTC,INST
3	ENTC	IOT	CE,ME,EE,CSE,IT,INST
		Electronics and Telecommunication Engg.	CE,ME,EE,CSE,IT,INST
4	ME	Mechanical Engineering	CE,EE,ENTC,CSE,IT,INS
		Automation & Robotics	CE,EE,ENTC,CSE,IT,INS
		Industrial Management	ME,CE,ENTC,CSE,IT,EE,INST
5	CE	Building Construction and Management	ME,EE,ENTC,CSE,IT,INST
		Business Economics	ME,EE,ENTC,CSE,IT,INST,CE
6	EE	Energy Engineering	ME,CE,ENTC,CSE,IT,INST
		Electrical Motors & Drives	ME,CE,ENTC,CSE,IT,INST
7	INST	Instrumentation and Control	ME,CE,ENTC,CSE,IT,EE
		Banking and Finance	ME,CE,ENTC,CSE,IT,EE,INST

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Name of Programme /Minor Course	Course Code	Civil Engineering		Mechanical Engineering			Electrical Engineering	
		Building Construction and Management (TRACK-I)	Business Economics (TRACK-II)	Mechanical Engineering (TRACK-I)	Automation & Robotics (TRACK-II)	Industrial Management (TRACK-III)	Energy Engineering(TRACK-I)	Electrical Motors & Drives (TRACK-II)
MinorCourse-1	XX1315/16/17	CE1315 Basics of Civil Engineering	CE1316 Principles of Macroeconomics	ME1315 Production Technology	ME1316 Hydraulics and Pneumatics	ME1317 Organizational Behaviour	EE1315 Introduction to Renewable Energy	EE 1316 Electrical Motors
MinorCourse-2	XX1415/16/17	CE1415 Building Construction	CE1416 Principles of Microeconomics	ME1415 New and Renewable Energy Sources	ME1416 Automation in Manufacturing	ME1417 Human Resource Management	EE1415 Energy Resources, Environment and Economics	EE 1416 Special Electrical Machines
MinorCourse-3	XX1515/16/17	CE1515 Building Planning & Drawing	CE1516 Business Statistics	ME1515 Automobile Engineering	ME1516 Mechatronic Systems	ME1517 Material Management	EE1515 Energy Efficiency in Electrical Utilities	EE 1516 Power Electronics
MinorCourse-4	XX1615/16/17	CE1615 Building Estimates & Tendering	CE1616 Financial Accounting	ME1615 Basic of Product Design	ME1616 Industrial Robotics	ME1617 Marketing Management	EE1615 Energy Management	EE 1616 Electrical Drives and Control
MinorCourse-5	XX1715/16/17	CE1715 Construction Management	CE1716 Minor Project	ME1715 Industrial Management and Quality Control	ME1716 Computer Integrated Manufacturing	ME1717 Corporate Financial Reporting and Analysis	EE1715 Project	EE 1716 Project

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Name of Programme /Minor Course	Course Code	Electronics Engineering		Computer Engineering		Information Technology		Instrumentation Engineering	
		Internet of Things (TRACK-I)	Electronics and Telecommunication Engg. (TRACK-II)	Data Science (TRACK-I)	AI (TRACK-II)	Machine Learning (TRACK-I)	Software Engineering(TRACK-II)	Instrumentation and Control (TRACK-I)	Banking and Finance(TRACK-II)
MinorCourse-1	XX1315/16	ET1315 Introduction to internet of things	ET1316 Digital Circuits	CS1315 Fundamentals of data science	CS1316 Introduction to Artificial Intelligence	IT1315 Essential math for machine learning	IT1316 Data Structure & Algorithms	IN1315 Industrial Measurement I	IN1316 Bank operations Management
MinorCourse-2	XX1415/16	ET1415 IoT Architecture & Protocols	ET1416 Communication Engineering	CS1415 Computational Data Analytics	CS1416 Data Mining	IT1415 Artificial Intelligence	IT1416 Software Engineering	IN1415 Industrial Measurement II	IN1416 Strategic management and innovation in banking
MinorCourse-3	XX1515/16	ET1515 Programming with Arduino and Raspberry-Pi	ET1516 Microprocessor &Embedded System	CS1515 Natural Language Processing	CS1516 Introduction to Machine Learning	IT1515 Machine learning	IT1516 Object Oriented Design & Programming	IN1515 Control system Engineering	IN1516 Security analysis and portfolio management
MinorCourse-4	XX1615/16	ET1615 Industrial Internet of Things	ET1616 Wireless Communication	CS1615 Application of data science	CS1616 Optimization Methods in Machine Learning	IT1615 Deep Learning	IT1616 Software Testing	IN1615 Industrial Automation	IN1616 Spreadsheet based data analysis
MinorCourse-5	XX1715/16/17	ET1715 Project	ET1716 Project	CS1715 Marketing Analytics for Big Data	CS1716 Human Applications of AI	IT1715 Minor Project	IT1716 Minor Project	IN1715 Programming for PLAC,DCS & SCADA	IN1716 IT operations &Management

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	LIST OF OPEN ELECTIVE COURSES		
	OE-I	**OE-II**	**OE-III**
Course Code	SH1401	SH1501	SH1701
A	**Appreciating Indian Music**	**Environmental law**	**Operational Research**
B	**Introduction to Human Psychology**	**Cyber law**	**Digital Marketing**
C	**Nanotechnology, Science and Application**	**Introduction to Mass Communication**	**Biology for Engineers**
D	**Introduction to Exercise Physiology & Sports Performance**	**Foreign Language Japanese (N5) /German (A1)**	**Foreign Language Japanese(N4) /German(A2)**
	SWAYAM/NPTEL **https://onlinecourses.nptel.ac.in/noc22_hs57/preview** **https://onlinecourses.nptel.ac.in/noc24_hs39/preview** **https://onlinecourses.nptel.ac.in/noc19_mm21/preview** **https://onlinecourses.nptel.ac.in/noc24_hs86/preview**	**SWAYAM/NPTEL**	**SWAYAM/NPTEL**

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LIST OF PROGRAM ELECTIVES HONOR'S COURSES (Swayam/NPTEL)			
COURSE CODE/AREA ADVANCED SIGNAL PROCESSING		**COURSE CODE/AREA SOFT COMPUTING**	
ET1521	DSP Architecture	ET1531	Artificial Intelligence
ET 1522	Digital Image and Video Processing	ET 1532	Introduction to Soft Computing and Machine Learning
ET 1621	Wavelet Signal Processing	ET 1631	Computer Vision
ET 1622	Advanced Digital Signal Processing	ET 1632	Natural Language Processing
ET 1721	Pattern Recognition and Computational Intelligence	ET 1731	Optimization Methods in Machine Learning
ET 1722	Adaptive Signal Processing	ET 1732	Hardware for Deep Learning

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Honour's Courses:

Advanced Signal Processing

ET1521 DSP Architecture : NPTEL Course on MAPPING SIGNAL PROCESSING ALGORITHMS TO DSP ARCHITECTURES: NOC | Mapping Signal Processing Algorithms to Architectures (nptel.ac.in)

ET1522 Digital Image and Video Processing: a. Digital Image Processing: https://onlinecourses.nptel.ac.in/noc22_ee116/preview

b.Digital Video Processing: https://archive.nptel.ac.in/courses/117/104/117104020/#

ET1621 Wavelet Signal Processing: Introduction to Time-Frequency Analysis and Wavelet Transforms:

https://archive.nptel.ac.in/noc/courses/noc16/SEM2/noc16-ch05/

ET1622 Advanced Digital Signal Processing: Advanced Digital Signal Processing –

Multirate and Wavelets: https://archive.nptel.ac.in/courses/117/101/117101001/

ET1721 Pattern Recognition and Computational Intelligence **:**

Pattern Recognition and Application: https://onlinecourses.nptel.ac.in/noc19_ee56/preview

ET1722 Adaptive Signal Processing: Introduction To Adaptive Signal Processing: https://onlinecourses.nptel.ac.in/noc23_ee138/preview

Soft Computing

ET1531 Foundations of Artificial Intelligence: Fundamentals Of Artificial Intelligence: https://onlinecourses.nptel.ac.in/noc21_ge20/preview

ET1532 Introduction to Soft Computing and Machine Learning:

a. Introduction To Soft Computing: https://onlinecourses.nptel.ac.in/noc22_cs54/preview

b. Introduction to Machine Learning: https://onlinecourses.nptel.ac.in/noc24_cs51/preview

ET1631 Computer Vision: Computer Vision: https://onlinecourses.nptel.ac.in/noc19_cs58/preview

ET1632 Natural Language Processing: Natural Language Processing: https://onlinecourses.nptel.ac.in/noc23_cs45/preview

ET1731 Optimization Methods in Machine Learning: Optimisation for Machine Learning: Theory and Implementation: https://archive.nptel.ac.in/courses/106/106/106106245/#

ET1732 Hardware for Deep Learning: Deep Learning: https://archive.nptel.ac.in/noc/courses/noc18/SEM2/noc18-cs41/

LIST OF MINOR COURSES FOR DOUBLE MINOR (EMBEDDED SYSTEM)							
COURSE CODE	**Civil Engineering**	**Mechanical Engineering**	**Electrical Engineering**	**Electronics Engineering**	**Computer Engineering**	**Information Technology**	**Instrumentation Engineering**
XX1541				ET1541/Embedded System Design with ARM			
XX1542				ET1542/Embedded System Interfacing			
XX1641				ET1641/RTOS			
XX1642				ET1642/Embedded System Design Verification			
XX1741				ET1741/Industrial IoT			
XX1742				ET1742/IoT Edge			

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Double Minor Courses:

ET1541 Embedded System Design with ARM: NOC22 CS93: Embedded System Design with ARM: https://onlinecourses.nptel.ac.in/noc22_cs93/preview

ET1542 Embedded System Interfacing: NOC 24 EE68: Embedded Sensing, Actuation and Interfacing Systems: https://onlinecourses.nptel.ac.in/noc24_ee68/preview

ET1641 RTOS: Real Time Operating System: https://archive.nptel.ac.in/courses/106/105/106105172/

ET1642 Embedded System Design Verification: Embedded System-Design Verification and Test: https://archive.nptel.ac.in/courses/106/103/106103182/

ET1741 Industrial IoT: Introduction to Industry 4.0 and Industrial Internet of Things: https://nptel.ac.in/courses/106105195

ET1742 IoT Edge: NOC23 CS65: Foundation of Cloud IoT Edge ML https://onlinecourses.nptel.ac.in/noc23_cs65/preview

Sample Guidelines for the Honour with Research Project

The purpose of this course is to introduce students to the process of conducting research projects/work. The students will be helped to conceptualise, design and execute a research project by a teacher guide.

Stage-1:

- Student have to complete online course related to topic/perquisite course prescribed by the assigned guide/BOS

  OR
- The focus will be on discussions and analysis of assignments. Learners will be encouraged to read books and research journals related to his/her research topic (literature review, theory and hypotheses etc) and share them in the seminars and evaluated by two member Team of department and same to be enter in ICA format.

Stage-2:

Sample steps:

- Research design/Methodology
- Sampling tool of data collection
- data processing and analysis
- Plan of research report
- Publish review paper in peer view journal/Scopus indexed journal and seminar on it
- The faculty supervisor will assess the method and procedures used by the learner
- At end evaluated by two member Team of department

Stage-3:

- If applicable initiate Actual implementation
- Data Analysis and Interpretation: The outcome of the research is presented in tabular form with the help of statistical procedures. The data are analysed and interpreted and presented in the form of a research report and presentation /seminar.
- Report writing
- Publish paper on findings in peer view journal/Scopus indexed journal.
- Two member Team of department will assess the Findings method and procedures
- The faculty supervisor will assess the presentation of major findings depending on the methodology used, presentation of results, interpretation of the results with discussion, summary of the proposed research problem and conclusion.
- Two member Team of department (may evaluated by Guide and external expert) will assess the Findings method and procedures etc

Note : Guide Teaching load : 4 Hrs per student in Research stage -1 /2/3

Equivalence Scheme

Programme Name:-B. Tech. (Electronics and Telecommunication)

S N.	Course code with Name of course (old) Revised Curriculum 2019-20			Course code with Name of course(NEW) (NEP Version-II)		
	Code	Name	Credit	Code	Name	Credit
1	ETU324	Network Theory	4		No Equivalence	
2	ETU321	Electronic Devices and Circuits	4	ET1301	Electronic Devices and Circuits	3
3	ETU322	Signals and Systems	3	ET1302	Signals and Systems	3
4	ETU323	Digital Electronics	3	ET1303	Digital Electronics	3
5	ETU325	Electronics Devices and Circuits Lab.	1	ET1304	Electronic Devices and Circuits Lab	1
6	ETU326	Signal and Systems Lab.	1	ET1305	Signals and Systems Lab	1
7	ETU327	Digital Electronics Lab.	1	ET1306	Digital Electronics Lab	1
8		Newly Added		ET1307	Innovation, Creativity & Entrepreneurship	1
9	ETU328	Computer Programming Lab.	1		No Equivalence	
	ETU621	Control Systems	3	ET1404	Control System	3
10	ETU422	Analog Communication	3	ET1401	Analog Communication	3
11	ETU423	Analog Circuits	3	ET1402	Analog Circuits	3
12	ETU424	Microprocessors and Microcontrollers	3	ET1403	Microprocessors and Microcontrollers	3

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13	ETU425	Digital System Design	4	ET1701	Digital System Design	3
14	ETU426	Analog Communication Lab.	1	ET1405	Analog Communication Lab.	1
15	ETU427	Analog Circuits Lab.	1	ET1406	Analog Circuits Lab	1
16	ETU428	Microprocessors and Microcontrollers Lab.	1	ET1407	Microprocessors and Microcontrollers Lab	1
17	ETU421	Probability and stochastic Process	3		No Equivalence	
18		Newly Added		ET1411	Introduction to Embedded System Design	4
19		Newly Added		ET1412	Learn the Art and Science of PCB Design with Eagle	4
20		Newly Added		ET1413	Internship / Technical Project	8
	Course code with Name of course(NEW) (NEP Version-II)			**Course code with Name of course(NEW) (NEP Version-II) 2025-2026**		
21	ET1307	Innovation, Creativity & Entrepreneurship	1	ET1310	IDEA Lab	1

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SEMESTER III

Course Code	SH1301D								Course category			BS
Course Name	TRANSFORMS AND LINEAR ALGEBRA											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	-	03

Course Objectives:

To study solution of partial differential equations and apply it to solve wave and heat equations.

1. To learn Laplace transform and its properties. Apply it to solve differential equation
2. To equip students with Vector spaces mostly used in varied applications in engineering and science.
3. To learn inner product spaces and related processes.
4. To learn vector calculus and their applications

Partial differential equations and its applications: (9 hours)

Definition, Formation of partial differential equation, Lagrange's linear equation, nonlinear equations of the first order. method of separation of variables for solving second order Partial differential equations, Solutions of wave equation, one dimensional heat flow equation and two dimensional heat flow equation in steady state (Laplace equation)

Laplace Transform :(9 hours)

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic Functions, Inverse Laplace Transform, Convolution theorem. Unit step function, unit impulse function. Applications of Laplace transforms to linear differential equations and simultaneous linear differential equations

Vector Spaces I: (9 hours)

Vector spaces and Subspaces, Linear dependence and Independence of vectors, Bases and dimensions, Coordinate vectors, Linear transformation, Algebra of linear transformation,

Vector Spaces II: (9 hours)

Representation of linear transformation of matrices relative to basis, Inner product, Inner Product spaces ,Norm and Orthogonality, Orthogonal and orthonormal basis, Gram-Schmidt orthogonalisation process,

Vector Calculus: (9 hours)

Scalar and vector fields, line and surface integrals, gradient, divergence and curl, directional derivative, line integral independent of path, Green's, Gauss divergence and Stoke's theorems (Without proofs) and their simple applications

Text books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020, 44th edition.
2. Higher Engineering Mathematics, H.K.Das, S.Chand & Company Pvt.Ltd,2014.
3. A text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Volume-I and Volume-II Laxmi Publications, Reprint, 2023

Reference books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.

2. Higher Engineering Mathematics, B.V, Ramana, Tata Mc Graw Hill Publishing company Ltd.,New Delhi,2008, 6th edition.

3. Advanced Engineering mathematics, Reena Garg, Khanna book publishing company, 2021

Course Outcomes:

After the successfully completion of the course the student will able to

SH1301D.1 Study solution of partial differential equations and apply it to solve wave and heat equations.

SH1301D.2 Study Laplace transform and its properties. Apply it to solve differential equation

SH1301D.3 Equip students with Vector spaces mostly used in varied applications in engineering and science.

SH1301D.4 Study inner product spaces and related processes.

SH1301D.5 Solve vector calculus problems and their applications

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
SH1301D.1	3	3	3	3	3	0	0	0	0	0	0	0	2	0	0
SH1301D.2	3	3	3	3	3	0	0	0	0	0	0	0	2	0	0
SH1301D.3	3	3	3	3	3	0	0	0	0	0	0	0	2	0	0
SH1301D.4	3	3	3	3	3	0	0	0	0	0	0	0	2	0	0
SH1301D.5	3	3	3	3	3	0	0	0	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1301							Course category			PC
Course Name	ELECTRONIC DEVICES AND CIRCUITS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	-	03

Course Objectives:

Students undergoing this course are expected to

1. Introduce semiconductor devices and their properties.
2. Understand the behaviour of semiconductor devices under the application of DC and AC signals.
3. Study MOSFET and BJT model
4. Introduce MOS Technology and related circuits.

Course Contents:

Low frequency and high frequency models of BJT and MOSFET, Small signal Analysis of CE, CS, CD and Cascade amplifier

Field Effect Devices: MIS (metal-insulator-semiconductor) structures, concept of accumulation, depletion and inversion, MOSFET operation, I-V characteristics, C-V characteristics, MOS capacitor, MOSFET as a switch, CMOS logic gate circuits, Bi-CMOS circuits

MOSFET amplifiers: Current mirrors: Basic current mirror, Cascade current mirror, Single-ended amplifiers: CS amplifier – with resistive load, diode connected load, current source load, triode load, source degeneration. CG and CD amplifiers, Cascade amplifier

Frequency response of amplifiers, Differential Amplifiers, CMRR, Differential amplifiers with active load, two stage amplifiers

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapour deposition, sputtering, twin-tub CMOS process

Text Books:

1. Electronic devices & Circuits by Millman, Halkias & Jit, TMH 2/e 2008
2. CMOS VLSI Design by N.H.E.Weste, D. Harris, Pearson(3/e) 2005
3. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill 2/e 2017

Reference Books:

1. Microelectronic Circuits by A.S.Sedra & K.C.Smith, Oxford 5/e 2004
2. CMOS Analog Circuit Design by Allen, Holberg, Oxford 2/e 2004

Useful Links:

1. Web course on Basic Electronics, IIT Roorkee by Dr. Pramod Agarwal https://nptel.ac.in/courses/117107095
2. Video course on Analog Electronic Circuits, IIT Kharagpur by Prof. Pradip Mandal https://nptel.ac.in/courses/108105158

Course Outcomes:

After Completion of Course, the student will able to

ET1301.1 Be familiar with electronic devices, and their applications to circuits

ET1301.2 Analyze the characteristics of electronic device like MOSFET

ET1301.3 Analyze MOSFET and BJT amplifier circuits parameters

ET1301.4 Discuss about the frequency response of MOSFET amplifiers

ET1301.5 Understand the basic processes required for fabrication of electronic devices

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1301.1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0
ET1301.2	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0
ET1301.3	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0
ET1301.4	1	1	1	1	0	0	1	0	0	0	1	1	2	2	0
ET1301.5	1	1	2	2	1	0	1	0	0	0	1	1	2	2	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1302							Course category			PC
Course Name	SIGNALS AND SYSTEMS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	-	03

Course Objectives: Students undergoing this course are expected to

1. Know types of signals, their representations with sampling for signal processing
2. Know type of systems required for electronic Applications.
3. Know Fourier representation and Fourier transform of continuous and discrete time periodic signals
4. Understand concept of region of convergence(ROC) of Laplace transform and Z0 Transform

Introduction to signals and system: Continuous and discrete time signals, transformation of signals, unit impulse and unit step functions. System - continuous & discrete time system, continuous and discrete LTI system, properties of LTI system. Causal LTI system described by differential and difference equation.

Fourier series representation: Fourier Series Representation of Periodic Signal, properties of Continuous and Discrete -Time Fourier Series. Parseval's Relation of Periodic Signal.

Fourier Transform: continuous-time and discrete time Fourier Transform for Periodic Signals, Properties of the Fourier Transform. Discrete time Fourier transform (DTFT), Magnitude and Phase response, properties of DTFT such as convolution, multiplication and duality.

Review of Laplace and Z- transform: Introduction to Laplace and Z-transforms, properties of Laplace and Z-Transform. The Inverse Laplace and Z-Transform, Pole- zero plot, , Analysis and Characterization of LTI Systems, System function algebra and block diagram representation.

Sampling: The sampling theorem, sampling of continuous time signals, digitization and reconstruction of a signal, ideal interpolator, effect of under sampling: aliasing, discrete time processing of continuous time signals.

Text Books:

1. Oppenheim, A.V.,Willsky, A.S. and Nawab, S.H., "Signals & Systems", 2nd1997Ed., Prentice-Hall of India.
2. Haykin, S. and Van Been, B., "Signals and Systems" 2nd 2003Ed., John Wiley & Sons.

Reference books:

1. Roberts, M.J., "Fundamentals of Signals & Systems", Tata McGraw-Hill.2007
2. Ziemer, R.E., Tranter, W.H. and Fannin, D.R., "Signals and Systems: Continuous and Discrete", 4th2001Ed., Pearson Educat4.Lath
3. Lathi, B. P., "Linear Systems and Signals", 2nd2006 Ed., Oxford University press.

Useful Links:

1. https://www.youtube.com/playlist?list=PLC6210462711083C4
2. https://onlinecourses.nptel.ac.in/noc21_ee28/preview

Course Outcomes:

At the end of this course students will demonstrate the ability to

ET1302.1 Understand mathematical description and representation different types of signals and systems

ET1302.2 Develop IO relationship for LTI system and understand the convolution operator for continuous and discrete time system

ET1302.3 Represent continuous and discrete systems in time and frequencydomain using different transforms like Fourier series and Fourier Transform

ET1302.4 Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s- domain.

ET1302.5 Understand sampling and various issues related to it

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1302.1	1	0	0	0	1	0	0	0	0	0	0	0	1	1	0
ET1302.2	2	1	0	0	1	0	0	0	0	0	0	0	2	2	0
ET1302.3	2	2	1	1	2	2	0	0	0	0	0	0	2	2	0
ET1302.4	3	3	3	2	3	3	0	0	0	0	0	0	3	3	0
ET1302.5	1	1	2	1	1	1	0	0	0	0	0	0	1	1	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1303							Course category			PC
Course Name	DIGITAL ELECTRONICS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	-	03

Course Objectives:

1. To acquire the basic knowledge of digital logic circuit components
2. To implement minimization techniques and Boolean algebra for circuit minimization
3. To understand, analyse and design combinational logic circuits using gates and MSIs
4. To study various components and design sequential circuits and study semiconductor Memories

Number system and codes: Positional number system, conversions and arithmetic. Arithmetic using rth complements, Signed number representation and arithmetic, Codes: BCD, Gray, ASCII, etc and error detection and correction codes.

Boolean algebra and functions Minimization: Boolean algebra, Logic gates – basic, derived and universal, theorems and properties of Boolean algebra, DeMorgan's theorem, canonical and standard SOP and POS forms, simplification and synthesis of Boolean functions using gates, Boolean theorems, K-Map ,don't care condition (up to four variables) and Quine McCluskey method (up to 6 variables), Implementation of Boolean expressions.

Combinational logic Circuit- adders, subtractors, BCD adder, ripple carry look ahead adders, comparator, parity generator, encoders, decoders, multiplexers, de-multiplexers, Realization of Boolean expressions-using decoders-and multiplexers.

Sequential circuits – latches, flip flops, its triggering, inter-conversion, Shift registers: SISO, SIPO, PISO, PIPO, and Universal; Counters – Synchronous and asynchronous up/down counters, mod-N counter, Counters for random sequence.

Semiconductor logic families and memories: Semiconductor logic families: Introduction, Characteristics of digital ICs, RTL, DTL and TTL, comparisons of logic families; Semiconductor memories: RAM, ROM, PLA and PAL.

Text Books:

1. Digital Principles & Logic Design by A. Saha N. Manna by Infinity Science Press LLC, 2007
2. Digital Design by Morris Mano, Pearson education, 2018

Reference Books:

1. T. L. Floyd "Digital Fundamentals", 11th ed., Pearson Education, 2018.
2. Wakerly J F, "Digital Design: Principles and Practices, Prentice-Hall", 5th Ed., 2018.
3. Roth C.H., "Fundamentals of Logic Design", Jaico Publishers. V Ed., 2009.

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc22_ee55/preview or
2. https://archive.nptel.ac.in/courses/108/105/108105132/

Course outcomes

At the end of the course student will be able

ET1303.1 Optimize the digital circuits by applying the applying the Boolean algebra and other minimization techniques
ET1303.2 Examine and design the combinational circuits using gates and MSIs
ET1303.3 Realize the sequential circuits suing flip-flops counters and shift registers.
ET1303.4 Comparisons of logic families and implementation of gates using RTL, DTL and TTL
ET1303.5 Device logic circuits using SSIs and MSIs.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
ET1303.1	2	0	0	0	0	0	0	0	0	0	0	0	2	1	0
ET1303.2	2	1	0	0	0	0	0	0	0	0	0	0	3	2	0
ET1303.3	2	2	1	1	1	1	0	0	0	0	0	0	3	2	0
ET1303.4	1	2	1	2	2	2	0	0	0	0	0	0	3	1	0
ET1303.5	3	3	1	2	3	1	0	0	1	1	0	0	3	3	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1304						Course category			PC
Course Name	ELECTRONIC DEVICES AND CIRCUITS LABORATORY									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
-	-	02	02	-	-	-	-	-	25	25	50	01

Course Objectives:

Students undergoing this course are expected to

1. Plot the characteristics of transistors to understand their behavior
2. Understand the input and output characteristics of these devices
3. Study and understand the devices in detail to use this devices for various application
4. Understand a few of the circuit applications using appropriate Circuit Simulation package

Hardware Experiments

1. MOSFET modes of operation

2. Output and transfer characteristic of n-channel MOSFET

3. Output and transfer characteristic of p-channel MOSFET

4. MOSFET amplifier

5. Current mirror

circuits Simulation

Experiments

6. Simulate frequency response of single stage BJT CE / FET CS amplifier.

7. MOS CS amplifier with resistive load, diode connected load, current source load

8. Differential amplifier

Course Outcomes:

After Completion of Course, the student will able to

ET1304.1 Be familiar with electronic devices and their applications to circuits

ET1304.2 Demonstrate simple amplifier circuits using BJT and FET

ET1304.3 Analyze simple current mirror circuits

ET1304.4 Demonstrate theoretical device/circuit operation in properly constructed analog circuits

ET1304.5 Simulate a few of the circuit applications using appropriate Circuit Simulation package

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
ET1304.1	1	0	0	0	0	1	1	0	0	0	1	3	2	0	1
ET1304.2	1	1	0	0	0	1	1	0	0	0	1	1	2	0	1
ET1304.3	1	1	0	0	0	1	1	0	0	0	1	1	2	0	1
ET1304.4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0
ET1304.5	1	0	0	0	0	0	1	0	0	0	0	0	1	0	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1305						Course category		VSE1
Course Name	SIGNALS AND SYSTEMS LABORATORY								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory			Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
-	-	02	02	-	-	-	-	-	25	25	50	01

The term work shall include minimum 10 experiments based on theory syllabus signal and systems as per sample list given below, using MATLAB or equivalent MATHCAD, LAB VIEW etc application software packages.

Course Objectives:

The objectives of this course are to

1. Provide learning practical implementation of the basic principles of signals
2. Acquire knowledge regarding types of system and their properties
3. Verify the concept of DFT, Z- transform and Laplace transform in the laboratory.
4. Verify the concepts and applications of sampling and aliasing in the laboratory.
5. Provide practical exposure to random variables and processes.

List of Experiments

Sample list is given below but other experiments can be included as per the instructor

1. To demonstrate generation of various types of signal representation.
2. To explore the effect of transformation of signal parameters (amplitude-scaling, and time shifting).
3. To verify different properties of a given system as linear or non-linear, causal or non-causal, stable or unstable etc.
4. Verification of Parseval's theorem associated with Fourier series analysis for a periodic square wave sampled using appropriate sampling frequency.
5. To verify Fourier Transform and inverse Fourier Transform.
6. Verification of Multiplication property associated with Fourier series analysis for a periodic triangular wave sampled using appropriate sampling frequency.
7. Verification of shifting property associated with Fourier series analysis for a periodic square wave sampled using appropriate sampling frequency.

8. To demonstrate the use of Laplace transform and inverse Laplace Transform.
9. To Implement Z transform and inverse Z transform.
10. To study sampling, aliasing of discrete and continuous signals.

Course Outcomes:

Student shall be able to

ET1305.1 Verify basic concepts of signals and systems.
ET1305.2 Analyzing signal and systems in time and frequency domain
ET1305.3 Substantiate the use of discrete Fourier transformation
ET1305.4 Understand and verify need and concept of Z and Laplace transform
ET1305.5 Substantiate the process of sampling and various issues related to it.

Note:

ICA – The Internal Continues Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1305.1	1	0	0	0	1	0	0	0	0	0	0	0	1	1	0
ET1305.2	1	1	0	0	2	0	0	0	0	0	0	0	2	2	0
ET1305.3	2	2	2	2	3	2	0	0	0	0	0	0	3	3	0
ET1305.4	2	2	2	2	3	3	0	0	0	0	0	0	3	3	0
ET1305.5	1	2	1	3	1	3	0	0	0	0	0	0	1	1	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1306						Course category		VSE2
Course Name	DIGITAL ELECTRONICS LABORATORY								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
-	-	02	02	-	-	-	-	-	50	-	50	01

Course Objectives:

To make student able

1. To acquire the hands-on experience of digital component, circuit realization using breadboard
2. To realize combinational logic circuits using gates and MSIs
3. To realize sequential circuits using gates and MSIs
4. To design Combinational Logic Circuits

The instructor may choose experiments as per his/her choice, so as to cover entire course contents of ET1303. Minimum 8 experiments should be performed.

Following list of laboratory experiments is indicative but not limited to following topics

1. To verify working of different logic gates and Boolean algebra.
2. To realize all gates using NOR/and NAND gates
3. Combinational Logic design using basic gates (Code Converters, Comparators, etc).
4. Combinational Logic design using decoders and MUXs.
5. Realize Arithmetic circuits - Half and full address and subtractors.
6. Design Arithmetic circuits – design using adder ICs, BCD adder.
7. Flip flop circuit (RS latch, JK & master slave) using basic gates.
8. Inter conversation of Flip Flops
9. Asynchronous Counters
10. Synchronous counters, Johnson & Ring counters.
11. Sequential Circuit designs (sequence detector circuit).

Course Outcomes:

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

ET1306.1 Realize the importance of Boolean algebra

ET1306.2 Apply concepts and methods of Combinational circuit design techniques introduced in ET1303 through experimentation.

ET1306.3 To design, analyze, synthesize and realize combinational circuits using componentsand ICs

ET1306.4 Apply concepts and methods of Sequential circuit design techniques introduced inET1303 through experimentation.

ET1306.5 Able to design and realize simple digital systems

Note:-

 ICA – The Internal Continues Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

 ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1306.1	1	0	0	0	1	0	0	0	0	0	0	0	1	1	0
ET1306.2	1	1	1	0	1	1	0	0	0	0	0	0	2	1	0
ET1306.3	2	2	1	1	2	1	0	0	0	0	0	0	2	2	0
ET1306.4	3	3	2	1	2	2	0	0	1	0	0	0	3	3	0
ET1306.5	3	3	3	3	3	3	0	0	0	0	0	0	3	3	-

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1310								Course category			EM1
Course Name	IDEA Lab											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
-	-	02	02	-	-	-	-	-	50	-	50	01

Course Objectives:

1. Understand design thinking and innovation concepts and approaches.
2. Understand the problems faced by society.
3. Identify new and unaddressed social needs.
4. Design and development of Small project based on Laboratory equipment like Machine hardware, Electronic hardware and software etc.

Students are expected to complete work in group of max.three students in pertaining to following aspects under the supervision of course coordinator/teacher.

1. Demonstration of modern manufacturing facilities available at the institute
2. Demonstration of automation and programming tools.
3. Active Sessions on brainstorming, creativity, idea generation, problem-solving techniques and new product development.
4. Visit social sites for the identification of social needs and community problems. The report on this visit is to be submitted.
5. Identification of product problems through customer surveys.
6. The minor project based on hardware (along with software if desire).
7. Building prototype and identifying modifications.
8. Write a project report.
9. The Course Coordinator/Teacher may arrange demonstration with poster presentation of all minor projects developed by the students at the end of semester.

Course Outcomes:

ET1310.1 Gain knowledge of design thinking and innovation with the modern machines and devices available in the idea lab.
ET1310.2 Generate different ideas for innovative products through ideation and brainstorming.
ET1310.3 Identify, discuss and justify the technical aspects of the chosen idea with a comprehensive and systematic approach.
ET1310.4 Design and develop innovative products for specific problems considering user- centric perspective and market.
ET1310.5 Communicate and report effectively project related activities.

References Books:

1. Ulrich, Karl T., Steven D. Eppinger, and Maria C. Yang. Product design and development Vol. 4. Boston: McGraw-Hill higher education, 2008.
2. Mueller-Roterberg, Christian. "Handbook of design thinking." Independently publish 2018 (2018).
3. Koh, Joyce Hwee Ling, et al. Design thinking and education. Springer Singapore, 2015.
4. Uebernickel, Falk, et al. Design thinking: The handbook. World Scientific, 2020.
5. Woolery, Eli. Design thinking handbook. In Vision, 2019.

Web Resource:

1. https://www.coursera.org/learn/uva-darden-design-thinking-innovation?action=enroll
2. https://www.mygreatlearning.com/academy/learn-for-free/courses/design-thinking

Note:-

ICA – The Internal Continues Assessment shall be based on project development and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1310.1	1	0	0	0	0	1	1	0	0	0	1	3	2	0	1
ET1310.2	1	1	0	0	0	1	1	0	0	0	1	1	2	0	1
ET1310.3	1	1	0	0	0	1	1	0	0	0	1	1	2	0	1
ET1310.4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0
ET1310.5	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Semester IV

Course Code	ET1401								Course category			PC
Course Name	ANALOG COMMUNICATION											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2.30 Hrs.	-	-	100	03

Course Objectives:

The course aims to provide the students with

1. The concepts and issues related to analogue communication such as modulation, demodulation, transmitters and receivers and noise performance.
2. The techniques for generating and demodulating narrow-band and wide-band frequency and phase modulated signals
3. Various radio receivers with their parameters.
4. Basic introduction to antennas, their principal of operation also introduce to wave propagation.

Course Contents:

Introduction to communication systems: The communication process, Sources of information, Communication networks, communication channels, Electromagnetic frequency spectrum, communication systems, need of modulation and its types, bandwidth requirement.

Noise: Sources of noise and its types signal to noise ratio, noise factor, noise figure, definition of noise figure, calculation of noise figure, noise figure from equivalent noise resistance, noise temperature and noise equivalent temperature.

Amplitude (Linear)Modulation and Demodulation: Amplitude modulation (AM), double side band (DSB), double side band suppressed carrier (DSB-SC), single side band (SSB), vestigial side band modulation (VSB): generation, demodulation; independent side band(ISB) transmission, modulation index, frequency spectrum, power requirement of these systems, super heterodyne radio receiver. Noise in AM receivers using coherent detection and envelop detection. Signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) for low noise conditions

Angle (Exponential) Modulation and Demodulation: Generalized concept and features of angle modulation; Frequency modulation (FM): modulation index, power requirement, frequency spectrum, bandwidth, phasor comparison of narrowband FM and AM waves, generation of FM, demodulation, interference in FM system, pre-emphasis and de-emphasis
techniques, FM receiver, noise in FM receiver. Signal-to-noise ratio (SNR) calculations for frequency modulation (FM) for low noise condition.

Phase modulation (PM): modulation index, power requirement, frequency spectrum, bandwidth analysis of narrow band FM, wide band FM and PM, interference in angle modulated system.

Antenna and Wave propagation:

Antenna: Introduction, Basic Antenna system, Antenna parameters, Yagi Uda antenna, Dishantenna
Wave propagation: Fundamentals of electromagnetic waves, Ground wave propagation, skywave, space wave, tropospheric scatter, Extraterrestrial propagation.
Ionosphere: Structure, layers of Ionosphere, critical frequency, MUF, skip distance andvirtual height.

Text Books:

1. Modern Digital and Analog Communication Systems, B. P. Lathi, 4rd edition,Oxford University press, 2009
2. Electronic communication systems, G. Kennedy and B. Davis, 5th edition, TataMcGraw Hill, 2012.

Reference Books:

1. Communication System, S. Haykin, 5th edition, John Wiley and sons, 2009.
2. Electronic communications, R. Dennis and J. Coolen, 4th edition, Prentice Hall
3. Communication Electronics Principles and Application, "Frenzel", Tata McGraw Hill, 3rd Edition

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc23_ee117/preview
2. https://www.udemy.com/share/101Ina/

Course Outcomes: After completion of course, students will be able to:

ET1401.1 Interpret the basic concept of communication systems and gain the knowledge of components of analogue communication system.
ET1401.2 Understand the concepts of analog modulation transmission and reception, various methods of analog communication.
ET1401.3 Illustrate and evaluate the parameters of analog communication system.
ET1401.4 Analyze the effect of noise on various transmission systems and summarize the concepts of wave propagation.
ET1401.5 Understand and evaluate antenna parameters and design antenna.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1401.1	1	0	0	0	1	0	0	0	1	0	0	1	1	1	0
ET1401.2	1	0	0	0	1	0	0	2	1	1	2	2	1	1	1
ET1401.3	3	1	0	0	1	1	1	0	1	0	0	0	2	1	1
ET1401.4	3	2	1	1	1	2	2	2	1	2	2	2	2	2	3
ET1401.5	3	3	2	1	1	1	2	2	1	2	3	3	2	3	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Sign Sign Sign Sign
Member Secretary BoS Chairperson Dean, Academics Principal

Course Code	ET1402						Course category			PC
Course Name	ANALOG CIRCUITS									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	-	03

Course Objectives:

Students undergoing this course are expected to

1. Study negative feedback and power amplifier circuits
2. Study various Oscillators circuits
3. Develop the skill to build, test, diagnose and rectify the OP-AMP based electronic circuits.
4. Study various active filters using OP-AMP

Course Contents:

Feedback Amplifier : Classification of amplifier, concept of feedback, types of feedback (positive and negative feedback), general characteristics of negative feedback amplifier - transfer gain, input resistance and output resistance, negative feedback amplifier - analysis of voltage series, current series, voltage shunt and current shunt negative feedback amplifier

Large Signal Amplifier: High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier, current mirrors and differential amplifiers. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues.

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Multivibrator: astable, bistable and monostable multivibrator.

OP-AMP, inverting, non-inverting, differential amplifier configurations, Input offset voltage, input bias and offset current, Thermal drift, CMRR, PSRR.
OP-AMP applications: review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Text Books:

1. Elecronic devices & Circuits by Millman, Halkias & Jit, TMH 2/e 2008
2. Linear Integrated Circuits by D.Roy Choudhary, Shail Jain, New Age International

Reference Books:

1. Electronic Circuits Analysis and Design by Donald A Neamen, TMH 2/e 2002

2. Op-Amps and Linear Integrated Circuits by Ramakant A Gayakwad, PHI 4/e
3. Operational amplifiers, Design and applications by Tobey, Graeme, Huelsman , McGraw Hills Edition

Useful links:

1. Web course on Analog Circuits, IIT Roorkee by Dr. Pramod Agarwal https://nptel.ac.in/courses/117107094
2. Video course on Analog Circuits and Systems, IISC Bangalore by Prof. K. Radhakrishna Rao https://nptel.ac.in/courses/117108107

Course Outcomes:

After Completion of Course, the student will able to

ET1402.1 Analyze negative feedback amplifier and power amplifiers circuits

ET1402.2 Understand various oscillator circuits

ET1402.3 Understand the functioning of OP-AMP and design OP-AMP based circuits

ET1402.4 Troubleshoot various linear applications of OP-AMP

ET1402.5 Helps students to know about active filter design using OP-AMP

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1402.1	1	1	1	1	0	0	1	0	0	0	1	1	2	1	0
ET1402.2	1	1	1	1	0	0	1	0	0	0	1	1	2	1	0
ET1402.3	1	1	2	2	1	0	1	0	0	0	1	1	3	2	0
ET1402.4	1	1	1	1	1	0	1	0	0	0	1	1	1	1	0
ET1402.5	1	0	1	1	0	0	1	0	0	0	1	1	2	1	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1403						Course category			PC
Course Name	MICROPROCESSOR AND MICROCONTROLLER									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	-	03

Course Objectives:

To make the student able

1. To learn the fundamentals of microprocessors and microcontrollers
2. To understand the concepts of Assembly Language Programming
3. To understand the basic hardware interfacing
4. To develop application systems based on microprocessors and microcontrollers with efficient programming

Course Contents:

8- bit Microprocessors: Block diagram and operation of microcomputer system, Introduction to Intel's 8085 Architecture and its description along with functional pin diagram, organization of Memory in microcomputer system. Flag structure, Addressing Modes & Instruction set of 8085.

Assembly Language Programming: Assembly language Programming and timing diagram of instructions; Concept of Interrupts and its structure and programming in 8085 & Interrupt service routines, timer/counter; Serial communication basics in 8085.

Microcontrollers: Introduction to MCS51 family, microprocessor and microcontroller comparison, architecture of 8051, pin configuration and description, register organization, input/output port structure, timer structure and their modes, interrupts and serial port modes, Addressing modes, instruction set, bit and byte level logical operations, programming of serial and parallel ports, timer/counters, and interrupts..

Interfacing with 8051: Interfacing of LED, Seven segment, LCD, ADC, DAC, memory, DC and Stepper motor.

Introduction to Advanced Microcontrollers: ARM and PIC

Text Books:

1. Microprocessor, Architecture, Programming and Applications with 8085, Ramesh S. Gaonkar, 5th edition, Penram International Publication, 2004.
2. The 8051 microcontroller, Kenneth Ayala, 3rd edition, Delmar Cengage Learning,

2005.
3. 8051 Microcontroller and Embedded System, Muhammad Ali Mazidi, 2nd edition, Prentice Hall, 2000

Reference books:

1. 0000 to 8085 – Introduction to Microprocessor for Engineers and Scientists, P. R. Sridhar and P. K. Ghosh, 2nd edition, Prentice Hall India Ltd, 2005.
2. Introduction to Microprocessor, Aditya P. Mathur, 3rd edition, Tata McGraw-Hill,2004.
3. Advanced microprocessors and Peripherals, A.K.Ray and K.M.Bhurchandi, 2nd edition, Tata McGraw Hill, 2008
4. Design with PIC microcontrollers, John B. Peatman, 1st edition, PHI, 1998

Useful Link:

1. https://archive.nptel.ac.in/courses/108/105/108105102/

Course Outcomes:

After completing this course, Students shall be able to:
ET1403.1 Understand Microprocessor and Microcontrollers basics

ET1403.2 Develop and implement Assembly language programs

ET1403.3 Understand the hardware interfaces required to develop a simple microcomputer system

ET1403.4 Learn Assembly language programming for 8085

ET1403.5 Develop simple application based projects.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1403.1	2	0	0	0	1	0	0	0	0	0	0	0	1	1	0
ET1403.2	2	1	0	0	1	0	0	0	0	0	0	0	2	2	0
ET1403.3	2	2	1	1	3	1	0	0	0	0	0	0	2	2	0
ET1403.4	1	2	2	2	2	2	0	0	0	0	0	0	3	3	0
ET1403.5	3	3	2	2	3	1	0	0	1	1	0	0	3	3	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1404							Course category			PC
Course Name	CONTROL SYSTEMS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2.30 Hrs.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. To learn modelling of a physical system
2. To understand the concept of stability of system
3. To understand the systems in time and frequency domain
4. To understand the state space modelling and its analysis

Course Contents:

Introduction: Basic Components of a Control System, Examples of Control System Applications, Open Loop Control Systems, Closed Loop Control Systems, Effect of Feedback on System Parameters, Block Diagrams, and Signal Flow Graphs Analysis.

Time Domain Analysis: Standard Test signal, Time response of systems to ,First order and second order system, steady state error and error constant, effect of adding zeros to a system, Design specification of second order system.

Stability Analysis: concept of stability, necessary condition for stability, Hurwitz, Routh stability criteria, special cases for determining relative stability, Root locus concept.

Frequency Domain Analysis: Nyquist stability criterion, Assessment of relative stability, Bode Plot, stability margins on Bode plot.

State variable Analysis: Concept of state, state Variable and state model, state model for linear continuous time system, State variable and linear discrete time system, solution of state equation, concept of controllability and Observability.

Text Book:

1. I.J. Ngarath and M. Gopal, "Control system Engineering" New Age International Publisher

Reference Books:

1. Kuo, B.C., "Automatic Control System", Prentice Hall

2. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill.

3. Ogata, K., "Modern Control Engineering", Prentice Hall,

Useful Link:

1. https://archive.nptel.ac.in/courses/107/106/107106081

Course Outcomes:

ET1404.1 Model a physical system by means of block diagrams, mathematical model and Transfer functions

ET1404.2 Analyze the systems in time.

ET1404.3 Investigate stability of a system using different tests

ET1404.4 Analyze the system in frequency domain Model

ET1404.5 Analyze the control systems using state space analysis

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1404.1	3	2	3	2	1	1	0	1	2	2	2	3	0	1	1
ET1404.2	3	2	2	3	1	1	1	0	2	1	2	2	0	1	1
ET1404.3	2	2	2	3	2	1	1	1	2	2	2	2	0	1	1
ET1404.4	2	2	3	3	2	1	0	1	2	2	2	3	0	1	1
ET1404.5	2	2	3	0	3	1	0	1	2	2	0	0	0	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	SH1401A							Course Category			OE1
Course Name	Appreciating Indian Music										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	Ct-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	30	2 hrs 30 min	-	-	100	03

Course Objectives:

1. To familiarize students with the historical and cultural context of Indian Classical Music.
2. To introduce students to the fundamental concepts of raga, tala, and improvisation.
3. To develop students' listening skills through analysis and appreciation of classical music recordings.
4. To provide students with practical training in basic vocal or instrumental techniques.
5. To encourage critical thinking and reflection on the aesthetic and philosophical aspects of Indian Classical Music.

Course Contents:

Introduction to Indian Music:
Historical overview: origins, evolution, and major developments, definitions (sangeet, swar and its types, saptak and its types, aroha, aavaroha, pakad, alankar, wadi swar, sanvadi swar,varjit swar, sthayi and antara) Regional variations and prominent classical music traditions (Hindustani and Carnatic). Influence of spirituality, mythology, and philosophy on Indian Classical Music.

Fundamentals of Raga:
Understanding the concept of raga (melodic framework) and its elements, Notation systems and the role of improvisation within the framework of raga (Paluskar and Bhatkhande lipi), Different THAATs and their brief information, Definition of Raga, Sargam geet, the concept of Khyal , aalap and tana, Raga and Time Association, Basic ragas (Bhupali, Yaman, Bhimpalasi and Kedar) along with Aaroha, avaroha, pakad and sargam geet and khyal.

Introduction to Taala:
Understanding the components of a tala cycle (Defining- Taal, Lay and its types, matras, theaka, sum,tali, kaal, avartan).
Study of common talas (Teental, Rupak, Kehrarva, Dadra and Bhajni Theaka)
Practical exercises in clapping and counting rhythms to internalize talas.

Introduction to Musical Instruments:
Classification of Indian Musical Instruments (String, wind, percussion and Solid Instruments), components parts of Indian classical instruments along with neat sketch
Biography- Ustad Zakir Husen (Tabla), Pandit Appa Jalgaokar (Harmonium)
Pandit Ravi Shankar (Sitar), Pandit Hari Prasad Chaurasiya (Flute), Dr. N Rajam (Violin)

Sign Sign Sign Sign
Member Secretary BoS Chairperson Dean, Academics Principal

Textbooks:

1. Indian Classical Music By Ravi S. Prasanna
2. Appreciating Indian Music By Emmons E. White
3. Fundamental of Indian Music By. S. Sharma.

References:

1. Indian Music By Dr. Thakur J. Sing
2. Finding the Raga By Amit Choudhari.
3. History of Indian Music By B. A. Pingle
4. Raga Harmony By L. Subramaniam

Course Outcomes:

After successful completion of this course student will be able to

SH1401A.1: Students will demonstrate an understanding of the historical development and cultural significance of various genres and styles of Indian music.
SH1401A.2: Students will understanding classical, folk, and contemporary forms, by discussing key historical milestones and movements.
SH1401A.3: Students will be able to applying knowledge of musical elements such as raga, tala, swara, and laya to identify stylistic features, structural patterns, and aesthetic qualities.
SH1401A.4: Students will develop skills and competencies relevant to careers in music education.
SH1401A.5: Students will develop skills and competencies relevant to research, arts administration, cultural advocacy, or related fields, preparing them for further academic pursuits or professional endeavors in the music industry.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
SH1401A.1	1	0	0	0	0	1	2	2	3	0	0	0	1	0	2
SH1401A.2	1	0	0	0	0	1	2	2	3	0	0	0	1	0	2
SH1401A.3	1	0	0	0	0	1	2	2	3	0	0	0	1	0	2
SH1401A.4	1	0	0	0	0	1	2	2	3	0	0	0	1	0	2
SH1401A.5	1	0	0	0	0	1	2	2	3	0	0	0	1	0	2

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	SH1401B							Course Category			OE1
Course Name	Introduction to Human Psychology										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students will be able to:

1. Understand the human behaviour.
2. Helps humans in exerting more control over situations
3. Basic cognitive processes that guide human behaviours.
4. Tackling everyday problems and attaining optimal solutions
5. Knowledge about human cognitive systems in designing sophisticated Artificial Intelligence (AI) systems.

Course Contain:

Introduction to Cognitive Psychology:

- History,
- Theory
- Research in Human Cognition

Basic Cognitive Processes:

- Object Perception and Recognition
- Attentional Processes and cognition
- Memory Introduction
- Long Term Memory

Organizational Knowledge:

- Memory of general knowledge.
- Concept Formation
- Visual and Spatial Memory

The Use of Knowledge:

- Human language skills.
- Thought process and Problem Solving
- Reasoning
- Decision Making

Textbooks:

1. Kathleen Galotti, Cognitive Psychology, Cengage Learning.
2. Robert Stenberg, Applied Cognitive Psychology, Cengage Learning.

References:

1. Bridger Riegler, Cognitive Psychology, Pearson Press
2. Stephen Kosslyn, Cognitive Psychology, PHI Press

Course Outcomes:

At the end of this course, students will demonstrate the ability to
SH1401B.1: To learn history of Human Psychology.
SH1401B.2: To understand, theory and research in Human Psychology.
SH1401B.3: To learn the Basic Cognitive Processes.
SH1401B.4: To understand about Organizational Knowledge.
SH1401B. 5: Apply the knowledge of human Psychology to developed process of problem solving, reasoning, decision making.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
SH1401B.1	2	3	0	0	0	0	0	1	2	0	0	0	3	1	2
SH1401B.2	2	0	0	0	0	0	0	1	2	0	0	0	2	1	1
SH1401B.3	2	2	0	0	0	0	0	1	2	0	0	0	2	1	1
SH1401B.4	2	0	0	0	0	0	0	1	2	0	0	0	2	1	1
SH1401B.5	2	2	0	0	0	0	0	1	2	0	0	0	2	1	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	SH1401C							Course Category			OE1
Course Name	Nanotechnology, Science and Application										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	Ct-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	00

Course Objectives:

Students will be able to:
1. To understand the history, background and nature of Nano science and nanotechnology as well as the quantum and Nano sized scale effect on materials.
2. To acquire theoretical understanding of different types of nanostructure
3. To understand the synthesis technique and its types.
4. To learn the different methods of characterization.
5. Aim to approach towards advance research and application of nanoparticals.

Course Contents:

Basics of Nanoscience:

Introduction, Effect of reduction of dimensions on physical properties, History of Nanotechnology, Quantum size effect,

Different classes of Nanomaterial's:

Classification based on dimensionality-Quantum Dots, Wells and Wires, preparation of quantum nanostructures, conduction electrons and dimensionality, Fermi gas and density of states, potential wells, partial confinement, properties dependent on density of states, exitons, single electron tunnelling.

Material Synthesis Method:

Nanostructures of one dimension: Crystalline growth, Template based synthesis. Nanostructures of two dimensions: Fundamentals of thin film growth, physical vapour deposition, chemical vapour deposition, atomic layer deposition, self-assembly, Sol-Gel films, and electrochemical deposition.

Material Characterization Methods:

UV visible microscopy, Scanning electron microscopy (SEM), Transmission electron microscope (TEM), x-ray diffraction (XRD). Atomic Force Microscope (AFM)

Application of Nanomaterial's:

Agriculture field, Medical field, Space Technology, Food Technology, Water Treatment, Energy Sector, Automobile, Electronics Field, Textile Field, Cosmetic.

Textbooks:

1. Introduction to Nanotechnology by C.P. Poole Jr. and F.J. Oweus, Wiley Interscience
2. Nano-Technology by Gregory Timp (Editior), AIP Press, Springer.
3. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd.

Reference Books and website links:

1. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press
2. Graphene: Synthesis and applications, edited by Wonbong Choi and Jo-won Lee.
3. Semiconductor Nanostructures and Nanodevices Vol 1-5-A. A. Balandin, K. L.Wang.
4. Springer Handbook of Nanotechnology: Bharat Bhushan
5. Nanofabrication towards biomedical application: Techniques, tools, Application and impact: Ed. Challa S., S. R. Kumar, J. H. Carola
6. A. S. Edelstein and R. C. Cammarata, "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Pub., 1998.
7. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties & Applications , Imperial College Press, 2004.
8. G.A. Ozin and A.C. Arsenault, "Nano chemistry : A chemical approach to nanomaterials", Royal Society of Chemistry, 2005.
9. Joel I. Gersten, "The Physics and Chemistry of Materials", Wiley, 2001.
10. K.W. Kolasinski, "Surface Science: Foundations of Catalysis and Nanoscience", Wiley, 2002.
11. Physical Chemistry – Atkins Peter, Paula Julio.
12. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications.

Course Outcomes:

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

SH1401C.1: To learn basic of Nano science with special, emphasize on nanomaterial's.
SH1401C.2: Correlate physical behavior of materials at the Nano scale.
SH1401C.3: Understand the physical, chemical and other important methods for synthesis of nanoparticles.
SH1401C.4: Understand the various characterization techniques of Nano materials.
SH1401C.5 Apply the knowledge gained to suggest different applications of Nano science and technology.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
SH1401C.1	2	0	2	0	0	0	0	0	1	2	2	3	2	2	1
SH1401C.2	3	2	3	0	2	0	2	0	0	3	2	3	2	2	1
SH1401C.3	3	2	3	2	0	0	3	3	1	3	3	3	2	2	1
SH1401C.4	3	2	3	2	2	0	2	0	0	3	3	3	2	2	1
SH1401C.5	3	2	3	2	2	0	3	1	0	3	3	3	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1405							Course category			PC
Course Name	ANALOG COMMUNICATION LABORATORY										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	00	---	25	25	50	01

Course Objectives:

To make the students will be able to:

1. Familiarize the students with basic analog communication systems.
2. Integrate theory with experiments so that the students appreciate the knowledgegained from the theory course, e.g., amplitude and frequency modulation, pulse modulation.
3. Understand Modulation and demodulation techniques of AM, FM.
4. Know Characteristics of AM and FM receivers.

Course Contents:

Minimum Ten experiments related to the course contents of Analog Communication are to be performed.

Representative list of experiments related to the course contents of (ANALOG COMMUNICATION):

1. To Study Noise Spectral density.
2. AM modulation: Calculation of Modulation Index.
3. FM modulation: Calculation of Modulation Index.
4. Pre-emphasis and De-emphasis.
5. FM Modulation using PLL.
6. Demodulation of AM and FM.
7. Effect of noise on AM and FM
8. Pulse Amplitude Modulation and Demodulation.
9. Generation of double side band suppressed carrier.
10. To study SSB modulation and de-modulation.
11. Observe and plot radiation pattern of Omni-directional and directional antenna.

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical may/shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

ET1405.1 To develop practical knowledge about theories of analog communication.

ET1405.2 Evaluate analog modulated waveform in time /frequency domain and also find modulation index.

ET1405.3 Develop understanding about performance of analog communication systems.

ET1405.4 Analyze performance of noise on AM and FM.

ET1405.5 Illustrate techniques for antenna parameter measurements and analyze the performance of radiation pattern

CO – PO – PSO Mapping:

	Program Outcomes														
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1405.1	2	1	0	0	0	0	0	1	0	0	0	1	0	0	0
ET1405.2	3	2	0	0	0	0	0	1	0	0	0	0	0	2	0
ET1405.3	0	0	3	0	0	1	2	1	1	0	2	0	0	0	1
ET1405.4	3	2	0	0	2	1	2	1	1	2	1	2	2	2	1
ET1405.5	2	2	2	2	3	1	3	1	2	2	3	3	1	1	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

ICA – Internal Continuous Assessment shall be based on the practical record and knowledge/ skills acquired. The performance shall be assessed experiment wise using continuous assessment formats, A and B.

Course Code	ET1406						Course category		PC
Course Name	ANALOG CIRCUITS LABORATORY								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
-	-	02	02	-	-	-	-	-	25	25	50	01

Course Objectives:

Students undergoing this course are expected to

1. Design, test and analyze various clipping and clipper circuits.
2. Understand various oscillator circuits
3. Analyze and design various applications of OP-AMP circuits
4. Simulate a few of the circuit applications using appropriate Circuit Simulation package.

Course Contents:

Design Experiments

1. Single stage BJT CE amplifier.

   (Find performance parameters - Av, Ri, Ro & Bandwidth for BJT CE amplifier.)
2. Voltage series feedback amplifier
3. Voltage shunt feedback amplifier
4. Class A power amplifier with resistive load
5. Multivibrator - astable, monostable, bistable
6. OP-AMP applications- Integrator, Differentiators, etc.
7. OP-AMP applications- Schmitt trigger, etc.
8. Filter Design.

Simulation Based Experiments

1. Simulate frequency response of single stage BJT CE / FET CS amplifier.

   (Effect of coupling and bypass capacitors.)

2. Design and simulate LC and RC oscillators.

(Compare practical and theoretical oscillation frequency.)

3. Design and simulate active filters

Course Outcomes:

After Completion of Course, the student will able to

ET1406.1 Analyze negative feedback amplifier and power amplifiers

ET1406.2 Understand various oscillator circuits

ET1406.3 Understand the functioning of OP-AMP and design OP-AMP based circuits

ET1406.4 Troubleshoot various linear applications of OP-AMP

ET1406.5 Helps students to know about active filter design

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
ET1406.1	1	0	0	0	0	1	1	0	0	0	1	1	1	0	1
ET1406.2	1	1	0	0	0	1	1	0	0	0	1	1	1	0	1
ET1406.3	1	1	0	0	0	1	1	0	0	0	1	1	1	0	1
ET1406.4	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0
ET1406.5	1	0	0	0	0	0	1	0	0	0	0	0	1	0	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1407						Course category		VSE3
Course Name	MICROPROCESSOR AND MICROCONTROLLER LABORATORY								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
-	-	02	02	-	-	-	-	-	50	-	50	01

Course Objectives:

To make student able

1. To learn the instruction set of microprocessor and microcontroller
2. To understand the concept of Assembly Language Programming
3. To understand the interfacing of peripheral devices and their programming
4. To develop application based programs

Course Contents:

Minimum eight experiments shall be performed to cover entire curriculum of courseET1404. The list given below is just a guideline.

List:

1. To write Assembly Language Program (ALP) using 8085 and 8051
2. To develop programs on data transfer operations such as block move, exchange, sorting
3. To implement arithmetic operations (8-bit and 16-bit) like addition, subtraction, multiplication, division, square, cube using look-up tables, multi byte arithmetic operations
4. To implement logical operations such as Boolean & logical instructions bit manipulations.
5. To find largest/smallest element in an array,
6. To arrange the array elements in ascending/descending order using bubble sorting.
7. To understand the concept of Stack and Subroutine.
8. To understand the concept of serial communication.
9. To write delay subroutines using timer/counter.
10. Interfacing of
    a. Relays for controlling operations,
    b. Generation of various types of waveforms using ADC/DAC,
    c. Interfacing basic output devices like LED, LCD, keyboard, 7-segment display, DIP switches, Push button switches
    d. Implementation of stepper and DC motor control.
11. To implement a simple microcontroller based application system like temperature

control etc.

Course Outcomes:

After completing this course, Students shall be able to:

ET1407.1 Appreciate architecture of Microprocessor and Microcontrollers basics
ET1407.2 Realize the importance of Instruction set
ET1407.3 Develop Assembly language programs for 8085/8051
ET1407.4 Learn the hardware interfaces required to develop a simple microcomputer system
ET1407.5 Develop simple application based projects

Note :

 ICA – The Internal Continues Assessment shall be based on practical record and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

 ESE – The End Semester Exam for practical shall be based on performance in one of the experiments and followed by sample questions.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1407.1	1	0	0	0	1	0	0	0	0	0	0	0	1	1	0
ET1407.2	1	1	0	0	1	0	0	0	0	0	0	0	1	1	0
ET1407.3	2	2	1	1	3	1	0	0	0	0	0	0	2	2	0
ET1407.4	2	2	2	2	2	2	0	0	1	0	0	0	2	2	0
ET1407.5	3	3	3	3	3	2	0	0	2	1	0	0	3	3	-

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1411							Course category		EX2
Course Name	INTRODUCTION TO EMBEDDED SYSTEM DESIGN									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	08	08	--	--	--	--	--	50	--	50	04

Course objectives:

To make student able
1. To design and manufacture embedded system products
2. To design embedded systems using a building block approach
3. To know embedded systems using a microcontroller MSP430
4. To learn effective embedded programming techniques in C

Contents:

Introduction to Embedded Systems and Computer Systems Terminology. Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply.

Microcontroller Based Embedded System Design. Salient Features of Modern Microcontrollers. Elements of Microcontroller Ecosystem and their significance.

Introduction to MSP430 Microcontroller.

Fundamentals of Physical Interfacing. Connecting Input Devices: Switches, Keyboard and Output devices: LEDs, Seven Segment Displays (SSD).
Introduction to Embedded C. Interfacing LEDs and Switches with MSP430 using Digital Input and Output.

Useful Link:
1. Introduction to Embedded System Design - Course (nptel.ac.in)

Text Books :

1. Designing Embedded Hardware, John Catsoulis. 2nd edition. Shroff Publishers and Distributors. ISBN-10: 9788184042597

References Books:

1. Embedded System Design: A Unified Hardware / Software Introduction. Tony Givargis and Frank Vahid. Wiley. ISBN-10: 812650837X
2. MSP430 Microcontroller Basics. John H. Davies. Elsevier. ISBN-10: 9789380501857.
3. Programming Embedded Systems in C and C++. Micheal Barr. Shroff Publishers and Distributors. ISBN-10: 817366076X

Course Outcomes:

After completing this course, Students shall be able to:

ET1411.1 Acquire knowledge about devices and buses used in embedded networking

ET1411.2 Develop programming skills in embedded systems for various applications.

ET1411.3 Acquire knowledge about MSP430 Microcontroller

ET1411.4 Acquire knowledge about MSP430 Timer Module and its Modes of Operation

ET1411.5 Acquire knowledge about communication protocols

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1411.1	1	0	0	0	1	0	0	0	0	0	0	0	1	1	1
ET1411.2	1	1	1	0	2	0	3	0	0	0	1	2	1	1	1
ET1411.3	2	0	1	1	3	1	2	0	0	0	0	0	2	1	1
ET1411.4	2	0	0	1	2	2	2	0	1	0	0	0	2	1	1
ET1411.5	3	0	0	1	3	2	2	0	1	1	0	0	3	1	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1412	Course category	EX2
Course Name	PCB DESIGN WITH EAGLE		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	08	08	--	--	--	--	--	50	--	50	04

Course Objectives:

To make student able

1. To Learn Circuit design and PCB Design with the most powerful and most widely used tool Eagle
2. To be able to create single and double sided PCB Designs
3. To understand use of Eagle for PCB Design
4. To understand Gerber file and export gerber file for production
5. To Start designing the boards

Course contents

Basics of Printed Circuit Board, Downloading Eagle, Software installation and creating the project

An Overview of Circuit Boards and EAGLE Design, Overview of Circuit Design with EAGLE Designing a Simple Circuit: An Inverting Amplifier, The Inverting Amplifier Schematic, Board Layout, Routing, CAM Processor Layout and Design Rules
Single Sided PCB Design, Single Sided PCB Design Hands on

Creating PCB Project, Copper

Pour Double Sided PCB Design

SMT Components, Create Custom Library Component in Eagle

Use Link:

1. Learn the Art and Science of PCB Design with Eagle | Udemy

Book and References:

1. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards 2nd Edition by Simon Monk (Author), Duncan Amos (Author)

2. **Designing Circuit Boards with EAGLE: Make High-Quality PCBs at Low Cost** by Matthew Scarpino ,Released March 2014, Publisher(s): Pearson, ISBN: 9780133820027

Course Outcomes:

After completing this course, Students shall be able to:

ET1412.1 To design PCB with the most powerful and most widely used tool Eagle
ET1412.2 To design single and double sided PCB Designs
ET1412.3 To understand use of Eagle for PCB Design
ET1412.4 To understand Gerber file and export gerber file for production
ET1412.5 To Start designing the boards

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
ET1412.1	1	0	0	0	1	0	0	0	0	0	0	0	1	1	1
ET1412.2	1	1	1	0	2	0	3	0	0	0	1	2	1	1	1
ET1413.3	2	0	1	1	3	1	2	0	0	0	0	0	2	1	1
ET1414.4	2	0	0	1	2	2	2	0	1	0	0	0	2	1	1
ET1415.5	3	0	0	1	3	2	2	0	1	1	0	0	3	1	1

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1413						Course category		EX2
Course Name	ET1413 INTERNSHIP / TECHNICAL PROJECT								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
-	-	16	16	-	-	-	-	-	100	-	100	08

Course Objectives:

To make the students competent to:

1. Carry out industry internship / Technical Projects
2. Prepare report of industry internship / Technical Projects

Course Contents:

Industry internship

Students must complete Internship for a duration of minimum eight weeks, after completion of second semester of first year. The company/organization for Internship must be approved by the DFB. All the official formalities to be completed by the student.

The students should undergo related trainings and perform tasks assigned to him in the Industry, under the guidance of Industry personnel. The students shall submit the report based on the Industry Internship along with the Completion Certificate given by Industry.

Industry internship may be carried out in any one of the following construction industry:

i) Central Government Department related to Electronics and Telecommunication Engineering e.g. BSNL, BHARAT ELECTRONICS etc.
ii) State Government Department related to Electronics and Telecommunication Engineering e.g. MSETC, Pune Maharashtra Power Grid Corporation of India Ltd (PGCIL) etc.
iii) Private Limited Company related to Electronics and Telecommunication Engineering AIRTEL MOBILES, SAMSUNG, VIDEOCON etc.

At the end of internship, student should submit the report based on training received during internship and also give presentation for the same to the panel of examiners / Evaluation Committee comprising of Experts appointed by the Program Head.

Course Outcome:

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

ET1413.1: Prepare report based on Industry internship

ET1413.2: Give presentation based on Industry internship

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
ET1413.1	1	3	1	3	1	1	3	1	1	1	2	1	2	0	0
ET1413.2	1	3	1	3	1	1	3	1	1	1	2	1	2	0	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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SEMESTER V

Course Code	ET1515								Course category			MM
Course Name	PROGRAMMING WITH ARDUINO AND RASPBERRY PI											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs. 30 min.	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. Learn basic of Arduino Hardware
II. Learn Basic of Raspberry Pi
III. Learn Interfacing of Ardunio and Raspberry Pi with sensors, Actuators
IV. Study Installation, Testing and Verification Process

Course Content:

Basics of Arduino: Introduction to Arduino, Arduino Uno, Arduino Mega, Arduino Nano, Arduino IDE, Steps to install Arduino IDE, Basic commands for Arduino, LCD commands, Serial communication commands, Program with LED and Arduino and sketch.

Basics of Raspberry Pi: Introduction to Raspberry Pi, Raspberry Pi components, Installation of NOOBS and Raspbian on SD card , Terminal commands, Installation of Libraries on Raspberry Pi, Getting the static IP address of Raspberry Pi , Run a program on Raspberry Pi, Installing the Remote Desktop Server, Pi camera, Testing of the camera, Raspberry Pi camera as a USB video device, Face recognition using Raspberry Pi, Installation of I2C driver on Raspberry Pi, Serial Peripheral Interface with Raspberry Pi , Program with LED and Raspberry Pi, Program for read digital input and digital output.

Interfacing with Raspberry Pi and Arduino: Programing with sensors, PIR Sensor, Analog sensors, interfacing diagram/sketch, Programming with Actuators, DC motors, Servo motors, Interfacing diagram/sketch.

Python and Arduino with Pyfirmata (Python Library): Reading an Arduino digital input with Pyfirmata, Reading an analog input with Pyfirmata, Reading the Temperature Sensor values with Pyfirmata.

Connecting to the Cloud: DHT11 Data Logger with Thing Speak Server, Installation of DHT11 Library, Steps to create a channel in Thing Speak and Program, Blynk Application with Raspberry Pi.

Text Books:

1. Internet of things with Raspberry Pi and Arduino, Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, and Mahindra Swain 2019, CRC Press.

Reference books:

1. Learn Programming with Raspberry Pi with Python, Wolffram Donat, Apress.
2. Arduino and Raspberry Pi Sensor Projects - Robert Chin, Robert Chin
3. Guide To Raspberry Pi 3 And Android Development Programming Raspberry Pi 3 Getting Started with Android-up skill learning

Web Resources:

NPTEL course on Introduction to internet of things, by Prof. Sudip Misra, IIT Kharagpur
https://nptel.ac.in/courses/106105166

Course Outcome:

On completion of the course, students will be able to

ET1515.1 Realize Design Flow
ET1515.2 Analyze Arduino & Raspberry Pi Hardware
ET1515.3 Implementation Different Basic Applications
ET1515.4 Analyze cloud connecting application
ET1515.5 Analyze testing, Verification.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO/PSO											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ET1515.1	3	0	0	0	0	0	0	0	0	0	0	0
ET1515.2	0	2	0	0	0	0	0	0	0	0	0	0
ET1515.3	0	0	3	0	0	2	0	0	0	0	0	0
ET1515.4	0	0	0	2	0	0	2	0	0	0	2	0
ET1515.5	0	0	0	0	3	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ET1515.1	3	0	0	0	0	0	0	0	0	0	0
ET1515.2	0	2	0	0	0	0	0	0	0	0	0
ET1515.3	0	0	3	0	0	2	0	0	0	0	0
ET1515.4	0	0	0	2	0	0	2	0	0	0	2
ET1515.5	0	0	0	0	3	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1516							Course category			MM
Course Name	MICROPROCESSOR AND EMBEDDED SYSTEM										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. To learn the fundamentals Microcomputer System
II. To know microprocessors 8085, its architecture and working
III. To understand the concepts of Assembly Language Programming
IV. To learn and develop ALP programming using 8085
V. To know about 8051 and embedded System

Course Contents:

Introduction to Microprocessor: Microcomputer system, and Assembly language memory, Microprocessor Architecture and Microcomputing system, Microprocessor architecture and its operations, memory, input output (I/O) device, example of Microcomputer system

8085 Microprocessor Architecture and Memory interfacing the 8085 MPU: block diagram of 8085, Example of an 8085 based Microcomputer, memory interfacing, Illustrative examples, Programming model of 8085 Concept of Interrupts, 8085 interrupts, serial I/O basics.

8085 Instruction Set: types of instructions, Data Transfer, Arithmetic, Logical, Branch control, machine control instructions, Addressing modes: register, immediate, register indirect, implicit etc of instructions, Timing diagram of instructions

Assembly Language Programming: Assembly language Programming; programming using 8085 instructions simple programs, programs using conditions, using loops. Program to transfer data, array sorting, simple subroutines

Introduction to embedded System: role of Microcontroller, architecture of Microcontroller, components of Microcontroller and embedded system, 8051 microcontroller architecture, memory organization, Comparison of Microprocessors and Microcontrollers.

Text Books:

1. Microprocessor, Architecture, Programming and Applications with 8085, Ramesh S. Gaonkar,5th edition, Penram International Publication,2004.
2. The 8051 microcontroller, Kenneth Ayala,3rd edition, Delmar Cengage Learning,2005.

Reference Books:

1. 0000 to 8085 – Introduction to Microprocessor for Engineers and Scientists, P. R. Sridharand P. K.

Ghosh, 2nd edition, Prentice Hall India Ltd,2005.
2. Introduction to Microprocessor, Aditya P. Mathur,3rd edition, Tata McGraw-Hill,2004.
3. Advanced microprocessors and Peripherals, A. K. Ray and K. M. Bhurchandi, 2nd edition, Tata Mc Graw Hill, 2008
4. 8051 Microcontroller and Embedded System, Muhammad Ali Mazidi, 2nd edition, Prentice Hall,2000

Web Resources:

1. NPTEL course on Electrical Engineering - NOC:Microprocessors And Microcontrollers
   https://archive.nptel.ac.in/courses/108/105/108105102/#
   Prof. Santanu Chattopadhyay, Department of Electronics and Electrical Communication Engineering I IT Kharagpur week 1-6

Course Outcomes: On completion of the course, students will be able to

ET1516.1 Understand need of Microprocessor, Know various components of Microprocessor base system

ET1516.2 Realize working of various components of Microprocessor 8085

ET1516.3 Recognize the power of 8085 instruction set for programming

ET1516.4 Verify your logic with 8085 programs

ET1516.5 Understand basics of embedded systems

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ET1516.1	0	0	1	0	0	0	0	0	0	0	0	0
ET1516.2	1	1	1	0	0	0	0	0	0	0	0	0
ET1516.3	1	1	1	1	1	0	2	0	0	0	0	0
ET1516.4	1	2	2	2	2	0	2	0	0	0	0	0
ET1516.5	3	2	2	1	3	0	3	0	0	0	0	0

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ET1516.1	0	0	1	0	0	0	0	0	0	0	0
ET1516.2	1	1	1	0	0	0	0	0	0	0	0
ET1516.3	1	1	1	1	1	0	2	0	0	0	0
ET1516.4	1	2	2	2	2	0	2	0	0	0	0
ET1516.5	3	2	2	1	3	0	3	0	0	0	0

0-Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1501								Course category			PC
Course Name	ELECTROMAGNETIC WAVES											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 Hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To introduce students with different coordinate systems.
II. To familiarize the students with the different concepts of electrostatic, magneto-static and time varying electromagnetic fields.
III. To expose the students to the ideas of electromagnetic waves propagation in various media.
IV. To identify, formulate and solve static and dynamic electromagnetic fields and electromagnetic waves propagation problems.

Course Contents:

Electrostatics: Vector Analysis, Coulomb's law, Electric field intensity due to: Volume, Line, Surface Charge; Flux Density, Gauss's Law, Divergence Theorem, Maxwell's First Equation. Potential, potential difference, potential gradient. Current and current density, Continuity of current, Poisson's and Laplace's equation, Uniqueness Theorem.

Magnetostatics: Biot-Savart Law, Ampere's Circuital Law, Stokes's Theorem, Magnetic flux and flux density, Scalar and vector magnetic potentials, Derivation of steady magnetic field laws;

Time Varying Fields: Force on a moving charge, Dielectric and magnetic boundary conditions; Faraday's Law, Displacement Current, Maxwell's Equations, Retarded potential.

The Uniform Plane Waves: Wave propagation in free space, in a perfect dielectric, and perfect conductor, Skin Effect, Poynting Vector and Poynting Theorem. Reflection of uniform plane waves at normal and at oblique incidence angles.

Waveguides: Introduction, Wave equation in Cartesian coordinates, TE, TM modes in rectangular waveguide, Waveguide losses. Introduction to circular waveguide.

Radiation: Potential functions and EM field, Electric and magnetic fields due to oscillating dipole (Alternating Current Element), Power radiated and Radiation Resistance, Application to short antennas.
Note: The simple numerical based on the above syllabus should be covered.

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Text Books:

1. Engineering Electromagnetic, W. H. Hayt. and J. A. Buck, 7th edition, Tata McGraw Hill, 2006.

Reference Books:

1. Microwave Devices and Circuits, Samual Y. Liao, 3rd edition, Pearson, 2003.
2. Electromagnetic Waves and Radiating System, E. C. Jordan and K. C. Balamin, 2nd edition, Prentice Hall of India Private Limited, 1985.

Course Outcomes:

On completion of the course, students will be able to

ET1501.1 Understand the concept, analyze and apply the knowledge of engineering mathematics to evaluate various quantities of electrostatics.

ET1501.2 Understand the concept, analyze and apply the knowledge of engineering mathematics to evaluate various quantities of magnetostatics.

ET1501.3 Describe laws and theorems to analyze time varying EM fields.

ET1501.4 Analyze and evaluate EM wave propagation in different media

ET1501.5 Understand principle of radiation and radiation characteristics of an antenna

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1501.1	3	2	0	0	0	1	1	1	3	2	1	1	1	2	1
ET1501.2	2	3	1	1	1	2	2	0	3	2	2	2	1	2	1
ET1501.3	3	2	1	0	1	0	1	1	3	2	2	2	1	2	1
ET1501.4	3	2	2	1	0	1	1	1	3	2	1	2	2	3	1
ET1501.5	3	3	2	0	1	1	2	1	3	2	2	2	2	3	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1501.1	3	2	0	0	0	1	1	3	2	1	1	1	2	1
ET1501.2	2	3	1	1	1	2	2	3	2	2	2	1	2	1
ET1501.3	3	2	1	0	1	0	1	3	2	2	2	1	2	1
ET1501.4	3	2	2	1	0	1	1	3	2	2	1	2	3	1
ET1501.5	3	3	2	0	1	1	2	3	2	2	2	2	3	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Course Code	**ET1502**							**Course category**			**PC**
Course Name	**DIGITAL COMMUNICATION**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2.30 Hrs.	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. Understanding the key modules of digital communication systems with emphasis on digital modulation techniques.
II. To get introduced to the concept and basics of information theory. source and channel coding/decoding
III. Learn about theoretical bounds on the rates of digital communication system and represent a digital signal using several modulation methods.
IV. Draw signal space diagrams, compute spectra of modulated signals and apply redundancy for reliable communication.

Course Contents:

Pulse Modulation Techniques: Sampling theory. uniform and non-uniform quantization in pulse code modulation PCM, μ-law and A-law PCM, DPCM, DM, ADM, bandwidth requirement of PAM, PPM, PWM, PCM, TDM, FDM and CDMA.

Digital Communication System: Introduction, elements of digital communication system, importance of digital system.

Information Theory and Channel Capacity: Measure of information, encoding of the source output, Shannon's encoding algorithm. Huffman encoding algorithm, discrete communication channel and it's capacity, Shannon's theorem on channel capacity.

Baseband Data Transmission: Baseband binary PAM system, inter symbol interference, Nyquist's criteria for distortion less baseband binary transmission, correlative coding, duobinary signaling, modified duobinary technique, equalization, eye diagram, synchronization.

Digital Carrier Modulation and Demodulation Schemes: Coherent and non-coherent: binary ASK, PSK, FSK, probability of errors, comparison of digital modulation schemes, basics of DPSK and QPSK, M-ary signaling schemes and synchronization method.

Error Control Coding: Introduction. Methods, types, linear block codes, error-detecting and correcting capability, cyclic code, convolutional codes and viterbi decoding algorithm.

Spread Spectrum Techniques: Direct Sequence Spread Spectrum modulation, Frequency hop Spread Spectrum modulation - Processing gain and jamming margin.

Text Books:

1. Modern Digital and Analog Communication Systems, B. P. Lathi, 4rd edition, Oxford University press, 2009
2. Digital and Analog Communication Systems, Shanmugam, K. S., Wiley, 1979.

Reference Books:

1. Communication System, S. Haykin, 5th edition, John Wiley and sons, 2009.
2. Electronic communications, R. Dennis and J. Coolen, 4th edition, Prentice Hall
3. Communication Electronics Principles and Application, "Frenzel", Tata McGraw Hill, 3rd Edition
4. Digital Communications: Fundamentals and Applications, B. Sklar, P. K. Ray, 2nd Edition, Pearson

Course Outcomes:

On completion of the course, students will be able to

ET1502.1 Understand the principles of digital communications systems.
ET1502.2 Apply the knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise.
ET1502.3 Analyze the performance of advance modulation techniques.
ET1502.4 Explain the importance and use of channel coding in digital communication.
ET1502.5 Analyze the performance of spread spectrum communication system.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1503.1	3	1	2	0	1	0	2	0	3	2	2	2	3	2	1
ET1503.2	3	2	2	0	2	1	3	2	2	1	2	2	3	2	1
ET1503.3	2	2	2	1	2	1	2	1	2	1	1	3	3	2	1
ET1503.4	3	1	2	0	1	0	2	1	2	2	2	2	3	2	1
ET1503.5	2	2	2	1	2	1	2	1	2	1	1	1	3	2	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
ET1503.1	3	1	2	0	1	0	2	3	2	2	2	3	2	1
ET1503.2	3	2	2	0	2	1	3	2	1	2	2	3	2	1
ET1503.3	2	2	2	1	2	1	2	2	1	3	1	3	2	1
ET1504.4	3	1	2	0	1	0	2	2	2	2	2	3	2	1
ET1505.5	2	2	2	1	2	1	2	2	1	1	1	3	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	ET1503	Course category	PC
Course Name	DIGITAL SIGNAL PROCESSING		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. To strengthen ability of students to analyze discrete time signals and Discrete Time systems
II. To study implementation and applications of DSP algorithms.
III. To design digital filters and its implementation on DSP processor.
IV. To understand working of different processors and apply them in system design

Course Contents:

Transforms and Properties: Discrete Fourier transform (DFT), Properties of DFT, Discrete Time Fourier transform (DTFT) and Inverse, Fast Fourier transform (FFT) algorithms (Radix-2 and Radix-4), Applications of DFT and FFT

Digital Filter Design: Structures of FIR and IIR systems, structures of IIR and FIR systems. Introduction to digital filters, Infinite impulse response (IIR) filter design, impulse invariance, bilinear transformation, Finite impulse response (FIR) filter design using windows(rectangular, Blackman, Bartlett, Hamming) and frequency sampling method, pole zero placements.

Multirate Digital Signal Processing: Decimation and interpolation, sampling rate conversion, Polyphase filter structures, Multirate filter banks Applications of multirate signal processing: QMF, Design of phase shifters, subband coding of speech signals, Transmultiplexers.

Digital Signal Processors (DSPs) and Applications: Architecture of DSP processors, comparison of digital signal processors, Applications of DSP processors.

Textbooks:

1. **Digital Signal Processing** by Alan V. Oppenheim and Ronald W. Schafer
2. **Discrete-Time Signal Processing** by Alan V. Oppenheim and Ronald W. Schafer

Reference Books:

1. **Digital Signal Processing: A Computer-Based Approach** by Sanjit K. Mitra
2. **Fundamentals of Digital Signal Processing** by John G. Proakis and Dimitris G. Manolakis

Web Resource: NPTEL course on Digital Signal processing
https://archive.nptel.ac.in/courses/108/101/108101174/

Course Outcomes:

On completion of the course, students will be able to

ET1503.1 Analyze and apply Fourier transforms and its properties
ET1503.2 Design and implement applications of DSP algorithms
ET1503.3 Design and implement digital filters (FIR and IIR) using various techniques
ET1503.4 Understand and apply multirate signal processing concepts such as decimation, interpolation, sampling rate conversion
ET1503.5 Gain knowledge of DSP processors including their architecture, comparison, and applications in various domains

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1503.1	3	3	0	2	0	0	0	0	0	0	0	0	2	2	0
ET1503.2	3	0	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1503.3	3	3	0	2	0	0	0	0	0	0	0	0	2	3	0
ET1503.4	3	3	0	0	0	2	0	0	0	0	0	0	2	2	0
ET1503.5	3	2	0	0	2	0	0	0	0	0	0	0	2	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1503.1	3	3	0	2	0	0	0	0	0	0	0	2	2	0
ET1503.2	3	0	3	0	2	0	0	0	0	0	0	2	3	0
ET1503.3	3	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1504.4	3	3	0	0	0	2	0	0	0	0	0	2	2	0
ET1505.5	3	2	0	0	2	0	0	0	0	0	0	2	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

(An Autonomous Institute of Government of Maharashtra)

Course Code ET1504 (A) **Course category** PE

Course Name EDT WITH HDL

Teaching Scheme				Examination Scheme								
Th	Tu	Pr	Total	Theory					Practical		Total	Credits
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To designing digital circuit
II. To Study behavior and RTL modeling of digital circuits using Verilog HDL
III. To study System Task and Functions
IV. To study and understand sequential models

Course Content:

Introduction to Verilog HDL: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Programming Language Interface, Module. Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Data Types, Scalars and Vectors, Operators.

Gate Level Modeling: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tristate Gates, Array of Instances of Primitives, Design of Flip-Flops with Gate Primitives, Gate Delay, Strengths and Contention Resolution, Net Types. Modeling at Dataflow Level: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments, Assignment to Vector, Operators.

Behavioral Modeling: Introduction, Operations and Assignments, 'Initial' Construct, Always construct, Assignments with Delays, 'Wait 'Construct, Design at Behavioral Level, Blocking and Non Blocking Assignments, The 'Case' Statement, 'If' and 'if-Else' Constructs, 'Assign- De-Assign' Constructs, 'Repeat' Construct, for loop, 'The Disable' Construct, 'While Loop', Forever Loop, sequential and Parallel Blocks.

Switch Level Modeling: Basic Transistor Switches, CMOS Switches, Bidirectional Gates, Time Delays with Switch Primitives, instantiation with strengths and delays, Switch level modeling for NAND, NOR and XOR.

System Tasks, Functions and Compiler Directives: Parameters, Path Delays, Module Parameters, System Tasks and Functions, User Defined Primitives, Compiler directives. Sequential Circuit Description: Sequential Models - Feedback Model, Capacitive Model, Implicit Model.

Text Book:

1. Design Through Verilog HDL, T.R. Padmanabhan, B Bala Tripura Sundari, Wiley 2009.

Sign	Sign	Sign	Sign
Member Secretary	BoS Chairperson	Dean, Academics	Principal

2. Verilog HDL - Samir Palnitkar, 2nd Edition, Pearson Education, 2009.

Reference Book:

1. Fundamentals of Digital Logic with Verilog Design - Stephen Brown, Zvonko Vranesic, TMH, 2nd Edition.
2. Zainalabdien Navabi, Verliog Digital System Design, TMH, 2nd Edition.
3. Advanced Digital Logic Design using Verilog, State Machines & Synthesis for FPGA - Sunggu Lee, Cengage Learning, 2012.
4. Advanced Digital Design with Verilog HDL - Michel D. Ciletti, PHI, 2009.

Web Resources:

NPTEL course on Verilog: Hardware description Language
https://archive.nptel.ac.in/courses/108/103/108103179/
https://nptel.ac.in/courses/106105165

Course Outcome:

On completion of the course, students will be able to

ET1504 (A).1 Describe Verilog HDL
ET1504 (A).2 Design Digital circuits
ET1504 (A).3 Write behavior model of digital circuits
ET1504 (A).4 Write RTL models of digital circuits
ET1504 (A).5 Verify behavior and RTL models

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1504(A).1	1	1	0	0	0	0	0	1	0	1	1	0	0	0	0
ET1504(A).2	1	0	0	0	0	1	1	1	0	0	0	1	0	1	0
ET1504(A).3	1	1	0	0	0	0	0	2	0	0	0	0	2	2	1
ET1504(A).4	0	0	2	1	2	0	0	0	0	0	1	1	0	0	1
ET1504(A).5	0	0	0	0	1	1	0	1	2	2	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1504(A).1	1	1	0	0	0	0	1	0	1	0	1	0	0	0
ET1504 (A).2	1	0	0	0	0	1	1	0	0	1	0	0	1	0
ET1504 (A).3	1	1	0	0	0	0	2	0	0	0	0	2	2	1
ET1504 (A).4	0	0	2	1	2	0	0	0	0	1	1	0	0	1
ET1504 (A).5	0	0	0	0	1	1	1	2	2	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1504 (B)							Course category			PE
Course Name	ANTENNA AND WAVE PROPAGATION										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2.30 Hrs.	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. Understand the fundamental terms and concepts related to antenna.
II. Familiarize with the working principles of various types of antenna
III. Analyze various antenna parameters.
IV. Apply knowledge of antenna for wave propagation

Course Contents:

Fundamental Concepts: Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

Aperture and Reflector Antennas: Huygens Principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas.

Broadband Antennas: Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas.

Micro strip Antennas: Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, and synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

Basic Concepts of Smart Antennas: Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming. Different modes of Radio Wave propagation used in current practice.

Text Books:

1. Antennas, J. D. Kraus, McGraw Hill, 1988.
2. Antenna Theory - Analysis and Design, C. A. Balanis, John Wiley, 1982.

Reference Books:

1. Antennas and Radio Wave Propagation, R. E. Collin, McGraw Hill, 1985.
2. Antenna Engineering Handbook, R. C. Johnson and H. Jasik, McGraw Hill, 1984.
3. Micro Strip Antennas, I. J. Bahl and P. Bhartia, Artech House, 1980.
4. Electromagnetic Waves, R. K. Shevgaonkar, Tata McGraw Hill, 2005 16
5. Adaptive Antennas, R. E. Crompton, John Wiley

Course Outcomes:

On completion of the course, students will be able to

ET1504(B).1 Understand fundamental terms and concepts related to antenna.

ET1504(B).2 Understand the working principle and applications of different types of antennas

ET1504(B).3 Analyze various antenna parameters and their design

ET1504(B).4 Compare different types of antennae.

ET1504(B).5 Operate antenna design software tools and come up with the design of the antenna of required specifications.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1504(B).1	2	2	1	1	0	1	1	1	2	1	1	1	1	1	1
ET1504(B).2	3	3	2	3	1	2	2	1	2	1	1	1	3	2	1
ET1504(B).3	2	1	3	2	3	1	2	1	2	1	1	1	2	1	1
ET1504(B).4	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0
ET1504(B).5	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1504(B).1	2	2	1	1	0	1	1	2	1	1	1	1	1	1
ET1504 (B).2	3	3	2	3	1	2	2	2	1	1	1	3	2	1
ET1504 (B).3	2	1	3	2	3	1	2	2	1	1	1	2	1	1
ET1504 (B).4	0	0	0	0	0	1	0	0	1	0	0	1	0	0
ET1504 (B).5	0	0	0	0	0	1	0	0	0	0	0	0	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1504(C)						Course category		PE
Course Name	ENGINEERING TRANSFORMS								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To study various transform techniques that are essential for a student of physical sciences and engineering
II. To study and understand the Laplace transform and its standard functions
III. To study and understand Z-transforms and its standard functions
IV. To study and understand the use of Laplace transforms and Z-transforms

Course Content:

Introduction to Fourier series

Fourier Transforms: Fourier Transforms, Complex Form of Fourier Integral Formula, Fourier Integral Theorem. Properties of Fourier Transform, Fourier Sine and Cosine Transforms.

Laplace Transforms: Laplace Transform – Definition, Laplace Transform of Standard Functions, Elementary Theorems. Laplace Transform of Periodic Functions, Problems. Inverse Laplace Transforms, Standard Formulae, Basic Theorems, and Problems.

Z - Transforms: Definition, Properties, Z Transforms of Some Basic Functions, Problems. Inverse Z Transforms, Methods to Find the Inverse Z Transform, Use of Z Transforms.

Text Book:

1. Signals and Systems by Alan V. Oppenheim, Alan S. Willsky, and S. Hamid Nawab, published by Pearson.
2. The Laplace Transform: Theory and Applications by Joel L. Schiff, published by Springer.
3. Fourier Analysis and Its Applications by Gerald B. Folland, published by American Mathematical Society.

Reference Book:

1. The Z-Transform: Theory and Applications by Shankar Palaniappan, published by Wiley.
2. Laplace Transforms by Murray R. Spiegel (Schaum's Outline Series), published by McGraw-Hill Education.

Course Outcome: On completion of the course, students will be able to

ET1504(C).1 Determine the Fourier series of periodic functions for signal analysis.
ET1504(C).2 Apply Fourier transform techniques to solve engineering problems.
ET1504(C).3 Use Laplace transforms to solve differential equations, including periodic functions.

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Member Secretary	BoS Chairperson	Dean, Academics	Principal

ET1504(C).4 Compute inverse Z-transforms for discrete-time system analysis.
ET1504(C).5 Integrate Fourier, Laplace, and Z-transforms to analyze complex engineering systems.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1504(C).1	3	3	0	2	0	0	0	0	0	0	0	0	2	2	0
ET1504(C).2	3	3	0	2	0	0	0	0	0	0	0	0	2	3	0
ET1504(C).3	3	3	0	2	0	0	0	0	0	0	0	0	2	3	0
ET1504(C).4	3	3	0	2	0	0	0	0	0	0	0	0	2	3	0
ET1504(C).5	3	3	0	2	0	0	0	0	0	0	0	0	2	3	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1504(C).1	3	3	0	2	0	0	0	0	0	0	0	2	2	0
ET1504 (C).2	3	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1504 (C).3	3	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1504 (C).4	3	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1504 (C).5	3	3	0	2	0	0	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1504 (D)	Course category	PE
Course Name	FUZZY LOGIC AND NEURAL NETWORKS		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. Understand the fundamental concepts of fuzzy sets, membership functions, and fuzzy arithmetic operations.
II. Formulate fuzzy rule-based systems and analyze the characteristics and applications of Mamdani and Takagi-Sugeno fuzzy inference systems.
III. Evaluate various neural network architectures, their activation functions, and develop training methodologies, including techniques for handling overfitting.
IV. Apply fuzzy logic and neural network principles to design effective models for real-world problem-solving.

Course Contents:

Introduction to Fuzzy Logic: Concepts of fuzzy sets and membership functions, definition and types of fuzzy sets, various membership functions (triangular, trapezoidal, gaussian), and operations on fuzzy sets such as union, intersection, and complement. Fuzzy arithmetic operations, Fuzzy relations and rules, definition and types of fuzzy relations and the formulation of fuzzy rule-based systems.

Fuzzy Inference Systems: Mamdani and Takagi-Sugeno models, its characteristics and applications in real-world problems. Construction of rule bases, aggregation of fuzzy rules, and various defuzzification methods like centroid and bisector.

Introduction to Neural Networks: Single layer and multi-layer perceptrons, structure of a perceptron, activation functions (step, sigmoid, tanh, ReLU), and the architecture of multi-layer networks.

Training Neural Networks: The backpropagation algorithm, gradient descent techniques (including stochastic gradient descent and Adam), and the significance of learning rates, overfitting and regularization techniques such as L1, L2, and dropout, along with cross-validation methods.

Applications of Fuzzy Logic and Neural Networks: Practical case studies in control systems and decision-making processes, demonstrating the application of fuzzy logic and neural networks across various domains.

Text Books:

1. Fuzzy Logic with Engineering Applications by Timothy J. Ross
2. Neural Networks and Deep Learning by Charu C. Aggarwal

Reference Books:

1. Fuzzy Logic: Intelligence, Control, and Information by John Yen and Reza Langari
2. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

Web Resources:

1. **An NPTEL course on Fuzzy Sets, Logic and Systems & Applications, by Prof. Nishchal Kumar Verma, IIT Kanpur,**
   https://onlinecourses.nptel.ac.in/noc25_ee40/course

Course Outcomes:

On completion of the course, students will be able to

ET1504(D).1 Define fuzzy sets and operations, demonstrating foundational knowledge of fuzzy logic.

ET1504(D).2 Construct fuzzy rule-based systems to solve specific problems in various domains.

ET1504(D).3 Compare the Mamdani and Takagi-Sugeno models to determine the most suitable fuzzy inference approach

ET1504(D).4 Design and implement perceptrons and multi-layer networks for given datasets.

ET1504(D).5 Assess the effectiveness of fuzzy logic and neural network applications in real-world scenarios.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1504(D).1	3	2	0	2	0	0	0	0	0	0	0	0	1	2	0
ET1504(D).2	3	0	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1504(D).3	2	3	0	0	0	2	0	0	0	0	0	0	1	2	0
ET1504(D).4	3	0	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1504(D).5	0	3	0	2	0	2	0	0	0	0	0	0	1	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1504(D).1	3	2	0	2	0	0	0	0	0	0	0	1	2	0
ET1504 (D).2	3	0	3	0	2	0	0	0	0	0	0	2	3	0
ET1504 (D).3	2	3	0	0	0	2	0	0	0	0	0	1	2	0
ET1504 (D).4	3	0	3	0	2	0	0	0	0	0	0	2	3	0

ET1504 (D).5	0	3	0	2	0	2	0	0	0	0	0	1	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**ET1504(E)**	**Course category**	**PE**
Course Name	**NETWORK ANALYSIS**		

Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To understand network analysis engineering laws and theorems
II. To understand the basic concepts on RLC circuits.
III. To know the behaviour of the steady states and transient states in RLC circuits.
IV. Circuit analysis in S domain
V. To understand the two port network parameters

Course Contents:

Circuit Analysis: Node and mesh analysis

Basic Components and Electric Circuits: Nodes, Paths, Loops, and Branches, KCL, KVL, The Single-Loop Circuit, The Single-Node-Pair Circuit, Series and Parallel Connections, Voltage and Current Division, Basic Nodal and Mesh Analysis: Nodal Analysis, The Super node, Mesh Analysis, The Super mesh, Nodal vs. Mesh Analysis: A Comparison. Network theorems: superposition, Thevenin's theorem, Norton's theorem, reciprocity.

Capacitors And Inductors: Circuits with Capacitors, Duality basic RL, RC and RLC circuits, the Overdamped/ Critical Damping/ Underdamped Parallel RLC Circuit, The Source-Free Series RLC Circuit, The Complete Response of the RLC Circuit, The Lossless LC Circuit, Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits.

Sinusoidal steady state analysis: Phasors, complex power, maximum power transfer. Characteristics of Sinusoids, Forced Response to Sinusoidal Functions, The Complex Forcing Function, The Phasor, Impedance and Admittance, Nodal and Mesh Analysis, Superposition, Source Transformations and Thevenin's Theorem, Phasor Diagrams

Circuit Analysis in the S-Domain: Z(s) and Y(s), Nodal and Mesh Analysis in the s-Domain, Additional Circuit Analysis Techniques, Poles, Zeros, and Transfer Functions, Convolution, The Complex-Frequency Plane, Natural Response and the s Plane, Technique for Synthesizing the Voltage Ratio H(s) = Vout/Vin, solution of network equations using Laplace transform.

Two-Port Networks: Linear 2-port network parameters, One-Port Networks, Admittance Parameters, Some Equivalent Networks, Impedance Parameters, Hybrid Parameters, Transmission Parameters wye-delta transformation.

Text Books:

1. Networks And Systems Paperback , Choudhury D. Roy New Age 2/e
2. Engineering circuit analysis, William H. Hayt, Jr., Jack E. Kemmerly, Steven M. Durbin. By Mc GrawHill 8/e
3. Network Analysis, Revised, M. E. Van Valkenburg/T.S. Rathore, Pearson Education/e

Reference Books:

1. Theory and Problems of electric circuits 4/e Mahmood Nahvi, Joseph A. Edminister Schaum's Outline Series McGraw-Hill 4/e

Web Resources:

1. NPTEL :: Electrical Engineering - NOC:Network Analysis
   https://archive.nptel.ac.in/courses/108/105/108105159/
   Prof. Tapas Kumar Bhattacharya, Department of Electrical and Electronics Engineering
   IIT Kharagpur.

Course Outcomes:

On completion of the course, students will be able to

ET1504(E).1 To appreciate network analysis engineering laws and theorems
ET1504(E).2 To recognize the basic concepts on RLC circuits.
ET1504(E).3 To analyse the behaviour of the steady states and transient states in RLC circuits.
ET1504(E).4 Perform Circuit analysis in S domain
ET1504(E).5 Appreciate working of two port network and its parameters

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1504(E).1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
ET1504(E).2	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0
ET1504(E).3	1	1	1	1	1	0	0	0	0	0	0	0	1	1	0
ET1504(E).4	1	2	1	1	2	0	0	0	0	0	0	0	2	2	0
ET1504(E).5	3	2	2	2	2	0	0	0	0	0	0	0	3	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2015 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1504(E).1	0	0	0	0	0	0	0	0	0	0	0	1	1	0
ET1504 (E).2	0	1	0	0	0	0	0	0	0	0	0	1	1	0
ET1504 (E).3	1	1	1	1	1	0	0	0	0	0	0	1	1	0
ET1504 (E).4	1	2	1	1	2	0	0	0	0	0	0	2	2	0
ET1504 (E).5	3	2	2	2	2	0	0	0	0	0	0	3	2	0

Sign
Member Secretary

Sign
BoS Chairperson

Sign
Dean, Academics

Sign
Principal

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**ET1505**	**Course category**	**PC**
Course Name	**DIGITAL COMMUNICATION LAB**		

Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	00	---	25	25	50	01

Course Objectives: Students undergoing this course are expected to

I. Acquire practical knowledge of digital communication systems, integrating theoretical concepts with hands-on experiments, including modulation techniques such as ASK, FSK, and PSK.
II. Identify and measure factors that affect communication systems, developing skills to analyze and mitigate these issues.
III. Design and implement various digital modulation and demodulation techniques, enhancing proficiency in modern digital communication systems.

Minimum eight experiments shall be performed to achieve course outcomes.
It is a representative list of practical/exercises. The Course Teacher may choose experiments to fulfill the course outcomes.

List of Experiments:

1. Verify sampling theorem
2. Verify different pulse modulation techniques
3. Verify time division multiplexing and de-multiplexing
4. Analyze pulse code modulation (PCM) for uniform and non-uniform quantization
5. Measure signal to noise ratio for pulse code modulation (PCM) system with uniform quantization
6. Compare delta modulation and adaptive delta modulation systems.
7. Generate phase shift keying and its spectral analysis
8. Spectral analysis of line codes
9. Generation and detection of direct spread spectrum (DS-SS) binary shift keying (BPSK)

10. Simulation of any digital communication system using MATLAB
11. Implementing Convolution Encoder/Decoder using MATLAB.
12. Implementing Viterbi Algorithm using MATLAB.

Note:

ICA: The Internal Continuous Assessment shall be based on practical record and knowledge/skills acquired. The performance shall be assessed experiment wise by using continuous assessment formats, A&B

ESE: The end semester Exam for practical may/shall be based on performance in one of the experiments and may be followed by sample questions.

Course Outcomes:

On completion of the course, students will be able to

ET1505.1 Design and implement different modulation and demodulation techniques.

ET1505.2 Analyze digital modulation techniques by using MATLAB tools

ET1505.3 Identify and describe different techniques in modem digital communications, in particular in source coding using MATLAB tools.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1505.1	3	2	2	0	2	0	3	2	2	1	2	3	3	2	1
ET1505.2	2	2	2	1	2	0	2	1	2	1	1	3	3	2	1
ET1505.3	3	1	2	0	1	0	2	1	2	2	2	2	3	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1505.1	3	2	2	0	2	0	3	2	1	3	2	3	2	1
ET1505.2	2	2	2	1	2	0	2	2	1	3	1	3	2	1
ET1505.3	3	1	2	0	1	0	2	2	2	2	2	3	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

(An Autonomous Institute of Government of Maharashtra)

Course Code	ET1506	Course category	VSE
Course Name	DIGITAL SIGNAL PROCESSING LAB		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	00	---	25	25	50	01

Course Objectives: Students undergoing this course are expected to

I. To provide hands-on experience in implementing and analyzing digital signal processing algorithms.
II. To develop practical skills in using software tools for DSP design and simulation.
III. To gain insights into real-world applications of DSP principles.

Minimum eight experiments shall be performed to achieve course outcomes.
It is a representative list of practical/exercises. The Course Teacher may choose experiments to fulfill the course outcomes.

List of Experiments:

1. To study DFT and its properties.
2. To study convolution sum/correlation using DFT properties
3. Design and implement FIR filters using windowing methods (e.g., rectangular, Hamming, Hanning).
4. Design and implement IIR filters (Butterworth and Chebyshev Approximation).
5. Analyze the frequency response and impulse response of designed filters.
6. To study decimation and interpolation filters.
7. Analyze the effects of decimation and interpolation on the signal spectrum.
8. Experiment with polyphase filter structures for efficient multirate implementation.
9. Develop and execute simple DSP algorithms on a dedicated DSP processor.
10. To study interfacing of the DSP processor.

Course Outcomes:

On completion of the course, students will be able to

ET1506.1 Implement and analyze various digital signal processing algorithms using software tools.
ET1506.2 Design and implement digital filters (FIR and IIR) for specific applications.
ET1506.3 Analyze the performance of DSP systems and optimize their parameters.

Sign	Sign	Sign	Sign
Member Secretary	BoS Chairperson	Dean, Academics	Principal

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1506.1	3	3	0	0	2	0	0	0	0	0	0	0	2	3	0
ET1506.2	3	0	3	2	0	0	0	0	0	0	0	0	2	3	0
ET1506.3	3	3	0	0	0	2	0	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1506.1	3	3	0	0	2	0	0	0	0	0	0	2	3	0	3
ET1506.2	3	0	3	2	0	0	0	0	0	0	0	2	3	0	3
ET1506.3	3	3	0	0	0	2	0	0	0	0	0	2	3	0	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Member Secretary

Sign
BoS Chairperson

Sign
Dean, Academics

Sign
Principal

Course Code	ET1507	Course category	PE
Course Name	LABORATORY 1		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	00	---	50	00	50	01

Minimum eight experiments shall be performed to achieve course outcomes.
It is a representative list of practical/exercises. The Course Teacher may choose experiments to fulfill the course outcomes.

List of Experiments:

1. Model AND, OR, XOR, NAND, NOR gates, and simulate their behaviour using Verilog HDL.
2. Design a half adder and full adder using Verilog HDL and verify their functionality using test benches.
3. Implement a 2-to-1, 4-to-1, and 8-to-1 MUX and simulate their operation using Verilog HDL.
4. Measure and plot the radiation patterns of simple antennas (like dipoles) and analyze the angular distribution of radiated power.
5. Perform measurements of the electric and magnetic fields at different distances from an antenna and distinguish between near and far-field regions.
6. Measure the transmission and reception characteristics of an antenna and verify that the transmission and reception patterns are identical, demonstrating reciprocity.
7. Measure the power radiated by a dipole antenna and calculate its directivity and gain. Compare the theoretical and measured values.
8. Simulate various types of fuzzy sets (triangular, trapezoidal, Gaussian) and observe how different membership functions behave.
9. Implement and simulate the union, intersection, and complement of fuzzy sets.
   Visualize the fuzzy sets before and after each operation.
10. Simulate fuzzy arithmetic using various membership functions and observe the results.
11. Test how fuzzy arithmetic works with different fuzzy values and discuss the results.
12. Simulating and observing the relationship between voltage, current, and resistance in a simple series or parallel circuit.
13. Analyzing the voltage drop and current in a simple circuit with resistors connected in series. The total resistance is the sum of individual resistances.
14. Simulating a closed loop circuit with voltage sources and resistors to verify KVL (the sum of voltages around a closed loop is zero).
15. Analyzing a node where multiple currents meet to verify KCL (the sum of currents entering a node equals the sum of currents leaving the node).

Course Outcomes:

On completion of the course, students will be able to

ET1507.1 Implement and verify combinational and sequential circuits using HDL tools.
ET1507.2 Analyze radiation patterns, impedance, and gain of antennas through simulations and experiments.
ET1507.3 Develop fuzzy logic controllers and neural networks for classification and decision-making.

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1507.1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
ET1507.2	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0
ET1507.3	1	1	1	1	1	0	0	0	0	0	0	0	1	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1507.1	0	0	0	0	0	0	0	0	0	0	0	1	1	0
ET1507.2	0	1	0	0	0	0	0	0	0	0	0	1	1	0
ET1507.3	1	1	1	1	1	0	0	0	0	0	0	1	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

PROGRAM ELECTIVES HONOR'S COURSES

Course Code	ET1521	Course category	PEH
Course Name	DSP ARCHITECTURE		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. To design custom architectures than general purpose computing architectures.
II. To study mapping and custom resource shared architectures.
III. To synthase and schedule using high level synthesis tools.
IV. To analyzing and improving the resulting architectures.

Course Content

Introduction to signal processing: Objectives and Pre-requisites, Review of digital logic, Timing and Power in digital circuits, Implementation Costs and Metrics, Example: Audio processing, Example: AlexNet, Architecture cost components, Examples of Architectures, Multi-objective Optimization, Number representation, Scientific notation and Floating point. Basic FIR filter, Serial FIR filter architectures, Simple programmable architecture, Block diagrams and SFGs, Dataflow Graphs, Iteration period, FIR filter iteration period, IIR filter iteration period,

Retiming basic concept, Example and uses of retiming, Resource sharing: adder example, Changing iteration period, Hardware assumptions and constraint analysis, Mathematical formulation, Examples with formulation, Example: Biquad filter, Hardware architecture, Review biquad folding sets, Complete biquad hardware, FFT in Vivado HLS, FFT synthesis,

Analyze FFT implementation, FFT interface, Scheduling: problem formulation, Example: differential equation solver, Heuristic approaches to scheduling, Mathematical formulation, ILP formulation, List scheduling, Hardware model, Force Directed Scheduling, HLS on FFT, FFT Simulation and Optimization,

FFT on FPGA board, Simulating SoC and SDK, Background: Understanding ELF files, On-chip communication basics, Many-to-Many communication, AXI bus handshaking, Microblaze processor on FPGA, Performance counter AXI peripheral, HW accelerator for FPGA, DMA and arbitration, Network-on-chip basics, NoC: topologies and metrics, routing, switching and flow control, Systolic Arrays.

Text Book:

1. VLSI Digital Signal Processing, K. K. Parhi, Wiley 1999
2. DSP Integrated Circuits, L. Wanhammar, Academic Press, 1999
3. Digital Signal Processing, Avatar Singh and S. Srinivasan, Thomson Learning, 2004

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Reference Book:

1. Proakis, John G., Digital signal processing: principles algorithms and applications, PHI.
2. Oppenheim, Alan V – Discrete-time signal processing, Pearson Education India.
3. Vaidyanathan, Parishwad P - Multirate systems and filter banks, Pearson Education India.
4. Vaidyanathan, Palghat P- The theory of linear prediction, Morgan and Claypool Publishers.
5. Haykin, Simon S. - Adaptive filter theory, Pearson Education India.
6. "Architectures for Digital Signal Processing", Peter Pirsch John Weily, 2008.

Web Resources:

NOC | Mapping Signal Processing Algorithms to Architectures (nptel.ac.in)
https://swayam.gov.in/nd1_noc19_ee70

Course Outcome:

On completion of the course, students will be able to

ET1521.1 Comprehend the knowledge and concepts of digital signal processing techniques.
ET1521.2 Apply the knowledge of DSP computational building blocks to achieve speed in DSP architecture or processor.
ET1521.3 Design mapping and custom resource shared architectures.
ET1521.4 Synthase and schedule using high level synthesis tools.
ET1521.5 Analyzing and improving the resulting architectures.

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1521.1	3	2	0	2	0	0	0	0	0	0	0	0	2	2	0
ET1521.2	3	0	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1521.3	3	0	3	2	0	0	0	0	0	0	0	0	2	3	0
ET1521.4	3	0	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1521.5	0	3	0	2	0	2	0	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1521.1	3	2	0	2	0	0	0	0	0	0	0	2	2	0
ET1521.2	3	0	3	0	2	0	0	0	0	0	0	2	3	0

ET1521.3	3	0	3	2	0	0	0	0	0	0	0	2	3	0
ET1521.4	3	0	3	0	2	0	0	0	0	0	0	2	3	0
ET1521.5	0	3	0	2	0	2	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**ET1522**							**Course category**			**PEH**
Course Name	**DIGITAL IMAGE AND VIDEO PROCESSING**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. To understand the basic fundamentals of digital image processing and Image Transforms.
II. To Master the Image Processing Techniques in Spatial Domain and Frequency Domain.
III. To learn the fundamentals of various Image restoration models.
IV. To understand the Basic Steps of Video Processing.
V. To learn the Mathematical and computational skills needed to understand the principal of 2-DMotion Estimation

Course Content

Fundamentals of Image Processing and Image Transforms: Digital Image fundamentals, Sampling and quantization of an Image, Relationship between pixels. Image Transforms: 2-D Discrete Fourier Transform, Properties, Discrete cosine Transform, Hadamard Transform.

Image Processing Techniques: Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial filtering, smoothing spatial filters, Sharpening Spatial filters.

Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening. Image Restoration: Degradation Model, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration. Image segmentation, Morphological image processing, object representation, description and recognition.

Basic steps of Video Processing: Analog video, Digital video, Time varying image formation model, Geometric image formation, formation, sampling of video signal and video sampling rate conversion.

Fourier Analysis of Video Signals and Frequency Response of the Human Visual System: Multidimensional Continuous-Space and Discrete Signals and Systems, Frequency Domain Characterization of Video Signals, Frequency Response of the Human Visual System.

Video Modeling: Camera model, Object model, Scene model, 2-D motion models.
2-D Motion Estimation Optical flow, Pixel based motion estimation, Region based Motion estimation, Multi resolution motion estimation, Application of motion estimation in video coding, Waveform-Based Video Coding, Video Compression Standards.

Text Books:

1. Digital Image Processing by Rafael C Gonzalez & Richard E Woods, 3rd Edition
2. Multimedia Communication Technology, J. R. Ohm, Springer Publication.

Reference Books:

1. Fundamentals of Digital Image Processing by Anil K Jain
2. Digital Image Processing by William K Pratt
3. Video Coding for Mobile Communications, David Bull et al, Academic Press.
4. Handbook on Image and Video Processing, A. I. Bovik, Academic Press.
5. Digital Video, Tekalp, Prentice Hall.

Web Resources:

https://onlinecourses.nptel.ac.in/noc22_ee116/preview
https://archive.nptel.ac.in/courses/117/104/117104020/#

Course Outcome:

On completion of the course, students will be able to

ET1522. 1 Understand the basic fundamentals of digital image processing and Image Transforms.
ET1522. 2 Master the Image Processing Techniques in Spatial Domain and Frequency Domain.
ET1522. 3 Learn the fundamentals of various Image compression models.
ET1522. 4 Understand the Basic Steps of Video Processing.
ET1522. 5 Learn the Mathematical and computational skills needed to understand the principle of 2-D Motion Estimation

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1522.1	3	2	0	2	0	0	0	0	0	0	0	0	2	2	0
ET1522.2	3	0	3	2	0	0	0	0	0	0	0	0	2	3	0
ET1522.3	3	3	0	2	0	0	0	0	0	0	0	0	2	3	0
ET1522.4	3	3	0	0	2	0	0	0	0	0	0	0	2	2	0
ET1522.5	3	3	0	2	0	0	0	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1522.1	3	2	0	2	0	0	0	0	0	0	0	2	2	0
ET1522.2	3	0	3	2	0	0	0	0	0	0	0	2	3	0

ET1522.3	3	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1522.4	3	3	0	0	2	0	0	0	0	0	0	2	2	0
ET1522.5	3	3	0	2	0	0	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1531	Course category	PEH
Course Name	ARTIFICIAL INTELLIGENCE		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. To acquire the basic concepts of AI
II. To Formulate Problems and Evaluation of Uniformed and Informed Search Strategies
III. To understand the various searching techniques, constraint satisfaction problem and example Problems game playing techniques.
IV. To make aware about knowledge-based systems and Predicate Logic

Course Contents:

Introduction to Artificial Intelligence: The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Risks and Benefits of AI, Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Problem Solving & Search Strategies: Problems, Problem Space and Search: Production Systems, Problem Characteristics, Production System Characteristics, Issues in the Design of Search Programs. Problem trees and graphs. Uninformed Search Strategies: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening Depth First Search, Bidirectional Search.

Informed Search Strategies: Generate-and-Test, Hill Climbing, Best-first Search, A* Algorithm, Problem Reduction, AND-OR Graphs, The AO* Algorithm, Minmax Algorithm. Constraint Satisfaction, Means ends Analysis.

Knowledge Representation using Predicate Logic: Knowledge Representation and approaches, representing simple facts in logic, augmenting the representation, resolution, conversion to clause form, Resolution in Propositional Logic and Predicate Logic, Unification Algorithms, Question Answering and Natural Deduction

Symbolic Reason under Uncertainty: Introduction to Non-Monotonic Reasoning, Logics for Non-Monotonic Reasoning, Semantic Nets, Statistical Reasoning, Statistical Reasoning: Probability and Bayes' theorem, Bayesian Networks.

Text Books:

1. Artificial Intelligence ,Elaine Rich, Kevin Knight, Nair (Third Edition) [Mc Graw Hill]
2. Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig (Pearson - 4th Ed.)

3. Artificial Intelligence, Patrick Henry Winston, Third Edition, Addison-Wesley Publishing Company, 2004.
4. Principles of Artificial Intelligence, Nils J Nilsson, Springer Heidelberg, 2014.

Reference Books:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 3rd Edition, PHI2009.
2. Quest for Artificial Intelligence, Nils J. Nilsson, First Edition, Cambridge University Press, 2010.
3. Introduction to Artificial Intelligence and expert system ,Dan W. Patterson
4. Introduction to Artificial Intelligence , Rajendra Akerkar
5. A First Course in Artificial Intelligence, Deepak Khemani (Tata McGraw Hill 1st Ed.)
6. Artificial Intelligence and Expert Systems by Patterson (PHI)
7. Principles of Artificial Intelligence and Expert Systems, Rolston McGraw Hill.

Web Resources:

Fundamentals Of Artificial Intelligence: https://onlinecourses.nptel.ac.in/noc21_ge20/preview

Course Outcome:

On completion of the course, students will be able to

ET1531.1 Explain concepts of Artificial Intelligence and different types of intelligent agents and their architecture.

ET1531.2 Evaluate different informed and uninformed search algorithms on well formulate problems along with stating valid conclusions that the evaluation supports.

ET1531.3 Formulate and solve given problem using Propositional and first order logic.

ET1531.4 Apply reasoning for non-monotonic AI problems.

ET1531.5 Have a basic understanding of some of the more advanced topics of AI such as learning, Understanding, Natural Language Processing.

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1531.1	3	2	0	2	1	0	0	0	0	0	0	0	1	2	0
ET1531.2	3	3	0	2	0	1	0	0	0	0	0	0	1	3	0
ET1531.3	3	3	0	2	0	1	0	0	0	0	0	0	1	3	0
ET1531.4	3	3	0	2	0	1	0	0	0	0	0	0	1	3	0
ET1531.5	3	2	0	2	1	0	0	0	0	0	0	0	1	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1531.1	3	2	0	2	1	0	0	0	0	0	0	1	2	0
ET1531.2	3	3	0	2	0	1	0	0	0	0	0	1	3	0
ET1531.3	3	3	0	2	0	1	0	0	0	0	0	1	3	0

Course Code	ET1532	Course category	PEH
Course Name	INTRODUCTION TO SOFT COMPUTING AND MACHINE LEARNING		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

ET1531.4	3	3	0	2	0	1	0	0	0	0	0	1	3	0
ET1531.5	3	2	0	2	1	0	0	0	0	0	0	1	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Objectives: Students undergoing this course are expected to

I. Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
II. Introduce students to Genetic algorithms and traditional optimization method.
III. Introduce students to artificial neural networks and fuzzy theory from an engineering perspective
IV. Discuss the applications of Fuzzy logic and neural network

Course Content

Introduction to Soft Computing and Fuzzy logic: Fuzzy membership functions, Operations on Fuzzy sets Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences, Defuzzyfication Techniques-I, Defuzzyfication Techniques-II, Fuzzy logic controller-
I, Fuzzy logic Controller -II

Derivative free Optimization Genetic algorithms: Basic concepts, encoding, fitness function, and reproduction. Differences of GA and traditional optimization methods. Basic genetic programming concept Applications.

Introduction to EC-I, Introduction to EC-II, MOEA Approaches: Non-Pareto, MOEA Approaches: Pareto-I MOEA Approaches: Pareto-II, Introduction to ANN, ANN Architecture ANN Training-I, ANN Training-II, ANN Training-III, Applications of ANN

Neural networks: Single layer networks, Perceptrons: Adaline, Mutilayer Perceptrons Supervised Learning, Back-propagation, LM Method, Radial Basis Function Networks, Unsupervised Learning Neural Networks, Competitive Learning Networks, Kohonen Self-

Organizing Networks, Learning Vector Quantization, Hebbian Learning. Recurrent neural networks, Adaptive neuro-fuzzy information; systems (ANFIS), Hybrid Learning Algorithm, Applications to control and pattern recognition.

Text Book:

1. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
2. Neural Networks and Learning Machines Simon Haykin (PHI)
3. Neuro-Fuzzy and Soft Computing, J. S. R. Jang, C. T. Sun and E. Mizutani, PHI, 2004, Pearson Education 2004.
4. Fuzzy Logic with Engineering Applications, Timothy J. Ross, McGraw-Hill, International

Editions, Electrical Engineering Series, Singapore, 1997.

Reference Book:

1. An Introduction to Genetic Algorithm, Melanic Mitchell (MIT Press)
2. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)
3. Neural Network fundamental with Graph, Algorithms & Applications, N. K. Bose, Ping Liang, TMH, 1st Edition, 1998.
4. Neural Network & Fuzzy System, Bart Kosko,PHI Publication, 1st Edition, 2009. 3. Rich E, Knight K, Artificial Intelligence, TMH, 3rd Edition, 2012.
5. Fuzzy sets & Fuzzy Logic, Theory & Applications, George J Klir, Bo Yuan, PHI Publication, 1st Edition, 2009.
6. Neural Network Design, Martin T Hagen, Nelson Candad, 2nd Edition, 2008.

Web Resources:

a. Introduction to Soft Computing: https://onlinecourses.nptel.ac.in/noc22_cs54/preview
b. Introduction to Machine Learning:
https://onlinecourses.nptel.ac.in/noc24_cs51/preview

Course Outcome:

On completion of the course, students will be able to

ET1532.1 Learn about soft computing techniques and their applications
ET1532.2 Analyze various neural network architectures
ET1532.3 Understand perceptrons and counter propagation networks.
ET1532.4 Define the fuzzy systems
ET1532.5 Analyze the genetic algorithms and their applications.

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1532.1	3	3	0	2	0	0	0	0	0	0	0	0	2	2	0
ET1532.2	3	3	0	2	0	0	0	0	0	0	0	0	2	3	0
ET1532.3	3	3	0	2	0	1	0	0	0	0	0	0	2	3	0
ET1532.4	3	3	0	2	1	0	0	0	0	0	0	0	2	3	0
ET1532.5	3	3	1	2	0	1	0	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1532.1	3	3	0	2	0	0	0	0	0	0	0	2	2	0
ET1532.2	3	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1532.3	3	3	0	2	0	1	0	0	0	0	0	2	3	0
ET1532.4	3	3	0	2	1	0	0	0	0	0	0	2	3	0
ET1532.5	3	3	1	2	0	1	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**EE1551**	**Course Category**	**PER**
Course Name	**RESEARCH PROJECT STAGE – I**		

Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
00	00	08	08	00	00	00	00	--	100	00	100	04

Course Objectives: Students undergoing this course are expected to

I. Gain domain specific knowledge by completing the specific course
II. Collecting information on novel and latest development in the specific area of the Electronics and Telecommunication Engineering.
III. Formulating specific problem statement and design a suitable solution methodology for the problem
IV. Develop project management and teamwork skills by planning, executing, and presenting research findings effectively.

Course Contents:

At the beginning of V- semester, just before the commencement of classes, eligible students can register for the B. Tech. with Honours in Research. The research topic/area selected should have relevance to social needs of society and needs of the industry.
Registered Student will have to discuss with his/her respective guide about the specific area for carrying out the research work. He/she will have to complete the theory courses through online platform such as MOOCs, NPTEL etc. as prescribed by the guide/supervisor. Student will have to

(i) Formulate the specific problem statement,
(ii) Carry out the research literature survey for acquiring in depth knowledge in the chosen

domain.

(ii) Design a suitable solution methodology for the problem,

(iv) Share the details of literature survey, hypothesis, etc. with the guide.

Student will be required to deliver the seminar on the literature survey and proposed research topic at the end of V-semester.

Internal Continuous Assessment (ICA): Student will be required to deliver a seminar based on the work carried out. The ICA includes the assessment on the basis of seminar to be evaluated by the three-member committee constituted by the Head of Department.

Course Outcomes:

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

ET1551.1 Plan an investigative research problem

ET1551.2 Apply the in-depth knowledge gained in the domain area such as existing methods and their limitations, etc. through literature survey and course attended.

ET1551.3 Formulate suitable solution methodology for the research problem

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1551.1	2	3	3	0	0	0	0	0	0	0	2	0	0	2	0
ET1551.2	2	0	0	2	3	0	0	0	3	0	0	2	0	0	0
ET1551.3	3	0	3	3	0	2	2	0	0	0	0	0	0	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1551.1	2	3	3	0	0	0	0	0	0	0	2	0	2	0
ET1551.2	2	0	0	2	3	0	0	3	0	2	0	0	0	0
ET1551.3	3	0	3	3	0	2	2	0	0	0	0	0	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

(An Autonomous Institute of Government of Maharashtra)

MINOR COURSES FOR DOUBLE MINOR

Course Code	ET1541								Course category			MN
Course Name	EMBEDDED SYSTEM DESIGN WITH ARM											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. To study the concept of Embedded System Design.
II. To study architecture and inbuilt peripherals of ARM Microcontroller.
III. To recognize the importance task scheduling in real time embedded systems.
IV. To understand the developmental aspects of Internet of Things (IoT) based designs.

Course Contents:

Introduction to embedded systems and microcontrollers: Building blocks of Embedded systems: Core of the Embedded system, Memory Devices, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System components, Characteristics of Embedded systems, Quality attributes of Embedded System.

Introduction to ARM Microcontroller: ARM microcontroller, History, Features and ARM family and its inbuilt Peripherals, Instruction set architecture of ARM microcontroller, and assembly language programming.

ARM Application and Programming: D/A and A/D converter, sensors, actuators and their interfacing Microcontroller development boards and embedded programming platforms

Features of ARM Microcontroller: Temperature sensing unit, Light sensing unit, Sound sensing unit, Feedback control system, relay control unit, driving electrical appliances like motors, bulb, pump, etc.

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Principal

Introduction to IoT: Introduction to Internet of Things, smart home concepts, motion sensing using accelerometer, control of appliances over SMS

Text Book:

1. Embedded System Design: A Unified Hardware/Software Introduction, F. Vahid and T. Givargis, Wiley India Pvt. Ltd., 2002.
2. Introduction to Embedded System, Shibu K. V, McGraw Hill Education

Reference Book:

1. ARM System Developer's Guide: Design and Optimizing System Software, A.N. Sloss, D. Symes and C. Wright, Morgan Kaufman Publishers, 2004.
2. Computers as Components: Principles of Embedded Computing System Design, W. Wolf, Morgan Kaufman Publishers, 2008.

Web Resources:

http//Embedded System Design With ARM - Course

Course Outcome:

On completion of the course, students will be able to

ET1541.1 Recognize the concept of Embedded Systems.
ET1541.2 Articulate the architecture and inbuilt peripherals of ARM Microcontroller.
ET1541.3 Evaluate the programming of AVR Microcontroller in C.
ET1541.4 Compare task, process & threads in Real Time Embedded System.
ET1541.5 Access Internet of Things with Embedded Entities.

CO-PO-PSO Mapping as per NBA Jan -2016 Format:

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1541.1	0	0	1	1	0	0	0	2	1	0	0	1	0	0	0
ET1541.2	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0
ET1541.3	1	0	0	0	0	1	0	1	0	0	0	1	0	1	1
ET1541.4	0	0	0	0	0	0	0	1	1	2	0	1	0	0	2
ET1541.5	0	0	0	0	2	1	1	1	0	0	0	0	0	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1541.1	0	0	1	1	0	0	2	1	0	1	0	0	0	0
ET1541.2	1	0	0	0	1	0	1	0	0	0	1	0	0	0
ET1541.3	1	0	0	0	0	1	1	0	0	1	0	0	1	1

ET1541.4	0	0	0	0	0	0	1	1	2	1	0	0	0	2
ET1541.5	0	0	0	0	2	1	1	0	0	0	0	0	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

(An Autonomous Institute of Government of Maharashtra)

Course Code	**ET1542**	**Course category**	**MN**
Course Name	**EMBEDDED SYSTEM INTERFACING**		

Teaching Scheme				**Examination Scheme**								**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. To understand core of the Embedded System
II. To develop practical technical skills among the students to integrate various sensing, actuation units
III. To recognize the importance task scheduling in real time embedded systems.
IV. To get acquainted with architecture & design of an Embedded System.

Course Content

Introduction: Overview of embedded system; Importance of sensors, actuators and interfacing circuits in embedded control system; Characteristics; Applications. Embedded Sensors and Actuators**:**
Various types of important sensors, actuators and their working principles: e.g. thermal, mechanical, electrical, magnetic, optical, chemical, smart material and meta material based.

Interfacing Aspects of Sensors and Actuators to Embedded Controller and their Communication Protocols: Signal conditioning circuits; Various Op-Amp based interfacing circuit implementation: Amplifier, Filter, ADC, DAC etc.; Various Serial Communication protocols for interfacing.

Advancement in Interfacing Schemes of Resistive Sensors for Linearity Improvement and Error Reduction: Resistive sensor examples; non-idealities in basic interfacing circuits; Linearization techniques; Error reduction schemes due to environmental effects and remote communication.

Advanced Techniques for Direct Interfacing of Resistive Sensors with Embedded controller:
Embedded controller-based excitation system; Direct interfacing schemes of various resistive sensors topologies (e.g., single, differential and bridge type) to microcontrollers; Interfacing scheme for sensor array.

Advanced Techniques for Direct Interfacing of Capacitive Sensors with Embedded Controller:
Capacitive sensor examples; Interfacing scheme for different capacitive sensor configurations; Direct interfacing schemes. Advancement in Design of Interfacing Circuits for Lossy Capacitive Sensors; Lossy Capacitive sensor characteristics; Various advanced interfacing schemes for lossy capacitive sensor.

Sign	Sign	Sign	Sign
Member Secretary	BoS Chairperson	Dean, Academics	Principal

Miniaturization Technology for Smart Sensors and Actuators: Background of miniaturization; Miniaturized device fabrication process technology for Smart sensors and actuators. Miniaturized Sensors, Actuators and their Interfacing Electronics**:** Various types of important MEMS sensors and actuators: Design and operation; Interfacing Electronics for MEMS Devices; System-on-Chip integration; Application.

Text Book:

1. Sensors, Actuators, and their Interfaces, Nathan Ida,1st ed., SciTech Publishing, 2014.
2. Analog Interfacing to Embedded Microprocessor Systems, Stuart R. Ball, Elsevier, 2004.
3.Advanced Interfacing Techniques for Sensors, B. George, J. Roy, V. Jagadeesh Kumar, S. C. Mukhopadhyay, 1st ed., Springer, 2017

Reference Book:

1.Sensors and Signal Conditioning, John G. Webster and Ramón Pallás-Areny, John Wiley & Sons, 2nd ed., 2000.
2. Fundamentals of Microfabrication and Nanotechnology, Marc Madou, 3rd ed., 2018.
3. Smart Sensors and MEMS, S. Nihtianov, A. Luque, 1st ed., Elsevier, 2014
4. Instrument Engineers Handbook, Bela G Liptak, CRC press, 4th ed., 2003.
5. Understanding Automotive Electronics: An Engineering Perspective, William B. Ribbens, Elsevier, 8th ed., 2017.

Web Resources:

https://onlinecourses.nptel.ac.in/noc24_ee68/preview

Course Outcome: On completion of the course, students will be able to

ET1542.1 Recognize the concept of Embedded Systems
ET1542.2 Summarize the quality attributes of Embedded System
ET1542.3 Perform effectively as entry level Embedded Systems professionals
ET1542.4 Interfacing Aspects of Sensors and Actuators to Embedded Controller and their Communication Protocols
ET1542.5 Direct Interfacing of Resistive Sensors and Capacitive Sensors with Embedded Controller

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1542.1	1	0	0	0	0	1	0	2	1	0	0	1	0	0	0
ET1542.2	1	0	0	0	1	0	0	1	0	0	1	0	1	0	0
ET1542.3	1	0	0	0	0	1	0	1	0	0	0	1	0	1	1
ET1542.4	0	0	0	0	0	0	0	1	1	2	0	1	1	0	2
ET1542.5	0	0	0	0	2	1	1	1	0	0	0	0	1	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
ET1542.1	1	0	0	0	0	1	2	1	0	1	0	0	0	0
ET1542.2	1	0	0	0	1	0	1	0	0	0	1	1	0	0
ET1542.3	1	0	0	0	0	1	1	0	0	1	0	0	1	1
ET1542.4	0	0	0	0	0	0	1	1	2	1	0	1	0	2
ET1542.5	0	0	0	0	2	1	1	0	0	0	0	1	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

SEMESTER VI

Course Code	ET1615	Course category	MM
Course Name	INDUSTRIAL INTERNET OF THINGS		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To provide Knowledge and Evaluation of IIoT
II. To provide students with good depth of knowledge of Implementation systems for IioT.
III. To provide knowledge of Designing Industrial IOT Systems for various application.
IV. Understand and address security challenges in IIoT implementations.

Course Contents:

Introduction to Industrial IoT (IIoT) Systems: The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories.

Implementation systems for IIoT: Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.

IIoT Data Monitoring & Control: IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.

Cyber Physical Systems: Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis

Industrial IoT- Applications: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management

Case Studies of IIoT Systems: IIoT application development with Embedded PC based development boards, Development of mini Project on new version of Operating systems and Edge development board. That project should also address to the current societal needs.

Text Book:

1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist, Publications: Apress

Reference Book:

1. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics, Bartodziej, Christoph Jan, Springer Publication
2. Embedded System: Architecture, Programming and Design, Rajkamal, TMH3.
3. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, , River Publishers

Web Resources:

https://onlinecourses.nptel.ac.in/noc20_cs69/preview
Introduction to Industry 4.0 and Industrial Internet of Things

Course Outcome:

On completion of the course, students will be able to
ET1615.1 Realize Design Flow
ET1615.2 Knowledge of theory and practice related to Industrial IoT Systems.
ET1615.3 Ability to identify, formulate and solve engineering problems by using Industrial IoT
ET1615.4 Ability to implement real field problem by gained knowledge of Industrial applications with IoT capability
ET1615.5 Analyze various case studies.

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ET1615.1	3	0	0	0	0	0	0	0	0	0	0	0
ET1615.2	0	2	0	0	0	0	0	0	0	0	0	0
ET1615.3	0	0	3	0	0	2	0	0	0	0	0	0
ET1615.4	0	0	0	2	0	0	2	0	0	0	2	0
ET1615.5	0	0	0	0	3	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ET1615.1	3	0	0	0	0	0	0	0	0	0	0
ET1615.2	0	2	0	0	0	0	0	0	0	0	0
ET1615.3	0	0	3	0	0	2	0	0	0	0	0
ET1615.4	0	0	0	2	0	0	2	0	0	0	2
ET1615.5	0	0	0	0	3	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Name	WIRELESS COMMUNICATION

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2.30 Hrs.	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To get introduced to the wireless communication systems
II. To study the multiple access techniques used in wireless communication
III. To study the various system standards used in wireless communication
IV. To study the cordless system and other wireless systems

Course Contents:

Introduction: Evolution of Wireless Communication, advantages and disadvantages, Different types of Wireless Systems, Evolution to Next-Generation Wireless Networks, and Applications.

Multiple Access Technique: Frequency division multiple access (FDMA), time division multiple access (TDMA), frequency hop multiple access (FHMA), space division multiple access (SDMA).

Wireless Systems and Standards: Global system for mobile (GSM), system architecture, radio subsystem, channel types, frame structure, signal processing in GSM, code division multiple access CDMA (IS-95), frequency and channel specifications, forward and reverse CDMA channel.

Cordless Systems and WLL: Introduction to cordless systems, cordless telephony standard (CT2) and digital enhanced cordless telecommunication (DECT): standards, architecture, frame format and radio link, operation; IEEE802.16, role of wireless local loop (WLL), propagation considerations for WLL, local multipoint distribution services (LMDS) and multichannel multipoint distribution services (MMDS).

Wireless LAN: Overview, technologies; types: infrared, spread-spectrum, narrow band microwave LAN, mobile data networks, cellular digital packet data (CDPD), global packet for radio service (GPRS), wireless application protocol (WAP), introduction to Bluetooth technology

Text Books:

1. Wireless Communications Principles and Practice, T. S. Rappaport, 2nd edition, Pearson Education, 2010
2. Wireless Communications, T. L. Singhal, 4th reprint, Tata McGraw Hill, 2012

Reference Books:

1. Mobile Cellular Telecommunications, W. C.Y. Lee, 2nd edition, MGH, 2006
2. Wireless Communications and Networks, W. Stallings, 2nd edition, Pearson Education, 2009
3. Mobile Cellular Communication, G. S. Rao, 1st edition, Pearson Education, 2013

Course Outcomes:

On completion of the course, students will be able to

ET1616.1 Understand the functioning of wireless communication systems, and their evolution

ET1616.2 Demonstrate ability to explain various multiple access techniques for Wireless communication

ET1616.3 Compare the various wireless system standards

ET1616.4 Understand cordless and wireless local loop concepts

ET1616.5 Understand the concept of different wireless networks and Bluetooth technology

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ET1616.1	2	1	1	1	2	0	0	0	0	1	0	2
ET1616.2	2	2	3	2	2	0	0	0	0	1	0	1
ET1616.3	3	3	2	3	2	0	0	0	0	1	0	1
ET1616.4	3	3	2	3	2	0	0	0	0	0	0	0
ET1616.5	3	3	2	3	2	0	0	0	0	0	0	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ET1616.1	2	1	1	1	2	0	0	0	1	2	0
ET1616.2	2	2	3	2	2	0	0	0	1	1	0
ET1616.3	3	3	2	3	2	0	0	0	1	1	0
ET1616.4	3	3	2	3	2	0	0	0	0	0	0
ET1616.5	3	3	2	3	2	0	0	0	0	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1601	Course category	PC

Course Name	EMBEDDED SYSTEM											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To introduce the Building Blocks of Embedded System
II. To Educate in Various Embedded Development Strategies
III. To Introduce Bus Communication in processors, Input/output interfacing.
IV. To impart knowledge in various processor scheduling algorithms.
V. To introduce Basics of Real time operating system and example tutorials to discuss on one real time operating system tool

Course Contents:

Introduction to Embedded system: Block diagram of embedded system, RISC, CISC processors comparison, Features of 89c51, PIC, AVR, ARM Microcontroller, Characteristics of Embedded system, Classification of embedded system

Programming using Embedded C: Embedded C programming- Arithmetic and logical operations, data transfer with memory and port, decision control and looping, Timer /counter, serial communication, Interrupt control

Communication standard Protocol: Synchronous, Asynchronous mode of communication, RS232, MAX232 serial communication Standard, communication protocol: I2C, CAN, USB, IrDA, Bluetooth, Zigbee

Interfacing IO devices & C-programming: Output devices- LED, LCD, Relays, 7 Segment Displays, Input Devices- Key, Matrix Key board, Stepper motor, ADC/DAC and sensor interfacing.

Real Time Operating System: Introduction to RTOS, Characteristics of RTOS, Functions of RTOS: Task management, scheduling, Resource allocation. Features. WatchDog timer, Semaphore, Deadlock

Test Books:

1. The 8051 Microcontroller and Embedded Systems: Using Assembly and C; Author, Mazidi Muhammad Ali; Publisher, Pearson India, 2007
2. An Embedded Software Primer by Simon David E, Adission Welsely

Reference Books:

1. Microcontroller Principal and Application: Pal, Ajit , PHI New Delhi
2. Microcontrollers: Architecture, Programming, Interfacing and System Design, Rajkmal, Perason

Web Resources:

https://onlinecourses.nptel.ac.in/noc20_ee98/preview

Course Outcome:

On completion of the course, students will be able to

ET1601.1 Acquire a basic knowledge about fundamentals of microcontrollers
ET1601.2 Acquire a basic knowledge about programming and system control to perform a specific task
ET1601.3 Acquire knowledge about devices and buses used in embedded networking
ET1601.4 Develop programming skills in embedded systems for various applications
ET1601.5 Acquire knowledge about Life cycle of embedded design and its testing.

CO-PO-PSO Mapping as per NBA Jan -2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1601.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET1601.2	0	2	0	0	0	0	0	0	0	0	0	0	2	3	0
ET1601.3	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0
ET1601.4	0	0	0	2	0	0	2	0	0	0	2	0	0	0	0
ET1601.5	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO/PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1601.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
ET1601.2	0	2	0	0	0	0	0	0	0	0	0	2	3	0
ET1601.3	0	0	3	0	0	2	0	0	0	0	0	0	0	0
ET1601.4	0	0	0	2	0	0	2	0	0	0	2	0	0	0
ET1601.5	0	0	0	0	3	0	0	0	0	0	0	0	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Sign
Dean, Academics

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Principal

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Course Code	ET1602							Course category			PC
Course Name	CMOS DESIGN										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives:

Students undergoing this course are expected

I. To learn basic CMOS circuits
II. To understand CMOS fabrication processes
III. To study and analyze different CMOS digital circuits
IV. To study and analyze different CMOS analog circuits

Course Contents:

CMOS Technology: NMOS, CMOS, BiCMOS, Introduction to CMOS Circuits, CMOS Design Introduction: Flow of circuit design, fabrication process steps, Layout Design rules

CMOS Digital circuits: Inverter, Static logic gates, Transmission Gates and Flip flops, Dynamic logic Gates, Memory circuits, Phase locked loops (PLL), Random circuits.

Circuit characterization and performance estimation: Resistance, Capacitance estimation, Switching characteristics, Interconnects, Delay models, Packaging, I/O pads.

CMOS Analog Circuits: MOS Analog models, Current sources and sinks, References, Amplifiers, Differential Amplifiers, Operational amplifiers.

CMOS Scaling: Short Channel Effects (SCEs), Power dissipation, variability, reliability. Introduction to novel FETs like FinFETS, NCFETs.

Text Books:

1. CMOS VLSI Design by N. H. E. Weste, D. Harris, Pearson(3/e) 2005
2. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill 2/e 2017

Reference Books:

1. CMOS Analog Circuit Design by Allen, Holberg, Oxford 2/e 2004

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Course Outcomes:

On completion of the course, students will be able to

ET1602.1 Know fundamental principal of CMOS circuit
ET1602.2 Realize CMOS fabrication process flow
ET1602.3 Analyze and design digital logic using CMOS circuit
ET1602.4 Analyze and design analog logic using CMOS circuit
ET1602.5 Design performance parameters related to CMOS circuit

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1602.1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0
ET1602.2	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0
ET1602.3	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0
ET1602.4	1	1	1	1	0	0	1	0	0	0	1	1	2	2	0
ET1602.5	1	1	2	2	1	0	1	0	0	0	1	1	2	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1602.1	1	1	1	1	0	0	1	0	0	1	1	1	1	0
ET1602.2	1	1	1	1	0	0	1	0	0	1	1	1	1	0
ET1602.3	1	1	1	1	0	0	1	0	0	1	1	1	1	0
ET1602.4	1	1	1	1	0	0	1	0	0	1	1	2	2	0
ET1602.5	1	1	2	2	1	0	1	0	0	1	1	2	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1603 (A)	Course category	PE
Course Name	MEMS (MICRO-ELECTRO-MECHANICAL SYSTEMS)		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To introduce the fundamentals of MEMS technology and its applications.
II. To understand the design, fabrication, and characterization of MEMS devices.
III. To explore the integration of MEMS with electronic systems.
IV. To study the materials, processes, and tools used in MEMS fabrication.

Course Content

Introduction to MEMS: Definition and history of MEMS, Applications of MEMS in various fields (automotive, biomedical, consumer electronics, aerospace, etc.), Comparison between MEMS and traditional macro-scale systems, Advantages and limitations of MEMS.

Fundamentals of MEMS: Scaling laws in MEMS, Materials used in MEMS: Silicon, polymers, metals, and ceramics, Mechanical properties of MEMS materials: Stress, strain, Young's modulus, and Poisson's ratio, Basic MEMS structures: Beams, diaphragms, and cantilevers.

MEMS Fabrication Technologies: Overview of micro fabrication techniques, Photolithography and pattern transfer, Thin-film deposition: CVD, PVD, and electroplating, Etching techniques: Wet etching and dry etching (RIE, DRIE), Bulk micromachining and surface micromachining, Wafer bonding and packaging techniques.

MEMS Sensors and Actuators: Principles of sensing and actuation, Types of MEMS sensors: Pressure sensors, accelerometers, gyroscopes, and biosensors, Types of MEMS actuators: Electrostatic, thermal, piezoelectric, and electromagnetic actuators, Case studies of MEMS devices (e.g., MEMS accelerometers in smartphones).

MEMS Design and Modelling: MEMS design process and tools (e.g., CAD tools for MEMS), Finite Element Analysis (FEA) for MEMS, Analytical modeling of MEMS devices, Simulation of MEMS behaviour using software tools (e.g., COMSOL, ANSYS).

MEMS Integration with Electronics: Integration of MEMS with ICs (CMOS-MEMS), Challenges in MEMS-IC integration, Signal conditioning and interfacing circuits for MEMS devices,System-on-Chip (SoC) and System-in-Package (SiP) approaches.

Text Books:

1. Microsystem Design, Stephen D. Senturia, Springer Publication
2. Fundamentals of Micro fabrication, Marc J. Madou, Taylor Francis
3. MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering, Tai-Ran Hsu, Wiley

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Reference Books:

1. Introduction to Microelectromechanical Systems Engineering, Nadim Maluf, Artec House
2. MEMS: Design and Fabrication, Mohamed Gad-el-Hak., CRC Press
3. MEMS Mechanical Sensors, Stephen Beeby, Artec House

Web Resources:

https://nptel.ac.in/courses/117105082

Course Outcome: On completion of the course, students will be able to

ET1603(A).1 Understand the principles and applications of MEMS technology.
ET1603(A).2 Design and analyze simple MEMS devices using analytical and simulation tools.
ET1603(A).3 Explain the fabrication processes and materials used in MEMS.
ET1603(A).4 Integrate MEMS devices with electronic systems.
ET1603(A).5 Evaluate the challenges and future trends in MEMS technology.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1603(A).1	1	0	0	0	0	1	0	0	0	0	3	0	0	0	0
ET1603(A).2	0	2	0	0	0	0	0	0	1	0	0	2	0	0	0
ET1603(A).3	0	0	1	0	0	0	0	0	0	0	0	0	3	0	2
ET1603(A).4	0	0	0	2	0	0	0	0	0	0	0	0	0	3	0
ET1603(A).5	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1603(A).1	1	0	0	0	0	1	0	0	0	0	3	0	0	0
ET1603(A).2	0	2	0	0	0	0	0	1	0	2	0	0	0	0
ET1603(A).3	0	0	1	0	0	0	0	0	0	0	0	3	0	2
ET1603(A).4	0	0	0	2	0	0	0	0	0	0	0	0	3	0
ET1603(A).5	0	0	0	3	0	0	2	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1603(B)	Course category	PE
Course Name	INFORMATION THEORY AND CODING TECHNIQUES		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2.30 Hrs.	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. Define and apply the basic concepts of information theory (entropy, channel capacity etc.)
II. Learn the principles and applications of information theory in communication systems
III. Study various data compression methods and describe the most common such methods
IV. Understand the theoretical framework upon which error-control codes are built

Course Contents:

Prerequisite for this course: ET1502 Digital Communication.

Information Theory: introduction, Uncertainty and information, Average, Mutual Information and Entropy, Information Measures for continuous random variables.

Channel capacity and coding: channel Models. Channel Capacity. Channel coding, Channel Capacity Using the Noise Matrix, Shannon Capacity, Memory Sources (Markov Sources), Finite and Homogeneous Markov Chains.

Source Coding: Types of Codes, Prefix Codes, Source Coding Theorem, Binary Codes Used in Data Transmission, Storage or computing. Coding Efficiency: Compression Ratio, Lossless Compression Algorithms, Run Length Coding (RLC), Dictionary Techniques. Lempel-Ziv Type Algorithms, Arithmetic Coding, Lossy Compression in Differential Coding.

Cryptography Basics, Cryptosystems: Role and Classification, Cryptanalytic Attacks and Algorithms Security. Modern Symmetric (Conventional) Cryptography. Block Ciphers. DES (Data Encryption Standard). Public Key Cryptography.

Error Control Coding: The Hamming Codes, Burst Error Correcting Codes: Burst Errors, Interleaved Codes, and BCH Codes.

Text Books:

1. Information Theory, Coding and Cryptography, R. Bose, Second Edition, Tata McGraw Hill, Reprint 2012.
2. Fundamentals in Information theory and coding, Monika Borada, Springer, Scientific Publishing Services Pvt. Ltd., Chennai, India.201 l.

Reference Books:

1. Fundamentals of Information Theory and Coding Design, R. Togneri, C.J.S deSilva, Taylor and Francis.20l I
2. Elements of Information Theory, T. M. Cover, J. A. Thomas, Wiley.
3. Information and Coding, N. Abramson, McGraw Hill, 1963.
4. Introduction to Information Theory, M. Mansurpur, McGraw Hill, 1987.
5. Information Theory, R.B. Ash, Prentice Hall, 1970.

Course Outcomes:

On completion of the course, students will be able to

ET1603(B).1 Quantity the notion of information in a mathematically sound way.
ET1603(B).2 Calculate entropy and channel capacity of a system.
ET1603(B).3 Differentiate between lossy and lossless compression techniques.
ET1603(B).4 understand concepts of encryption and decryption.
ET1603(B).5 Apply Error control coding techniques to data

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1603(B).1	3	2	2	1	1	2	2	1	2	2	1	2	2	2	1
ET1603(B).2	3	2	2	1	2	0	2	2	2	2	2	2	2	1	0
ET1603(B).3	2	2	1	0	1	1	2	1	2	2	2	2	2	2	1
ET1603(B).4	3	2	2	1	2	1	2	3	3	2	2	3	3	3	2
ET1603(B).5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1603(B).1	3	2	2	1	1	2	2	2	2	2	1	2	2	1
ET1603(B).2	3	2	2	1	2	0	2	2	2	2	2	2	1	0
ET1603(B).3	2	2	1	0	1	1	2	2	2	2	2	2	2	1
ET1603(B).4	3	2	2	1	2	1	3	3	2	3	2	3	3	2
ET1603(B).5	0	1	0	0	0	0	0	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	ET1603(C)	Course category	PE
Course Name	MULTIRATE DIGITAL SIGNAL PROCESSING		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To understand the fundamental concepts of multirate signal processing, including sampling rate conversion, decimation, interpolation, and filter banks.

II. To analyze and design efficient multirate systems for various applications such as audio processing, image processing, and communications.

III. To develop skills in implementing and evaluating multirate algorithms using software and hardware tools.

Course Contents:

Introduction: Review of basic digital signal processing concepts (discrete-time systems, Z-transform, frequency response) Need of multirate signal processing, bandwidth reduction, data rate reduction, efficient filter design

Sampling Rate Conversion: Decimation: theory, implementation (polyphase structures), filter design for decimation filters, Interpolation: theory, implementation (polyphase structures), filter design for interpolation filters, Sampling rate conversion by rational factors

Polyphase Decomposition and Filter Banks: Polyphase decomposition of filters, Analysis and synthesis filter banks: uniform and non-uniform sampling, perfect reconstruction filter banks, Applications of filter banks: sub-band coding, wavelet transforms

Multirate Systems in Practice: Quantization effects in multirate systems, Finite word length effects in multirate implementations, Hardware and software implementations of multirate systems, Applications of multirate systems in audio processing, image processing, and communications.

Text Books:

1. Multirate Systems and Filter Banks by P. P. Vaidyanathan, Prentice Hall, 1st Edition (1993)
2. Fundamentals of Digital Signal Processing by J. G. Proakis and D. G. Manolakis, Pearson Education, 4th Edition

Reference Books:

1. Multirate Systems and Filter Banks" by R. E. Crochiere and L. R. Rabiner, Prentice-Hall Publication, 1st Edition (1983)
2. Wavelets and Filter Banks by G. Strang and T. Nguyen, Wellesley-Cambridge Press ,1st Edition (1996)

3. Digital Signal Processing: A Computer-Based Approach by S. K. Mitra, McGraw-Hill Education, 3rd Edition

Web Resources:

https://archive.nptel.ac.in/courses/108/106/108106136/

Course Outcomes:

On completion of the course, students will be able to

ET1603(C).1 Implement multirate systems using software tools like MATLAB Python.

ET1603(C).2 Understand and apply the concepts of polyphase decomposition and filter banks in multirate systems

ET1603(C).3 Analyze the effects of quantization and finite word length effects on the performance of multirate systems

ET1603(C).4 Apply multirate techniques to solve practical problems in audio processing, image processing, and communications

ET1603(C).5 Evaluate multirate systems using software tools like MATLAB Python.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1603(C).1	3	0	0	0	3	0	0	0	0	0	0	0	2	3	0
ET1603(C).2	3	0	3	0	0	0	0	0	0	0	0	0	2	3	0
ET1603(C).3	0	3	0	2	1	0	0	0	0	0	0	0	2	3	1
ET1603(C).4	3	0	3	0	0	0	0	0	0	0	0	0	2	3	1
ET1603(C).5	3	0	3	0	0	0	0	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1603(C).1	3	0	0	0	3	0	0	0	0	0	0	2	3	0
ET1603(C).2	3	0	3	0	0	0	0	0	0	0	0	2	3	0
ET1603(C).3	0	3	0	2	1	0	0	0	0	0	0	2	3	1
ET1603(C).4	3	0	3	0	0	0	0	0	0	0	0	2	3	1
ET1603(C).5	3	0	3	0	0	0	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1603(D)	Course category	PE
Course Name	SOFT COMPUTING		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. Understand the significance and components of soft computing, including fuzzy logic, neural networks, and genetic algorithms.
II. Explore applications of fuzzy logic in engineering through real-world case studies.
III. Examine various neural network architectures for pattern recognition and data analysis.
IV. Analyze key concepts of genetic algorithms and their applications in optimization problems.

Course Contents:

Introduction to Soft Computing: significance and components, including fuzzy logic, neural networks, and genetic algorithms, the basic principles, difference from traditional computing methods.

Fuzzy Logic in Soft Computing: applications of fuzzy logic in engineering, fuzzy controllers and systems, with case studies illustrating its effectiveness in real-world scenarios.

Neural Networks in Soft Computing: various neural network architectures, Radial Basis Function Networks and Self-Organizing Maps, and their applications in pattern recognition and data analysis.

Genetic Algorithms: evolutionary algorithms, key concepts such as selection, crossover, and mutation, and their applications in solving optimization problems across different fields.

Applications of Soft Computing Techniques: the use of soft computing in data mining, pattern recognition, and hybrid systems that integrate fuzzy logic, neural networks, and genetic algorithms, demonstrating of practical applications in diverse industries.

Text Books:

1. Soft Computing: A Fusion of Foundations, Methodologies and Applications by Ajith Abraham, et al.
2. Neural Networks and Fuzzy Systems by Kosko Bart

Reference Books:

1. Genetic Algorithms in Search, Optimization, and Machine Learning by David E. Goldberg
2. Soft Computing and Its Applications by S. Rajasekaran and G. A. Vijayalakshmi Pai

Course Outcomes:

On completion of the course, students will be able to

ET1603(D).1 describe key components of soft computing and their significance.

ET1603(D).2 apply fuzzy logic principles to develop fuzzy controllers.

ET1603(D).3 identify and differentiate between various neural network architectures.

ET1603(D).4 implement genetic algorithms for solving optimization problems.

ET1603(D).5 evaluate the impact of soft computing techniques in practical.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1603(D).1	3	2	0	2	0	0	0	0	0	0	0	0	1	2	0
ET1603(D).2	3	0	3	0	0	0	0	0	0	0	0	0	2	3	0
ET1603(D).3	3	3	0	0	0	0	0	0	0	0	0	0	2	3	0
ET1603(D).4	3	3	0	1	0	0	0	0	0	0	0	0	2	3	0
ET1603(D).5	0	3	1	2	0	0	0	0	0	0	0	0	2	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1603(D).1	3	2	0	2	0	0	0	0	0	0	0	1	2	0
ET1603(D).2	3	0	3	0	0	0	0	0	0	0	0	2	3	0
ET1603(D).3	3	3	0	0	0	0	0	0	0	0	0	2	3	0
ET1603(D).4	3	3	0	1	0	0	0	0	0	0	0	2	3	0
ET1603(D).5	0	3	1	2	0	0	0	0	0	0	0	2	2	0

Course Code	**ET1603(E)**							**Course category**			**PE**
Course Name	**ELECTRONIC MEASUREMENT AND INSTRUMENTATION**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 Hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. Understand fundamental concepts of electrical measurements including SI units, and errors.
II. Analyse various types of transducers and their applications.
III. Utilize various measuring equipment for measurement of electrical parameters.
IV. Evaluate different electrical and electronic measurement techniques.

Course Contents:

Introduction to Measurements and Errors: Fundamental concepts of electrical measurements: SI units, systematic and random errors in measurement, and the expression of uncertainty. Accuracy and precision, error and propagation of errors.

Transducers and Sensors: Types of transducers: resistance, inductance, capacitance, piezoelectric, thermoelectric, Hall effect, and photoelectric transducers. Measurement of physical quantities: displacement, velocity, acceleration, force, torque, strain, temperature, pressure, flow, humidity, thickness, and pH.

Measuring Equipment: Tools and equipment used for measurement, Measurement of resistance, inductance, and capacitance using bridges and potentiometers. Measurement of voltage, current, power, energy, frequency, time, and phase. Digital multimeters, digital voltmeters, oscilloscopes (including Digital Storage Oscilloscopes), and spectrum analyzers.

Electrical and Electronic Measurements: Electrical and electronic measurement techniques: PMMC, MI, and dynamometer-type instruments, DC potentiometers and bridges for measuring resistance, inductance, and capacitance (Q-meter). Measurement of voltage, current, and power in single-phase and three-phase circuits, true RMS meters, instrument transformers, and timer/counter measurements.

Biomedical Instruments and IoT Sensors: Biomedical instruments, including ECG, EEG, and blood pressure measurement techniques.

Text Books:

1. Electronic Instrumentation, H.S.Kalsi, 2nd Edition, Tata McGraw Hill, 2004.
2. Electronic instrumentation and measurements, Bell, David A. Regents/Prentice Hall, 1994.

Reference Books:

1. A course in Electrical and Electronic Measurements and Instrumentation,Sawhney, A. K., and Puneet Sawhney.Dhanpat Rai & Company, 2016.
2. Modern Electronic Instrumentation and Measurement Techniques, A.D.Helfrick and W.D. Cooper, 5th Edition, PHI, 2002.

Course Outcomes: On completion of the course, students will be able to

ET1603(E).1	Demonstrate the ability to analyze and calculate systematic and random errors in measurements and express uncertainty in their results.
ET1603(E).2	Identify and classify various types of transducers and sensors, explaining their working principles and applications in real-world scenarios.
ET1603(E).3	Perform accurate measurements using digital multimeters, oscilloscopes, and other measuring devices.
ET1603(E).4	Apply appropriate measurement techniques to determine electrical parameters in both single-phase and three-phase circuits, ensuring accuracy in their assessments.
ET1603(E).5	Discuss the working principles and applications of biomedical instruments.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1603(E).1	3	3	0	2	0	0	0	0	0	0	0	0	3	2	1
ET1603(E).2	3	2	0	2	0	0	0	0	0	0	0	0	3	3	1
ET1603(E).3	3	3	0	0	2	0	0	0	0	0	0	0	3	2	0
ET1603(E).4	3	3	0	2	0	0	0	0	0	0	0	0	3	2	0
ET1603(E).5	2	3	0	3	0	0	0	0	0	0	0	0	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1603(E).1	3	3	0	2	0	0	0	0	0	0	0	3	2	1
ET1603(E).2	3	2	0	2	0	0	0	0	0	0	0	3	3	1
ET1603(E).3	3	3	0	0	2	0	0	0	0	0	0	3	2	0
ET1603(E).4	3	3	0	2	0	0	0	0	0	0	0	3	2	0
ET1603(E).5	2	3	0	3	0	0	0	0	0	0	0	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

(An Autonomous Institute of Government of Maharashtra)

Course Code	ET1604 (A)	Course category	PE
Course Name	VLSI DESIGN		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	15	15	10	60	2 hrs 30 min	00	00	100	04

Course Objectives: Students undergoing this course are expected to

I. Understand fundamental principle of VLSI design
II. Understand RTL to GDS VLSI design flow
III. Learn hardware modeling, simulation and verification using Verilog
IV. Understand physical design flow for VLSI circuits
V. Study low power VLSI design

Course Contents:

Basic Concepts of Integrated Circuit: Structure, Fabrication, Types, Design Styles, Designing vs. Fabrication, Economics, Figures of Merit, Overview of VLSI Design Flow: Design Flows and Abstraction; Pre-RTL Methodologies: Hardware-software Partitioning, SoC Design, Intellectual Property (IP) Assembly, Behavioral Synthesis

Overview of VLSI Design Flow: RTL to GDS Implementation, Logic Synthesis, Physical Design, Verification and Testing, Post-GDS Processes

Logic Design: Modeling Hardware using Verilog, Simulation-based Verification, RTL Synthesis, Formal Verification, Logic Optimization

Static Timing Analysis: Synchronous Behavior, Timing Requirements, Timing Graph, Delay Calculation, Accounting for Variations

Physical Design: Basic Concepts for Physical Design, Chip Planning, Placement, Routing, Physical Verification and Signoff

Introduction to Low Power: Need for Low Power VLSI Chips, Sources of Power Dissipation in Digital Integrated Circuits, Emerging Low Power Approaches

Text Books:

1. Introduction to VLSI Design Flow, Sneh Saurabh, Cambridge University Press Publishers, 2023
2. Low Power Design Methodologies, Jan M. Rabaey and Massoud Pedram, Kluwer Academic Publishers, 5th reprint, ISBN 978-1-46 13-5975-3, 2002

Reference Books:

1. Digital VLSI Systems Design, Dr. S. Ramachandran, Springer, 2007
2. VLSI Physical Design: From Graph Partitioning to Timing Closure, Andrew B. Kahng, 2nd Edition, Springer, 2022
3. Low-Power CMOS VLSI Circuit Design, Kaushik Roy and Sharat Prasad, John Wiley, 2000

Web Resources:

1. https://nptel.ac.in/courses/108106191 VLSI Design Flow: RTL to GDS, NPTEL Video Lecture by Prof. Sneh Saurabh, IIIT Delhi

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Course Outcomes:

On completion of the course, students will be able to

ET1604(A).1 Describe fundamental principle of VLSI circuit design flow

ET1604(A).2 Realize hardware model using Verilog

ET1604(A).3 Analyse hardware model and its simulation and verification

ET1604(A).4 Analyse and interpret physical design flow for VLSI circuits

ET1604(A).5 Describe fundamental principle of low power VLSI circuit design

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1604(A).1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0
ET1604(A).2	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0
ET1604(A).3	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0
ET1604(A).4	1	1	1	1	0	0	1	0	0	0	1	1	2	2	0
ET1604(A).5	1	1	2	2	1	0	1	0	0	0	1	1	2	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1604(A).1	1	1	1	1	0	0	1	0	0	1	1	1	1	0
ET1604(A).2	1	1	1	1	0	0	1	0	0	1	1	1	1	0
ET1604(A).3	1	1	1	1	0	0	1	0	0	1	1	1	1	0
ET1604(A).4	1	1	1	1	0	0	1	0	0	1	1	2	2	0
ET1604(A).5	1	1	2	2	1	0	1	0	0	1	1	2	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**ET1604(B)**						**Course category**			**PE**
Course Name	**OPTICAL FIBER COMMUNICATION**									
Teaching Scheme				**Examination Scheme**						**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	15	15	10	60	2 hrs 30 min	00	00	100	04

Course Objectives: Students undergoing this course are expected to

I. Learn about various components used in optical fiber communication.
II. Understand the different kind of losses, signal distortion, SM fibers.
III. Gain the knowledge of the various optical sources, materials and fiber splicing.
IV. Learn the optical receivers and noise performance in photo detector.
V. Understand the link budget, WDM, and SONET/SDH network.

Course Contents:

Introduction: The general system, advantages; Basic optic principles, Ray theory, Electromagnetic mode theory, cylindrical fiber, Single mode fiber.
Transmission Characteristics of Optical Fiber: Attenuation, Linear and Non-linear Scattering losses, Fiber bend loss, Dispersion, nonlinear effects,
Optical Sources and Detectors: Optical sources - LEDs and Lasers, Photo-detectors, Operating principles, Population inversion, Quantum efficiency, responsivity, detector noise.
Optical Transmitters, Receivers: Optical transmitter, receiver, digital system planning consideration, power penalty, optical link design, power budgeting, multiplexing strategies, coherent and non-coherent modulation and demodulation scheme, optical switches.
Optical Amplifiers and Networks: Optical fiber amplifier, Semiconductor optical amplifiers, wavelength conversion, optical switches, photonic switching, SONET/SDH, fiber channel, optical interfaces. Introduction to WDM and DWDM systems.

Text Books:

1. Optical Fiber Communications: Principles and Practice, J. M. Senior, 3rd edition, PHI, 2009.
2. Optical Fiber Communications, Gerd Keiser, 4th edition, TMH, 2008

Reference Books:

1. Optical Fiber Communication System, J. Gowar, 3rd edition, PHI, 2000
2. Fiber-Optic Communications Systems, G. P. Agrawal, 3rd, John Wiley and Sons, 2002

Course Outcomes:

On completion of the course, students will be able to

ET1604(B).1 Apply the knowledge of basic concepts of ray theory to Optical Fiber Communication.

ET1604(B).2 Analyze and evaluate transmission characteristics of Optical Fiber Communication system.

ET1604(B).3 Acquaintance of different source of light as well as receiver and their comparative study.

ET1604(B).4 Ability to design, implements, analyzes and maintains optical Fiber communication system.

ET1604(B).5 Assess the different techniques to improve the capacity of the system and solve problems on Optical Fiber Communication system.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1604(B).1	3	2	1	2	1	0	0	0	0	0	0	1	3	0	1
ET1604(B).2	2	2	1	1	2	0	1	0	0	0	1	0	2	1	1
ET1604(B).3	1	1	3	1	2	0	0	0	0	0	3	0	3	2	0
ET1604(B).4	2	2	1	1	2	0	0	0	0	0	0	2	2	0	1
ET1604(B).5	2	2	2	1	1	0	0	0	0	0	0	1	2	0	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1604(B).1	3	2	1	2	1	0	0	0	0	1	0	3	0	1
ET1604(B).2	2	2	1	1	2	0	1	0	0	0	1	2	1	1
ET1604(B).3	1	1	3	1	2	0	0	0	0	0	3	3	2	0
ET1604(B).4	2	2	1	1	2	0	0	0	0	2	0	2	0	1
ET1604(B).5	2	2	2	1	1	0	0	0	0	1	0	2	0	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1604(C)	Course category	PE
Course Name	ADAPTIVE SIGNAL PROCESSING		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	15	15	10	60	2 hrs 30 min	00	00	100	04

Course Objectives: Students undergoing this course are expected to

I. To provide a comprehensive understanding of the principles and applications of adaptive filtering.

II. To equip students with the ability to analyze, design, and implement various adaptive filtering algorithms.

III. To develop a strong foundation in the mathematical and statistical concepts underlying adaptive signal processing.

IV. To enable students to apply adaptive filtering techniques to real-world problems in areas such as communications, acoustics, control, and biomedical engineering.

Course Contents:

Introduction to Adaptive Filtering: Fundamentals of Digital Signal Processing: Review of discrete-time systems, z-transform, frequency response, filter design. Introduction to Adaptive Filtering: Need for adaptive filters, basic concepts, applications (noise cancellation, equalization, echo cancellation). Performance Measures: Mean-squared error (MSE), misadjustment.

Least Mean Squares (LMS) Algorithm: Derivation of the LMS algorithm: Steepest descent method, stochastic gradient descent. Analysis of LMS algorithm: Convergence analysis, stability, steady-state error, misadjustment. Applications of LMS algorithm: Noise cancellation, echo cancellation, system identification.

Recursive Least Squares (RLS) Algorithm: Derivation of the RLS algorithm: Recursive solution to the least squares problem. Analysis of RLS algorithm: Convergence properties, computational complexity. Fast RLS algorithms: Lattice RLS. Applications of RLS algorithm: Channel equalization, array processing.

Adaptive IIR Filters: Structure of IIR adaptive filters: Lattice filters, gradient lattice filters. Stability considerations in IIR adaptive filters. Applications of IIR adaptive filters: Predictors, equalizers.

Textbooks:

1. Adaptive signal processing by Bernard Widrow and Stearns, Pearson Education
2. Adaptive Filter Theory by Simon Haykin

Reference Books:

1. Digital Signal Processing by Proakis and Manolakis
2. Fundamentals of Adaptive Filtering by Alexander D. Poularikas
3. Introduction to Adaptive Filters by Shurendra Prasad

NPTEL Course Links:

1. https://archive.nptel.ac.in/courses/108/101/108101174/
2. https://onlinecourses.nptel.ac.in/noc22_ee99/preview
3. https://onlinecourses.nptel.ac.in/noc23_ee138/preview

Course Outcomes:

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

ET1604(C).1 Understand discrete-time systems, z-transforms, and filter design principles, laying the groundwork for adaptive filtering.

ET1604(C).2 Identify the need for adaptive filters and apply basic concepts to noise/echo cancellation and equalization.

ET1604(C).3 Derive and analyze the LMS algorithm, understanding its convergence, stability, and application in system identification

ET1604(C).4 Derive and analyze the RLS algorithm, compare its convergence and complexity to LMS, and understand fast RLS variations.

ET1604(C).5 Learn IIR filter structures, address stability issues, and apply them to prediction and equalization tasks.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO/PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1604(C).1	3	2	0	2	0	0	0	0	0	0	0	0	2	3	0
ET1604(C).2	3	3	0	0	0	0	0	0	0	0	0	0	2	3	0
ET1604(C).3	3	2	0	2	0	0	0	0	0	0	0	0	2	3	0
ET1604(C).4	3	3	0	0	0	0	0	0	0	0	0	0	2	3	0
ET1604(C).5	3	0	3	0	0	0	0	0	0	0	0	0	2	3	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1604(C).1	3	2	0	2	0	0	0	0	0	0	0	2	3	0
ET1604(C).2	3	3	0	0	0	0	0	0	0	0	0	2	3	0
ET1604(C).3	3	2	0	2	0	0	0	0	0	0	0	2	3	0
ET1604(C).4	3	3	0	0	0	0	0	0	0	0	0	2	3	0
ET1604(C).5	3	0	3	0	0	0	0	0	0	0	0	2	3	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	**ET1604(D)**							**Course category**			**PE**
Course Name	**MACHINE LEARNING**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	15	15	10	60	2 hrs 30 min	00	00	100	04

Course Objectives: Students undergoing this course are expected to

I. The ability of distinctions between supervised and unsupervised learning.
II. Utilize linear and logistic regression methods to model effectively.
III. Develop skills in constructing decision trees and applying ensemble techniques to enhance model performance.
IV. Gain proficiency in using SVMs and kernel methods for classification tasks across various domains.
V. Investigate different neural network architectures and their applications in deep learning, particularly in image and speech recognition.

Course Contents:

Introduction to Machine Learning: the fundamental differences between supervised and unsupervised learning, types of learning algorithms including reinforce learning and their applications.

Linear Regression and Logistic Regression: the concepts of regression analysis, modelling relationships between variables and predict outcomes, Introduction to logistic regression for binary classification tasks, Explanation of the logistic function and how it transforms linear outputs into probabilities, applications: Use cases in fields such as finance, healthcare, and marketing.

Decision Trees and Ensemble Methods: decision tree algorithms, its structure and advantages, ensemble methods like bagging and boosting, for enhancement of predictive performance, applications: Discuss applications in fraud detection, customer segmentation, and risk management.

Support Vector Machines and Kernel Methods: the principles of support vector machines, kernel functions: introduction to kernel methods, enabling SVMs to operate in high-dimensional spaces without explicit transformation, common kernel types: linear, polynomial, and radial basis function (RBF), and their applications in classification tasks and text recognition.

Neural Networks and Deep Learning: various neural network architectures, activation functions like ReLu, sigmoid, convolutional and recurrent networks, their architectures, training techniques and applications in image and speech recognition, applications in image recognition, speech recognition, and natural language processing.

Text Books:

1. Pattern Recognition and Machine Learning by Christopher M. Bishop
2. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy

Reference Books:

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
2. The Elements of Statistical Learning by Trevor Hastie, Robert Tibshirani, and Jerome Friedman

Web Resources:

1. Introduction to Machine Learning, by Prof. Balaraman Ravindran, IIT Madras

https://onlinecourses.nptel.ac.in/noc23_cs18/preview

Course Outcomes:

On completion of the course, students will be able to

ET1604(D).1 demonstrate the ability to distinguish between supervised and unsupervised learning and select appropriate algorithms for specific tasks.

ET1604(D).2 analyse and conduct regression analyses to model and predict outcomes based on given datasets

ET1604(D).3 build decision tree models and evaluate their performance using ensemble methods for improved accuracy.

ET1604(D).4 apply support vector machines and kernel functions to solve complex classification problems.

ET1604(D).5 create and train various neural network architectures for applications in computer vision and natural language processing.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1604(D).1	2	3	0	0	0	0	0	0	0	1	0	0	1	2	0
ET1604(D).2	2	0	2	3	0	0	0	0	0	0	0	0	1	2	0
ET1604(D).3	2	0	3	0	2	0	0	0	0	0	0	0	1	2	0
ET1604(D).4	2	3	0	0	3	0	0	0	0	0	0	0	1	2	0
ET1604(D).5	2	0	3	0	3	0	0	0	0	0	0	0	1	2	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1604(D).1	2	3	0	0	0	0	0	0	1	0	0	1	2	0
ET1604(D).2	2	0	2	3	0	0	0	0	0	0	0	1	2	0
ET1604(D).3	2	0	3	0	2	0	0	0	0	0	0	1	2	0
ET1604(D).4	2	3	0	0	3	0	0	0	0	0	0	1	2	0
ET1604(D).5	2	0	3	0	3	0	0	0	0	0	0	1	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**ET1604(E)**							**Course category**			**PE**
Course Name	**ANALOG AND DIGITAL ICS**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	15	15	10	60	2 hrs 30 min	00	00	100	04

Course Objectives: Students undergoing this course are expected to

I. Understand the principles, internal circuit, and applications of op-amps in linear and non-linear systems.
II. Design and simplify combinational and sequential logic circuits using Boolean algebra and logic gates.
III. Analyze and compare the characteristics of digital IC families (TTL, ECL, CMOS) for specific applications.
IV. Construct and test analog and digital circuits (oscillators, multivibrators, adders, counters) using ICs like 741, 555, and 723.
V. Develop innovative solutions to engineering problems by integrating analog and digital IC knowledge.

Course Contents:

Introduction to ICs and Operational Amplifiers: Operational amplifier – block schematic, internal circuits, Study of IC741, Measurement of op-amp parameters, balancing networks of op-amp, Frequency compensation techniques for op-amp.
Linear and non-linear application op-amp: Inverting amplifier, Non-inverting amplifier, Voltage follower, Differential amplifier, Integrator, Differentiator, Sinusoidal RC phase shift and Wein-bridge oscillator, Comparator, astable multivibrator, bistable multivibrator and monostable multivibrator, Schmitt trigger, Clipper and Clamper circuits.
Other linear ICs: Block schematic of regulator IC 723 and its applications, SMPS, block schematic of timer IC 555 and its applications as timer, astable, monostable, bistable multivibrator.
Boolean algebra, logic circuits and families: Logic gates: basic, derived and universal, Theorems and properties of Boolean algebra, De-Morgan's theorem, Canonical and standard SoP and PoS forms, simplification and synthesis of Boolean functions up to 4 variables using Boolean theorems and K-map, Characteristics of digital ICs, study of TTL, ECL, I^2L, CMOS logic families, tristate logic.
Combinational logic design using MSI ICs: Arithmetic circuits: half, full adders and subtractors, 4-bit adder / subtractor, 4-bit binary parallel adder IC, BCD adder using IC, Digital comparator, Multiplexer, de-multiplexer, Encoder, decoder.
Sequential logic design: one bit memory cell, Flip-flops: S-R, clocked S-R, J-K, master slave J-K, T-type, D-type, Shift registers, asynchronous counters, Up / down counters, Ripple counters, MOD-n counters, RAM bipolar cell.

Text Books:

1. Op-amps and linear integrated circuits, Gayakwad Ramakant A, Prentice-Hall, Inc., 1993.

2. Digital design, Ciletti Michael D., and M. Morris Mano,Hoboken: Prentice-Hall, 2007.

Reference Books:

1. Linear integrated circuits, Roy D. Choudhury, New Age International, 2003.
2. Digital integrated electronics, Taub Herbert, and Donald L. Schilling, 1977.

Course Outcomes:

On completion of the course, students will be able to

ET1604(E).1 Explain the working principles of operational amplifiers, their internal circuits, and their applications in linear and non-linear systems.

ET1604(E).2 Design and analyze combinational and sequential logic circuits using Boolean algebra, K-maps, and logic gates.

ET1604(E).3 Compare the characteristics of different digital IC families (TTL, ECL, CMOS) and select appropriate ICs for specific applications.

ET1604(E).4 Construct and test analog and digital circuits such as oscillators, multivibrators, adders, and counters using ICs like 741, 555, and 723.

ET1604(E).5 Propose innovative solutions to engineering problems by integrating knowledge of analog and digital ICs into practical applications.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1604(E).1	3	0	3	0	2	0	0	0	0	0	0	0	2	2	0
ET1604(E).2	2	3	2	0	0	0	0	0	0	0	0	0	2	3	0
ET1604(E).3	2	3	0	0	0	2	0	0	0	0	0	0	1	2	0
ET1604(E).4	3	0	3	2	0	0	0	0	0	0	0	0	2	2	0
ET1604(E).5	0	0	3	0	3	0	0	1	0	0	0	0	2	3	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1604(E).1	3	0	3	0	2	0	0	0	0	0	0	2	2	0
ET1604(E).2	2	3	2	0	0	0	0	0	0	0	0	2	3	0
ET1604(E).3	2	3	0	0	0	2	0	0	0	0	0	1	2	0
ET1604(E).4	3	0	3	2	0	0	0	0	0	0	0	2	2	0
ET1604(E).5	0	0	3	0	3	0	1	0	0	0	0	2	3	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	ET1605	Course category	VSE
Course Name	EMBEDDED SYSTEMS LAB		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	00	--	25	25	50	01

Course Objectives: Students undergoing this course are expected to

I. To Understand Embedded C programming fundamentals and I/O Interfacing
II. To Introduce Bus Communication in processors, Input/output interfacing.
III. To introduce Basics of Real time operating system and example tutorials to discuss on one real time operating system tool

Practical List:

1. Develop the algorithm, flowchart and C program to perform given operation (data transfer, arithmetic/logical operation, decision control and looping operations)
2. Develop the algorithm, flowchart and C program to perform given interfacing of LEDs
3. Develop the algorithm, flowchart and C program to perform given interfacing of Sensors/Relays
4. Develop the algorithm, flowchart and C program to perform given delay using timer/counter with microcontroller.
5. Develop the algorithm, flowchart and C program to perform given data transfer through serial communication port
6. Develop the algorithm, flowchart and C program to perform given interfacing of 7 Segment Display?
7. Develop the algorithm, flowchart and C program to perform given interfacing of LCD
8. Develop the algorithm, flowchart and C program to perform interfacing of DC motor and rotate in given direction
9. Develop the algorithm, flowchart and C program to perform interfacing of ADC
10. Develop the algorithm, flowchart and C program to perform interfacing of DAC

This is sample list; students can write any additional suitable related program with emphasis on application.

Course Outcome: On completion of the course, students will be able to

ET1605.1 Acquire a basic knowledge about fundamentals of microcontrollers and its operation
ET1605.2 Acquire a basic Knowledge of programming to perform a specific task and various circuit connections
ET1605.3 Develop Programming skills in embedded systems for various applications.

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CO-PO-PSO Mapping as per NBA Jan-2016 Format

Sign
Member Secretary

Sign
BoS Chairperson

Sign
Dean, Academics

Sign
Principal

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1605.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
ET1605.2	0	2	0	0	0	0	0	0	0	0	2	0	2	3	0
ET1605.3	0	0	3	0	0	2	2	0	0	0	0	0	0	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1605.1	3	0	0	0	0	0	0	0	0	0	0	0	0	3
ET1605.2	0	2	0	0	0	0	0	0	0	0	0	2	3	0
ET1605.3	0	0	3	0	0	2	2	0	0	0	2	0	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Member Secretary

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BoS Chairperson

Sign
Dean, Academics

Sign
Principal

Course Code	ET1606							Course category			PE
Course Name	CMOS DESIGN LAB										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	--	25	25	50	01

Course Objectives: Students undergoing this course are expected to

I. Understand various CMOS circuits
II. Understand the input and output characteristics of MOS devices and to use MOS device for various application
III. Analyze CMOS based amplifier circuits and Understand a few of the circuit applications using appropriate Circuit Simulation package

Practical List:

1. Design and simulate a circuit using Transistor as a switch.
2. Implementation of the Compound Gate using a combination of series and parallel switch CMOS structures.
3. Implement and simulate the CMOS based logic gates using Pass Transistor and Transmission Gates.
4. Design, simulate and characterize the Tristate using CMOS.
5. Design and simulate a 8×1 Multiplexer with (a) Complimentary gates design; (b) Transmission Gate; (c) Tristate and (d) 2×1 Multiplexer.
6. Design and simulate the CMOS single stage common source amplifier.
7. Design and compare the single stage common gate stage and source follower using CMOS for trans conductance and resistance of the circuit.
8. Implement and simulate the CMOS based Cascade Amplifier.
9. Implement and simulate the CMOS based Cascade Amplifier and compare it with Cascade Amplifier gain.
10. Simulate and analyze the CMOS based Differential Amplifier with source coupled pair.

Course Outcomes:

On completion of the course, students will be able to

ET1606.1 Acquire hands on knowledge about various CMOS circuits design and Simulate the input and output characteristics of CMOS circuits.

ET1606.2 Implement and analyze various digital CMOS logic.

ET1606.3 Learn design techniques of low voltage and low power CMOS circuits for various applications.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1606.1	3	1	2	2	0	0	0	0	0	0	0	1	3	1	2
ET1606.2	3	2	3	3	0	0	0	0	0	0	0	1	3	2	3
ET1606.3	3	1	1	2	0	0	0	0	0	0	0	1	3	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1606.1	3	1	1	1	0	0	0	0	0	1	0	3	1	1
ET1606.2	3	2	3	3	0	0	0	0	0	1	0	3	2	3
ET1606.3	3	1	1	2	0	0	0	0	0	1	0	3	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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BoS Chairperson

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Sign
Principal

Course Code	ET1607	Course category	FP
Course Name	LABORATORY-2/ MINOR PROJECT		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT1	CT2	ESE	ESE Duration	ICA	ESE		
00	00	04	04	00	00	00	---	50	00	50	02

Course Objectives: Students undergoing this course are expected to

I. The opportunity to demonstrate their competence in laboratory work and integrate the knowledge gained in courses studied.
II. Exercising maturity, initiative and creative ability.
III. Communication skills, both oral and written, to communicate results, concepts and ideas.

Course Contents:

Group of 2 students shall be permitted to work on minor project. The student(s) will carry out minor project based on one or more of the following aspects:

Prototype design, product preparations, working models, fabrication of set-ups, laboratory experiments, process modification/development, simulation, software development, integration of software and hardware, data analysis, survey etc.

The students are required to submit a **10 to 15 pages** report based on the work carried out.

Internal Continuous Assessment (ICA): Internal Continuous Assessment shall be based on the project report and knowledge /skills acquired. The performance shall assess by using continuous assessment formats, A and B.
End Semester Examination (ESE): The ESE shall be based on the demonstration of the minor project work and may be followed by viva.

Course Outcomes:

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

ET1607.1 Practice acquired knowledge within the chosen area of technology for project development.

ET1607.2 Reproduce, improve and refine technical aspects for engineering projects; and report effectively project related activities and findings.

ET1607.3 Work as an individual or in a team in development of technical projects.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1607.1	3	2	0	2	0	0	0	0	0	0	0	0	3	2	1
ET1607.2	3	3	2	0	0	0	0	0	0	0	0	0	3	3	2
ET1607.3	2	0	2	2	2	0	0	0	0	0	0	3	2	3	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1607.1	3	2	0	2	0	0	0	0	0	0	0	3	2	1
ET1607.2	3	3	2	0	0	0	0	0	0	0	0	3	3	2
ET1607.3	2	0	2	2	2	0	0	0	0	3	0	2	3	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	**ET1608**							**Course category**			**MNC**
Course Name	**MATLAB FUNDAMENTALS**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
02	00	00	02	15	15	20	00	---	00	00	50	00

Course Objectives: Students undergoing this course are expected to

I. Familiarize students with the MATLAB user interface and basic programming concepts.
II. Develop skills in creating scripts and visualizations using MATLAB.
III. Introduce students to the Simulink environment for modeling dynamic systems.
IV. Provide an understanding of physical modeling using Simscape.

Course Contents:

Introduction to MATLAB: Overview of the MATLAB user interface, understanding workspace variables and expressions, Basics of matrices and arrays, including array indexing and basic operations.

Programming and Visualization: Writing scripts and function files, Control structures: branching (if, else if, else and switch etc.) and looping (for, while etc.), Creating 2D and 3D plots for data visualization.

Introduction to Simulink: Overview of the Simulink graphical environment, working with the Simulink Library: sources, sinks, and math operations, Creating and simulating models in Simulink: building models, connecting blocks, simulation parameters, execution of simulation.

Physical Modelling with Simscape: Introduction to Simscape block libraries, Modeling and simulating multidomain physical systems (e.g., RC circuits, mechanical systems), Importing and exporting data with Simulink.

Event-Based Modelling with State flow: Fundamentals of state machines and State flow charts, Designing and simulating state transition diagrams and flow charts, Applications of state machines in various industries.

Text Books:

1. What every engineer should know about MATLAB and Simulink , Biran, Adrian B. CRC Press, 2010.
2. MATLAB/Simulink Essentials: MATLAB/Simulink for Engineering Problem Solving and Numerical Analysis, Eshkabilov, Sulaymon L. Lulu. com, 2016.

Reference Books:

1. MATLAB and Simulink for Engineers , Tyagi, Agam Kumar. *(No Title)* (2012).
2. MATLAB and Simulink In-Depth: Model-based Design with Simulink and Stateflow, User Interface, Scripting, Simulation, Visualization and Debugging, Patankar, Priyanka, and Swapnil Kulkarni, BPB Publications, 2022.

Web Resources:

Self Paced Courses on the MathWorks website.

1) MATLAB Onramp:
https://in.mathworks.com/learn/tutorials/matlabonramp.html
2) Simulink Onramp
https://matlabacademy.mathworks.com/details/simulink0onramp/simulink
3) MATLAB Fundamentals
https://matlabacademy.mathworks.com/details/matlab0fundamentals/mlbe
4) Simulink Fundamentals
https://matlabacademy.mathworks.com/details/simulink0fundamentals/slbe
5) Stateflow Onramp
https://matlabacademy.mathworks.com/details/stateflow0onramp/stateflow

Course Outcomes:

On completion of the course, students will be able to

ET1608.1 Navigate the MATLAB desktop environment and effectively use workspace variables and array operations.

ET1608.2 Develop MATLAB scripts and function files to automate tasks, utilizing control structures for decision-making and looping.

ET1608.3 Create and simulate models in Simulink, including control systems.

ET1608.4 Model and simulate complex physical systems using Simscape.

ET1608.5 Design and implement state machines using Stateflow for various applications.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1608.1	2	0	0	0	3	0	0	0	0	1	0	0	1	1	0
ET1608.2	2	0	0	0	3	0	0	0	0	1	0	0	1	2	0
ET1608.3	2	0	3	2	0	0	0	0	0	0	0	0	2	3	0
ET1608.4	2	0	3	0	2	0	0	0	0	0	0	0	2	3	0
ET1608.5	2	0	3	2	0	0	0	0	0	0	0	0	1	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1608.1	2	0	0	0	3	0	0	0	1	0	0	1	1	0
ET1608.2	2	0	0	0	3	0	0	0	1	0	0	1	2	0
ET1608.3	2	0	3	2	0	0	0	0	0	0	0	2	3	0
ET1608.4	2	0	3	0	2	0	0	0	0	0	0	2	3	0
ET1608.5	2	0	3	2	0	0	0	0	0	0	0	1	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Exit Courses

Course Code	ET1611							Course category		EX
Course Name	PC HARDWARE AND COMPUTER NETWORKING									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	08	08	00	00	00	00	---	50	00	50	04

Course Objectives: Students undergoing this course are expected to

I. Equip students with foundational knowledge of computer basics, including hardware, software, and input/output devices.
II. Provide a comprehensive understanding of basic networking concepts, including topologies and networking models like OSI and TCP/IP.
III. Introduce a range of networking devices and their functionalities in data transmission.
IV. Cultivate practical skills in network configuration, including IP addressing and troubleshooting.

Course Contents:

Introduction to Computers: Basics of computer, Organization of computer, Software and hardware, Input/output devices and peripherals, Opening the PC and identification of different blocks, Assembling and disassembling.

Basic Networking Concepts: Network topologies: LAN, WAN, MAN, PAN, CAN, Networking models: OSI model, TCP/IP model, Network adapters, Introducing protocols, Cabling and troubleshooting.

Introduction to Various Networking Devices: Routers, Switches, Modems, Hubs, Access Points, Network Interface Cards (NICs), Firewalls, Repeaters, Bridges and Gateways, Overview of wired and wireless technology, Role of networking devices in data transmission.

Network Basics and Configuration: Setting IP addresses, Subnetting concepts, DHCP configuration, Sharing files and folders, Network troubleshooting, PING test, Network performance monitoring, Network Address Translation, Wireless network configuration, Security settings for networks.

Introduction to Servers and Network Security: Types of servers: File servers, Email servers, Proxy servers, Basics of Internet and Intranet, Types of Internet connections: Dial-up, Broadband, Leased Line, Wi-Fi, Wi-Max, 2G, 3G, 4G, 5G, Cloud applications, Audio-video conferencing, Voice over Internet Protocol (VOIP), Recovery and backup, Essential security measures.

Text Books:

1. Computer Concepts: Illustrated Introductory, June Jamrich Parsons, Dan Oja, Course Technology Inc., 9th edition, 29 March 2012.
2. Computer Networking: A Top-Down Approach, James Kurose and Keith Ross, Pearson, 7th Edition, 26 April 2016.

Reference Books:

1. Upgrading and repairing PCs., Mueller, Scott. Que Publishing, 2004.
2. Building Your Own Computer Made Easy: The Step By Step Guide (Computers Made Easy), James Bernstein.

Web Resources:

1. The Bits and Bytes of Computer Networking, Coursera, 22Hrs.
2. Computer and Peripheral Hardware, Kevin Vaccaro, Coursera, 24Hrs

Course Outcomes:

On completion of the course, students will be able to

ET1611.1 Identify and describe key computer components and demonstrate assembly and disassembly skills.

ET1611.2 Understand and explain various networking models and concepts, including LAN, WAN, and OSI and TCP/IP frameworks.

ET1611.3 Identify networking devices and articulate their roles in communication.

ET1611.4 Configure network settings and perform basic troubleshooting using tools like PING and ip config.

ET1611.5 Explain different server types, internet connections, and implement basic network security measures.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1611.1	3	0	2	0	0	0	0	0	0	1	0	0	2	1	0
ET1611.2	3	2	0	2	0	0	0	0	0	0	0	0	2	2	0
ET1611.3	3	2	0	0	0	2	0	0	0	0	0	0	2	2	0
ET1611.4	3	0	3	2	0	0	0	0	0	0	0	0	2	3	0
ET1611.5	3	2	0	0	2	0	0	0	0	0	0	0	2	2	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	POSO1	PSO2	PSO3
ET1611.1	3	0	2	0	0	0	0	0	1	0	0	2	1	0
ET1611.2	3	2	0	2	0	0	0	0	0	0	0	2	2	0
ET1611.3	3	2	0	0	0	2	0	0	0	0	0	2	2	0
ET1611.4	3	0	3	2	0	0	0	0	0	0	0	2	3	0
ET1611.5	3	2	0	0	2	0	0	0	0	0	0	2	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	ET1612							Course category			EX
Course Name	IOT SYSTEM										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	08	08	00	00	00	00	-	50	00	50	04

Course Objectives:

I. To learn basic of IoT
II. To learn basic of Ardunio Hardware
III. To Learn Basic of Raspberry Pi.
IV. To Learn Interfacing of Ardunio and Raspberry Pi with sensors, Actuators.
V. To Study Installation, Testing and Verification Process.

Course Content

Introduction to IoT: Architectural overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology, Fundamentals-Devices and gateways, Data management, Business processes in IoT, Role of cloud in IoT

Basics of Arduino : Introduction to Arduino : Arduino Uno, Arduino Mega, Arduino Nano, Arduino IDE, Steps to Install Arduino IDE, Basic Commands for Arduino, LCD Commands, Serial Communication Commands, Programme with LED and Arduino and Sketch, Programme with LCD with Arduino and sketch.

Basics of Raspberry Pi: Introduction to Raspberry Pi, Raspberry Pi Components, Installation of NOOBS & Raspbian on SD Card , terminal Commands, Installation of Libraries on Raspberry Pi, Getting the Static IP Address of Raspberry Pi , Terminal Commands, Run a Program on Raspberry Pi, Installing the Remote Desktop Server, Pi Camera, Testing of the Camera, Raspberry Pi Camera as a USB Video Device, Face Recognition Using Raspberry Pi, Installation of I2C Driver on Raspberry Pi, Serial Peripheral Interface with Raspberry Pi , Programme with LED and Raspberry Pi, Programme with to read digital Input

Interfacing with Raspberry Pi and Arduino: Programing with sensors: PIR Sensor, Analog sensors, interfacing diagram/sketch, Programming with Actuators: DC Motors, Servo Motors, Interfacing diagram/sketch

Text Book:

1. Internet of things with Raspberry Pi and Arduino, Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, and Mahindra Swain , CRC Press

Reference book:

1. Learn Programming with Raspberry Pi With Python, Wolffram Donat, Apress.
2. Arduino and Raspberry Pi Sensor Projects - Robert Chin, Robert Chin
3. Guide To Raspberry Pi 3 And Android Development Programming Raspberry Pi 3 Getting Started With Android-up skill learning

Web Resources:

https://nptel.ac.in/courses/106105166

Course Outcome: On completion of the course, students will be able to

ET1612.1 Realize Design Flow
ET1612.2 Analyze Arduino & Raspberry Pi Hardware
ET1612.3 Implementation Different Basic Applications
ET1612.4 Analyze cloud connecting application
ET1612.5 Analyze testing, Verification.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1612.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ET1612.2	0	2	0	0	0	0	0	0	0	0	0	0	2	3	0
ET1612.3	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0
ET1612.4	0	0	0	2	0	0	2	0	0	0	2	0	0	0	0
ET1612.5	0	0	0	0	3	0	0	0	0	0	0	0	0	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	POSO1	PSO2	PSO3
ET1612.1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
ET1612.2	0	2	0	0	0	0	0	0	0	0	0	2	3	0
ET1612.3	0	0	3	0	0	2	0	0	0	0	0	0	0	0
ET1612.4	0	0	0	2	0	0	2	0	0	0	2	0	0	0
ET1612.5	0	0	0	0	3	0	0	0	0	0	0	0	2	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	ET1613								Course category			EX
Course Name	INTERNSHIP/ TECHNICAL PROJECT											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	16	16	00	00	00	00	---	100	00	100	08

Course Objectives: Students undergoing this course are expected

I. To develop skills in doing literature survey, technical presentation and report preparation
II. To perceive the idea and decide the objectives of project from literature survey
III. To enable project identification and execution of preliminary works on project

A) Project

Course Contents:

1. Preferably more than 25 % projects shall be Industry oriented / Research based.
2. Exhaustive survey of literature based on a clear definition of the s cope and focus of the topic should be carried out by the students.
3. Students should finalize the topic for the project after literature survey in consultation with the Guide.
4. The **Synopsis/Abstract** on the selected topic should be submitted to the department for approval.
5. On approval of the topic, students should initiate the topic based work.
6. Students should complete implementation of ideas given in synopsis, so that project work should be completed before end of semester.
7. Students shall submit the final project report in proper format as per guide lines given on the college website which shall include the work of both semesters.
8. For uniform and continuous evaluation, evaluation committee for each group s hall be formed by Program Head in which guide must be a member. Internal marks should be awarded by committee at the end of semester based on continuous evaluation.
9. Final examination of project shall include demonstration, presentation of complete work and oral examination based on the project work.

B) Industry Internship Project

1. The aim of Industry Internship Project is to closely work with industry to apply theoretical knowledge in a real-world context providing real industrial project enabling learning focused on the application knowledge. This gives a student an opportunity to make their first traces in the industrial reality and start building a personal network, an important prerequisite for a successful industry career.
2. The purpose of the INDUSTRY INTERSHIP PROJECT to solve real industrial problems by following established engineering methods, working in teams, and effectively communicating with various stakeholders.
3. The students can work in group decided by the department as per availability of Faculty. The individual students can also undertake the Industry Institute Project subject to availability of Industry Mentor/Guide. Students/Group selects the industry which is ready to provide INDUSTRY INTERSHIP PROJECT through oral/written communication. Once selected the student group has to visit the industry/stay as per need. The institute will not provide any assistance in Travel and Stay. The student/ Group need to submit acceptance letter from Industry regarding allowing the student/groups for INDUSTRY INTERSHIP PROJECT stating the Project name or research area.
4. Each group has an Industry Project Guide and Institute Project Guide. The meeting with Project guide is once within week/two week at Institute. These meetings typically include assistance in finding solutions recent problems in the projects, technical support on applied software packages, and support with writing the final report. The project groups do multiple company visits where they meet the industrial contacts to formulate the problem, collect data and information, and gain necessary experiences from the industry.
5. Furthermore, INDUSTRY INTERSHIP PROJECT includes seminars aiming to give the students experience of communicating to a larger audience, working in teams, etc. The Project monitoring will be done by Institute Guide to know whether learning objective is achieved or not.
6. The INDUSTRY INTERSHIP PROJECT undergone individual student/ Group will have to submit following documents on the successful completion of Industry Institute Project
   i. Authenticated attendance record from Industry internship project mentor/supervisor/Guide
   ii. Industry internship project signed by Industry Mentor/Guide
   iii. Industry internship project Completion Letter by Industry Mentor/ Guide
   iv. Project evaluation report signed by Industry Mentor/ Guide

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the

students in the Project work and knowledge/skill acquired. Oral examination shall be conducted on the Project report, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by Program Head.

Course Outcomes:

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

ET1613.1 Perceive the idea and decide the objectives of project from literature survey

ET1613.2 Integrate information from multiple sources.

ET1613.3 Identify, analyze, and solve problems creatively through sustained critical investigation.

ET1613.4 Implement the idea with effective leadership in prescribed schedule

ET1613. 5 Prepare the effective technical document related to work carried out

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1613.1	3	1	3	0	0	0	0	0	3	0	2	0	3	2	1
ET1613.2	2	3	2	3	0	0	0	0	2	0	3	0	1	3	0
ET1613.3	2	2	3	2	0	0	0	0	2	0	2	0	2	2	2
ET1613.4	2	2	3	2	0	0	0	0	2	0	2	0	2	3	3
ET1613.5	2	2	3	0	0	0	0	0	2	0	3	0	1	2	3

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1613.1	3	1	3	0	0	0	0	3	0	2	0	3	2	1
ET1613.2	2	3	2	3	0	0	0	2	0	3	0	1	3	0
ET1613.3	2	2	3	2	0	0	0	2	0	2	0	2	2	2
ET1613.4	2	2	3	2	0	0	0	2	0	2	0	2	3	3
ET1613.5	2	2	3	0	0	0	0	2	0	3	0	1	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

PROGRAM ELECTIVES HONOR'S COURSES

Course Code	**ET1621**							**Course category**			**PEH**
Course Name	**WAVELET SIGNAL PROCESSING**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	00	00	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To study Fourier series and transform (continuous and discrete)
II. To study basic concept and definition of TFA
III. To understand general properties, interference and pseudo WVD
IV. To study definition and interpretation of CWT

Course Content:

Basic definitions and concepts of Time Frequency Analysis: duration bandwidth principle, joint energy density, short-time Fourier transform (STFT), Wigner-Ville distributions and wavelet transforms.
Continuous Wavelet Transform: Wavelet transform-A first level introduction, Continuous time-frequency representation of signals, Properties of wavelets used in continuous wavelet transform, Continuous versus discrete wavelet transform. Discrete-Time Fourier Series, Discrete-Time Fourier Transform, Discrete Fourier Transform & Periodogram.
TFA: Basic Concepts & Definition, Bandwidth Equation, Instantaneous Frequency, Analytic Signals and Multicomponent Signals. Duration-Bandwidth Principle Joint Energy Density, Short Time Fourier Transform: Definition and Interpretations, General Properties, Applications of STFT.
Definition and Interpretations of WVD, Properties of WVD, Interference and Pseudo WVD, Cohen's class, Connections with Spectrogram, Applications of WVD.
Definition and Interpretations of CWT and DWT, Wavelets, TFA and Filtering Perspective, Scalogram, Scaling Function, Practical Aspects, Wavelet Maxima and Ridges, Application of CWT, Frame Theory: Quick Round-up, Multiresolution Approximation, Orthonormal Bases and Conjugate Mirror Filters, DWT Implementation: Pyramidal Algorithm, Choosing a Wavelet, Handling Boundary Effects, De-noising & Signal Estimation, Application of DWT.

Text Book:

1. Insight into Wavelets: From Theory to Practice, (Third Edition), K. P. Soman, K. I. Rmachandran, N. G. Resmi, PHI Learning Pvt. Ltd., 2010.
2. Introduction to Wavelets and Wavelet Transform, C. S. Burrus, Ramose and A. Gopinath, Prentice Hall Inc.

Reference Book:

1. A Wavelet Tour of Signal Processing, 2nd edition, S. Mallat, Academic Press, 1999.
2. Wavelet transforms: Introduction, Theory and applications, Raghuveer rao and Ajit S. Bopardikar, Pearson Education Asia, 2000.
3. Multiresolution signal Decomposition: Transforms, Subbands and Wavelets, A.N. Akansu and R.A. Haddad, Academic Press, Oranld, Florida, 1992.
4. Wavelets and signal processing: An application based introduction, Stark, Springer, 2005.
5. Insight into wavelets: From theory to Practice-K P Soman and K I Ramachandran, Prentice Hall of India

Web Resources:

https://archive.nptel.ac.in/noc/courses/noc16/SEM2/noc160ch05/

Course Outcome:

On completion of the course, students will be able to

ET1621.1 Study Continuous Time Fourier series and transform
ET1621.2 Study Discrete Time Fourier series and transform
ET1621.3 Study basic concept and definition of TFA
ET1621.4 Understand general properties, interference and pseudo WVD
ET1621.5 Describe interpretation of CWT and DWT

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1621.1	3	2	0	0	0	0	0	0	0	0	0	0	2	3	0
ET1621.2	3	3	0	0	0	0	0	0	0	0	0	0	2	3	0
ET1621.3	3	2	0	0	0	0	0	0	0	0	0	0	2	3	0
ET1621.4	3	3	0	0	0	0	0	0	0	0	0	0	2	3	0
ET1621.5	3	3	0	0	0	0	0	0	0	0	0	0	2	3	0

0- Not Correlated 1-Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1621.1	3	2	0	0	0	0	0	0	0	0	0	2	3	0
ET1621.2	3	3	0	0	0	0	0	0	0	0	0	2	3	0
ET1621.3	3	2	0	0	0	0	0	0	0	0	0	2	3	0
ET1621.4	3	3	0	0	0	0	0	0	0	0	0	2	3	0
ET1621.5	3	3	0	0	0	0	0	0	0	0	0	2	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**ET1622**							**Course category**			**PEH**
Course Name	**ADVANCED DIGITAL SIGNAL PROCESSING**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	00	00	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected to

I. Understand the basic concept of Wavelet and Multirate DSP
II. Understand the idea of wavelets, and the related notions of time frequency analysis, of time-scale analysis.
III. Know about the technical developments related to wavelets applications.
IV. Study multi-rate filter banks.
V. Apply the algorithms for wide area of recent applications.

Course Content:

Basic concepts of signals system theory: digital signal processing & discrete time signal processing, time-frequency analysis, Concept of Wavelets and Multirate Digital Signal Processing, multiresolution/ multiscale analysis, Piecewise constant approximation - the Haar wavelet, concept of dyadic Multiresolution Analysis (MRA), Equivalence - Functions And Sequences, Haar Filter Bank Analysis and Synthesis, Relating psi, phi and the Filters, Iterating the filter bank from Psi, Phi, Z-Domain Analysis Of Multi-rate Filter Bank, Two Channel Filter Bank, Perfect Reconstruction: Conjugate Quadrature Filters - Daubechies Family of MRA, Daubechies' Filter Banks.

Time and Frequency: Joint Perspective, Ideal Time Frequency behavior, The Uncertainty Principle, Time Bandwidth Product Uncertainty, Evaluating and Bounding square root omega, The Time Frequency Plane & its Tilings.

Short time Fourier Transform & Wavelet Transform: Reconstruction & Admissibility, Admissibility in Detail Discretization of Scale, Logarithmic Scale Discretization, Dyadic Discretization, Theorem of (DYADIC) Multiresolution Analysis, Variants of The Multiresolution Analysis Concept, JPEG 2000 5/3 Filter Bank & Spline MRA, Orthogonal Multiresolution Analysis with Splines, Building Piecewise Linear Scaling Function, Wavelet, Wave Packet Transform, Nobel Identities & The Haar Wave Packet Transform, Lattice Structure for Orthogonal Filter Banks, Constructing the Lattice & its Variants.

Lifting Structure & Polyphase Matrices: Polyphase Approach - The Modulation Approach, Modulation Analysis and the 3-Band Filter Bank, Applications, Applications of Data Mining and Face Recognition, M-Band Filter Banks.

Two band Filter Bank: Frequency Domain Analysis of Two band Filter Bank, Zoom in and Zoom out using Wavelet Transform, Wavelets through vanishing moments, Scaling Coefficients, Wavelet Applications.

Text Books:

1. The World according to Wavelets - A Story of a Mathematical Technique in the making, by Barbara Burke Hubbard, Second Edition, Universities Press (Private) India Limited 2003,
2. Fractal and Wavelet Image Compression Techniques, by Stephen Welstead, Prentice Hall of India, New Delhi – Eastern Economy Edition, ISBN 810203 282702,
3. Fourier and Wavelet Analysis, by George Bachman, Lawrence Narici, Edward Beckenstein, Springer International Edition (SIE), ISBN 8108128027600.

Reference Books:

1. Wavelet Analysis: The Scalable Structure of Information ,by Howard L. Resnikoff, Raymond O. Wells, Springer, 1998: available in Indian Edition.
2. Wavelet Transforms: Introduction to Theory and Applications by Raghuveer M. Rao, Ajit S. Bopardikar,
3. Insight Into Wavelets - From Theory to Practice,by K. P. Soman, K. I. Ramachandran, Prentice Hall of India, Eastern Economy Edition
4. An Introduction to Wavelets Through Linear Algebra, Michael W. Frazier, Springer,
5. Multirate Systems and Filter Banks, by P. P. Vaidyanathan, Pearson Education, Low Price Edition

Web Resources:

https://archive.nptel.ac.in/courses/117/101/117101001/

Course Outcomes:

On completion of the course, students will be able to

ET1622.1 Describe Basic exposition to signals system theory perhaps digital signal processing and discrete time signal processing.

ET1622.2 Introduce the idea of wavelets, and the related notions of time frequency analysis, of time-scale analysis.

ET1622.3 Describe the manner in which technical developments related to wavelets have led to numerous applications.

ET1622.4 Design multi-rate filter banks.

ET1622.5 Verify algorithms for wide area of recent applications.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1622.1	3	3	1	2	0	0	0	0	0	0	0	0	2	2	0
ET1622.2	3	2	3	2	0	0	0	0	0	0	0	0	2	3	1
ET1622.3	2	3	0	3	1	0	0	0	0	0	0	0	2	3	1
ET1622.4	3	3	3	2	2	0	0	0	0	0	0	0	3	1	1
ET1622.5	3	3	0	3	2	0	0	0	0	0	0	0	2	3	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
ET1622.1	3	3	1	2	0	0	0	0	0	0	0	2	2	0
ET1622.2	3	2	3	2	0	0	0	0	0	0	0	2	3	1
ET1622.3	2	3	0	3	1	0	0	0	0	0	0	2	3	1
ET1622.4	3	3	3	2	2	0	0	0	0	0	0	3	1	1
ET1622.5	3	3	0	3	2	0	0	0	0	0	0	2	3	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Sign	Sign	Sign	Sign
Member Secretary	BoS Chairperson	Dean, Academics	Principal

Course Code	**ET1651**						**Course Category**			**PER**
Course Name	**RESEARCH PROJECT STAGE – II**									
Teaching Scheme				**Examination Scheme**						**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
--	--	12	12	--	--	--	--	--	100	100	200	06

Course Objectives: Students undergoing this course are expected to

I. Research design, including the sampling size and techniques
II. Relevant data and analyze it using modern data processing tools/Carry out experimentation.
III. Improving the ability of presentation skill and communication techniques

Course Contents:

Prepare the research design, including the sampling size and techniques and the statistical tools for the analysis of for the research topic decided in Stage-I (V Semester).

Collect the relevant data, analyze and interpret the same using modern data processing tool, and test the hypotheses if necessary.

Develop a plan for preparing a report. Publish review paper in peer view journal/Scopus indexed journal.

The faculty supervisor will assess the method and procedures used by the learner.

Internal Continuous Assessment (ICA):

At the end of semester, the work carried shall be evaluated by three-member committee constituted by Head of Department.

End Semester Examination (ESE):

The internal and external examiner appointed by the competent authority will assess the research work carried out by the student through oral presentation and demonstration (if any).

Course Outcomes:
After completion of the course, the students will be able to:

ET1651.1 Analyze and interpret data to produce useful information.

ET1651.2 Show in-depth skill to use some laboratory, modern tools and techniques.

ET1651.3 Communicate results, concepts, analyses and ideas in written and oral form.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1651.1	0	3	3	3	0	0	2	3	0	0	2	2	0	2	0
ET1651.2	3	0	0	0	3	0	0	0	0	0	0	3	3	0	0
ET1651.3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1622.1	0	3	3	3	0	0	3	0	0	2	2	0	2	0
ET1622.2	3	0	0	0	3	0	0	0	0	3	0	3	0	0
ET1622.3	0	0	0	0	0	0	0	0	3	0	0	0	0	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	**ET 1631**							**Course category**			**PEH**
Course Name	**COMPUTER VISION**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	00	00	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To solve real world problems with image or video as input, understanding the real-world scene is important from the input.
II. To make the use of low-level image processing, pattern recognition algorithms to provide information about the real-world scene.
III. To design the algorithms to understand real world scene and provide information about the real-world objects.
IV. To understand the applications in many areas such as biometric, medical image diagnosis, surveillance etc.

Course Content:

Image processing: Fundamentals of image processing, color processing, and range image processing

Geometry: 2-D projective geometry, homography, camera geometry, and stereo geometry

Feature detection: Feature detection and description, feature matching, and model fitting

Machine learning: Deep neural architecture and applications, and the basics of machine learning and deep learning for computer vision

Signal processing: Digital signal processing and multi-dimensional signal processing

Pattern analysis: Pattern analysis and visual geometric modeling Optimization, Stochastic optimization

Text Books:

1. Multiple View Geometry in Computer Vision: R. Hartley and A. Zisserman, Cambridge University Press.
2. Computer Vision: Algorithms & Applications, R. Szeleski, Springer

Reference Books:

1. Computer vision: A modern approach: Forsyth and Ponce, Pearson.
2. Computer Vision: Algorithms and Applications, Springer-Verlag London Limited, Richard Szeliski.
3. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce,Pearson Education, 2003

Web Resources:

Computer Vision: https://onlinecourses.nptel.ac.in/noc19_cs58/preview

Course Outcome:

On completion of the course, students will be able to

ET1631.1 Learn fundamentals of computer vision and its applications
ET1631.2 Understand the basic image processing operations to enhance, segment the images.
ET1631.3 Understand the analyzing and extraction of relevant features of the concerned domain problem.
ET1631.4 Understand and apply the motion concepts and its relevance in real time applications
ET1631.5 Apply the knowledge in solving high level vision problems like object recognition, image classification etc

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1631.1	1	1	1	0	0	0	0	0	0	0	0	0	2	0	0
ET1631.2	0	0	0	1	2	0	0	0	0	2	1	1	0	0	0
ET1631.3	2	1	0	0	0	0	0	0	1	0	0	0	0	1	1
ET1631.4	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0
ET1631.5	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1631.1	1	1	1	0	0	0	0	0	0	0	0	2	0	0
ET1631.2	0	0	0	1	2	0	0	0	2	1	1	0	0	0
ET1631.3	2	1	0	0	0	0	0	1	0	0	0	0	1	1
ET1631.4	0	0	0	0	1	0	1	0	0	1	0	0	0	0
ET1631.5	1	0	0	0	0	0	2	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Sign
Member Secretary

Sign
BoS Chairperson

Sign
Dean, Academics

Sign
Principal

Course Code	**ET 1632**							**Course category**			**PEH**
Course Name	**NATURAL LANGUAGE PROCESSING**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	00	00	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To understand linguistic phenomena and learn to model them with formal grammars.
II. To understand and carry out proper experimental methodology for training and evaluating empirical NLP systems.
III. To learn how to manipulate probabilities, construct statistical models over string sand trees
IV. To estimate parameters using supervised and unsupervised training methods.
V. To design, implement, and analyze NLP algorithms. Able to design different language modeling Techniques.

Course Content:

Natural Language processing (NLP) : Introduction, Applications or Use cases of NLP, Components of NLP, Steps in NLP, Finding the Structure of Words: Words and Their Components, Lexemes, Morphemes, Morphology, Problems in morphological processing, Typology, Morphological Typology

Natural Language Processing with python NLTK package (Text Preprocessing Tasks): Word Tokenization, Sentence Tokenization, Filtering Stop words, Stemming, Tagging Parts of Speech, Lemmatization, Chunking, Chinking, Named Entity Recognition, Term Frequency and Inverse Document Frequency (TF-IDF)

Syntax Analysis: Parsing Natural Language, Tree banks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure: Syntax Analysis using Dependency Graph, Syntax Analysis using Phrase Structure Trees, Parsing Algorithms: Shift Reduce Parsing, Hyper Graphs and Chart Parsing (CYK Parsing), Models for ambiguity Resolution in Parsing: Probabilistic Context Free Grammar, Generative Models, Discriminative models for Parsing

Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems.

Semantic Parsing: Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems, Software Predicate-Argument Structure, Meaning Representation Systems, Software. Discourse Processing: Cohesion, Reference Resolution, Discourse Cohesion and Structure.

Text Books:

1. Multilingual natural Language Processing Applications: From Theory to Practice–Daniel M. Bikel and Imed Zitouni, Pearson Publication.
2. Speech and Natural Language Processing- Daniel Jurafsky & James H Martin, Pearson Publications.

Reference Books:

1. Speech and Language Processing, by Dan Jurafsky and James Martin. Prentice Hall, Second Edition, 2009.
2. Foundations of Statistical Natural Language Processing by Chris Manning and Hinrich Schütze, MIT Press, Cambridge
3. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U. S. Tiwary.

Web Resources:

Natural Language Processing: https://onlinecourses.nptel.ac.in/noc23_cs45/preview

Course Outcome:

On completion of the course, students will be able to

ET1632.1 Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.

ET1632.2 Understand and carry out proper experimental methodology for training and evaluating Empirical NLP systems.

ET1632.3 Able to manipulate probabilities, construct statistical models over strings and trees

ET1632.4 Will be able to estimate parameters using supervised and unsupervised training methods.

ET1632.5 Able to design, implement, and analyze NLP algorithms. Able to design different language modeling Technique

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1632.1	1	1	1	0	0	0	0	0	0	0	0	0	2	0	0
ET1632.2	0	0	0	1	2	0	0	0	0	2	1	1	0	0	0
ET1632.3	2	1	0	0	0	0	0	0	1	0	0	0	0	1	1
ET1632.4	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0
ET1632.5	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1632.1	1	1	1	0	0	0	0	0	0	0	0	2	0	0
ET1632.2	0	0	0	1	2	0	0	0	2	1	1	0	0	0
ET1632.3	2	1	0	0	0	0	0	1	0	0	0	0	1	1
ET1632.4	0	0	0	0	1	0	1	0	0	1	0	0	0	0
ET1632.5	1	0	0	0	0	0	2	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Sign
Member Secretary

Sign
BoS Chairperson

Sign
Dean, Academics

Sign
Principal

MINOR COURSES FOR DOUBLE MINOR (EMBEDDED SYSTEM)

Course Code	**ET1641**							**Course category**			**MN**
Course Name	**REAL TIME OPERATING SYSTEM**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To introduce the principles shared by many real-time operating systems,
II. To Understand use in the development of embedded multitasking application software
III. To Study UNIX as Real Operating system.

Course Contents:

Introduction: Introduction to Operating System: Computer Hardware Organization, BIOS and Boot Process, Multi-threading concepts, Processes, Threads, Scheduling

Basics of Real-Time Concepts: Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel Basics of Tast Scheduling. Cyclic Executives, Cyclic Scheduler.

Process Management: Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals.

Inter Process Communication: Messages, Buffers, mailboxes, queues, semaphores, deadlock, priority inversion, Pipes Management: - Process stack management, run-time buffer size, swapping, overlays, block/page management, replacement algorithms and real time garbage collection.

RMA Generalization, Resource Sharing among Real time tasks, Solution and Priority inversion problem, Highest Locker protocol.

Case Studies: Case study Linux POSIX system, RTLinux / RTAI, Windows system, Vxworks, uItron Kernel Design Issues: structure, process states, data structures, inter-task communication mechanism, Linux Scheduling

Text Book:

1. J. J Labrosse, MicroC/OS-II: The Real –Time Kernel, Newnes, 2002.
2. Jane W. S. Liu, Real-time systems, Prentice Hall, 2000.

Reference Book:

1.W. Richard Stevens, Advanced Programming in the UNIX® Environment, 2nd Edition, Pearson Education India, 2011.
2. Philips A. Laplante, Real-Time System Design and Analysis, 3rd Edition, John Wley& Sons, 2004 3. Doug Abbott, Linux for Embedded and Real-Time Applications, Newnes, 2nd Edition, 2011.

Web Resources:

https://archive.nptel.ac.in/courses/106/105/106105172/

Course Outcome:

On completion of the course, students will be able to
ET1641.1 Understand the fundamental concepts of real-time operating systems.
ET1641.2 Understand hardware Consideration in RTOS.
ET1641.3 Understand Process Management and Synchronization.
ET1641.4 Access the Concept of RMA Generalization.
ET1641.5 Case Studies In Different Area of RTO

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1641.1	0	0	0	1	1	0	0	0	0	1	0	0	2	0	0
ET1641.2	0	1	0	1	0	0	2	0	0	2	1	1	0	0	0
ET1641.3	2	1	0	0	0	0	0	0	1	0	0	0	0	1	1
ET1641.4	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0
ET1641.5	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1641.1	0	0	0	1	1	0	0	0	1	0	0	2	0	0
ET1641.2	0	1	0	1	0	0	2	0	2	1	1	0	0	0
ET1641.3	2	1	0	0	0	0	0	1	0	0	0	0	1	1
ET1641.4	0	0	0	0	1	0	1	0	0	1	0	0	0	0
ET1641.5	1	0	0	0	0	0	2	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	ET1642							Course category			MN
Course Name	EMBEDDED SYSTEM DESIGN VERIFICATION										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives: Students undergoing this course are expected

I. To introduce the principles and modelling technique in Embedded system Design
II. To Understand use in the development of embedded multitasking application software
III. To get acquainted with architecture & design of an Embedded System.
IV. To Understand Digital testing and Embedded System hardware Testing.

Course Content:

Introduction: Introduction to Hardware design, Hardware and software Portioning, Architectural Synthesis of hardware, system level design: uniprocessor scheduling, Multiprocessor scheduling.

Temporal logic: Introduction and basic operators of temporal logic. Syntax and Semantics of CTL. Equivalence between CTL formulas, Model checking Algorithm.

BDD and Symbolic model checking: Binary decision diagram, use of OBDDs for state transition System, Symbolic Model checking.

Introduction to Digital Testing: Introduction to Digital VLSI Testing, Automatic test pattern generation (ATPG). Introduction to Embedded system hardware testing: Scan chain based sequential circuit testing, Software-Hardware co-validation fault modes and high-level testing for complex embedded system.

Embedded System hardware testing: Testing for Embedded cores, Bus and Memory Testing. Advanced in embedded system hardware testing: Testing for advanced faults in real time embedded System. BIST for embedded Systems.

Text Book:

1. Introduction to Embedded System, Shibu K. V., McGraw Hill Education
2. Embedded Real-time Systems Programming, S.V. Iyer & Pankaj Gupta, McGraw Hill Education
3. AVR Microcontroller and Embedded systems using assembly and C, Muhammad Ali Mazidi, Sarmad Naimi and Sephers Naimi, Pearson Education, Inc. publishing as Prentice Hall 2013.

Reference Book:

1. Embedded Systems, Rajkamal, 2nd Edition, Tata McGraw Hill
2. Scheduling in Real Time Systems, Cottet, Delacroix & Mammeri, John Wiley & Sons.

Web Resources:

https://archive.nptel.ac.in/courses/106/103/106103182/

Course Outcome:

On completion of the course, students will be able to
ET1642.1 Understand Hardware design And Interfaces in embedded System.
ET1642.2 Understand Temporal logic, Syntax and Semantics of CTL
ET1642.3 Understand BDD and Symbolic model checking.
ET1642.4 Knowledge of Digital Testing
ET1642.5 Access to Advanced hardware testing.

CO-PO-PSO Mapping as per NBA Jan-2016 Format

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ET1642.1	0	0	0	1	1	0	0	0	0	1	0	0	2	0	0
ET1642.2	0	1	0	1	0	0	2	0	0	2	1	1	0	0	0
ET1642.3	2	1	0	0	0	0	0	0	1	0	0	0	0	1	1
ET1642.4	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0
ET1642.5	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0

0- Not Correlated 1-Weakly Correlated 2-Moderately Correlated 3- Strongly Correlated

CO-PO-PSO Mapping as per NBA 1-Jan-2025 Format

CO	PO / PSO													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
ET1642.1	0	0	0	1	1	0	0	0	1	0	0	2	0	0
ET1642.2	0	1	0	1	0	0	2	0	2	1	1	0	0	0
ET1642.3	2	1	0	0	0	0	0	1	0	0	0	0	1	1
ET1642.4	0	0	0	0	1	0	1	0	0	1	0	0	0	0
ET1642.5	1	0	0	0	0	0	2	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Sign
Member Secretary

Sign
BoS Chairperson

Sign
Dean, Academics

Sign
Principal