Curriculum Structure for B. Tech. Instrumentation Engineering Programme

(In light of NEP 2020)

NCrF Level 6

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

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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)	--	

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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	82	08	90
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	**18**
			ES	16--12	12
Program Courses	64-76	**67**	PC	44-56	**47**
			PE	20	20
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	**164-176**	167		**164-176**	**167**

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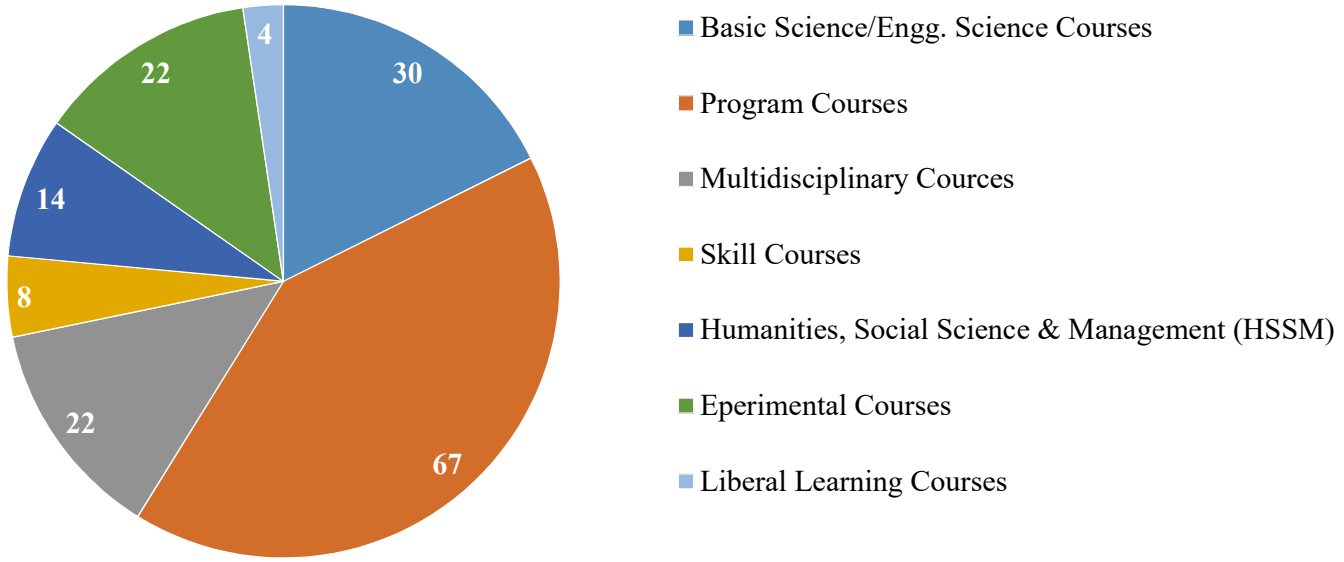
Broad Course Category Framewok Credits Percentage



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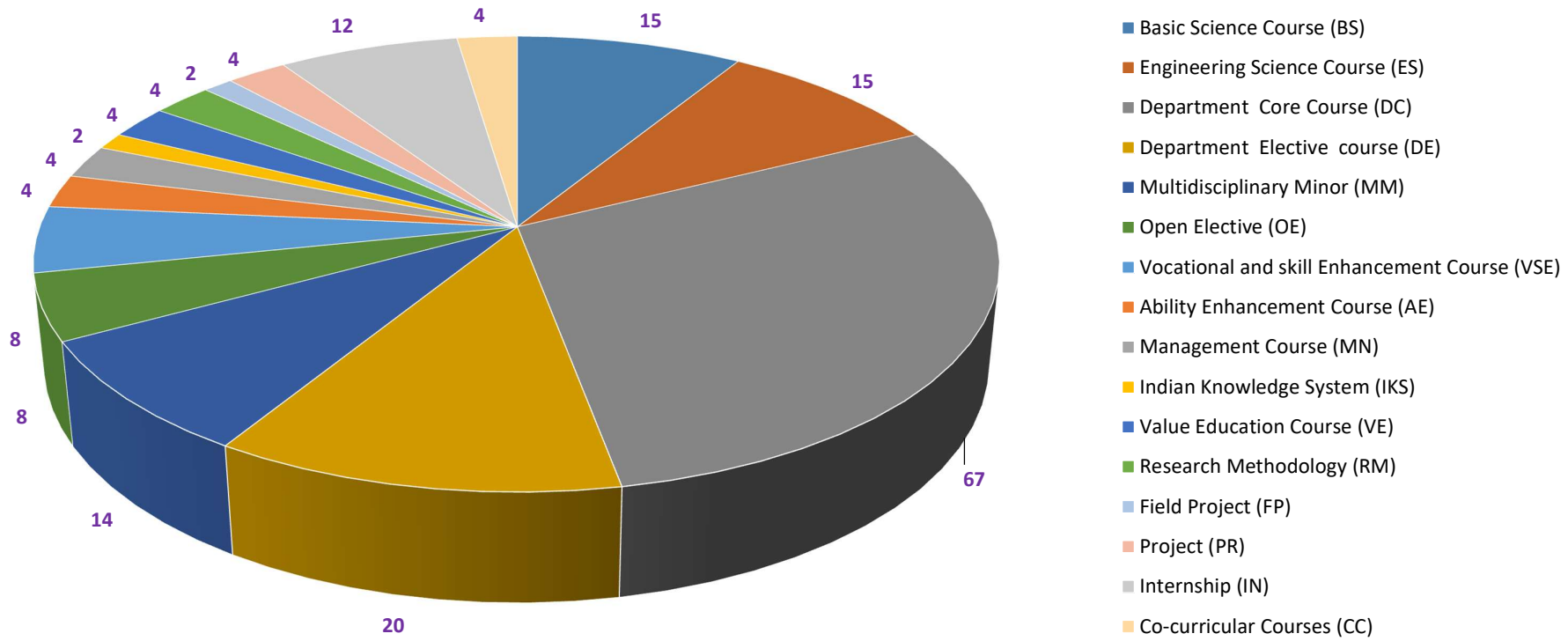
Course Category Credits



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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	12-16
3	Program Core Course (PC)		6	**10**	**11**	**10**	**7**	**3**		**47**	44-56
4	Program Elective Course (PE)					4	8	8		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	1	2	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**	**20**	**24**	**21**	**21**	**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 coursesPE1 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.

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(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. 2nd semester, 4th semester &6th semester and will commence from AY 2024-25 for UG Certificate, AY 2025-26 forUG 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. 1st, 3rd, 5th or 7th 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 84 **credits** are eligible for admission to the UG Bachelor's Degree with Honours/ Research/ Double Minor.

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SEMESTER –I														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
							Theory				**Practical**		**Total**	
		Induction Program	TH	TU	PR	Total	CT1	CT2	TA*	ESE	ICA*	ESE		
BS1	SH1121	Engineering Mathematics-I	3	1		4	15	15	10	60			100	4
BS2	SH1122	Engineering Physics	3			3	15	15	10	60			100	3
	SH1123	Engineering Physics Laboratory			2	2					25		25	1
ES1	EE1121	Basic Electrical Engineering	3			3	15	15	10	60			100	3
	EE1122	Basic Electrical Engineering Laboratory			2	2					25		25	1
ES2	CS1121	Programming for Problem Solving	2			2	15	15	10	60			100	2
	CS1122	Programming for Problem Solving Laboratory			2	2					25		25	1
ES3	ME1121	Workshop Practices			2	2					25		25	1
AE1	SH1124	Communication Skill			2	2	0	0	00		50		50	1
VE1	SH1125	Environment Science	2			2	15	15	20				50	2
IKS1	SH1126	Indian Knowledge System	2			2			40				40	2
Total			**15**	**1**	**10**	**26**	**75**	**75**	**100**	**240**	**150**		**640**	**21**

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SEMESTER –II

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT-1	CT-2	TA*	ESE	ICA *	ESE		
BS3	SH1221	Engineering Mathematics-II	3	1		4	15	15	10	60			100	4
BS4	SH1222	Engineering Chemistry	2			2	15	15	10	60			100	2
	SH1223	Engineering Chemistry Laboratory			2	2					25		25	1
ES4	ME1221	Engineering Graphics	2			2	15	15	10	60			100	2
	ME1222	Engineering Graphics Laboratory			2	2					25		25	1
PC1	IN1221	Elements of Measurement	3			3	15	15	10	60			100	3
ES5	IN1222	Elements of Measurement Lab			2	2					25		25	1
PC2	IN1223	Introduction to Mat LAB	2	1		3	15	15	10	60			100	3
AE2	SH1224	Modern Indian Language		2		2	15	15	20				50	2
VE2	SH1225	Universal Human Value	2			2	15	15	20				50	2
MNC1	SH1226	Yoga &Fitness			2	2			20				20	0
AE3	SH1227	Language Laboratory			2	2					25		25	1
			14	**3**	**10**	**28**	**105**	**105**	**110**	**300**	**100**		**720**	**22**

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Note : In first semester , the students of Civil, Electrical, Electronics &Telecommunication ,Instrumentation Engineering programmes will be offered the courses mentioned under Semester-I **AND** students of Mechanical , Computer Science Engineering and Information Technology will be offered the courses mentioned under Semester-II and in Second Semester Vice-versa except Engineering Mathematics-I (SH1101) and Engineering Mathematics-II (SH1201).

Equivalence code for NEP V1.0 to be used in NEP V2.0

Sr No	Course Name	Course code Used in NEP Ver 1.0	**New code in NEP V2.0**
1	Physics Laboratory	SH1104	SH1123
2	Basic Electrical & Electronics Laboratory	EE1201	EE1122
3	Workshop Practice	ME1102	ME1121
4	Communication Skill	SH1103	SH1124
5	Chemistry Laboratory	SH1204	SH1223
6	Engineering Graphics	ME1101	ME1221
7	Engineering Graphics Laboratory	ME1103	ME1223
8	Modern Indian Language	SH1203	SH1224

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Multiple exits: Following options are available for multiple exists:

Option	NCrFLevel	Qualification Title	Additional credit requirement	Bridge courses
Exit-1	4.5	One yr. 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 Yr 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 Yr 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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EXIT CRITERIA FOR U. G. Certificate														
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		
EX1	IN1211	Industrial Instrumentation	4			4				100				4
EX1	IN1212	Industrial Instrumentation Lab			4	4					25		50	4
		Technical Project/ Programming Language									25			
OR														
EX1	IN1213	Internship / Technical Project									100@		100	8
@ Based on seminar, Internship Report, Internship/ Project evaluation														

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SEMESTER –III														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
											Practical		**Total**	
			TH	TU	PR	Total	CT-1	**CT-2**	TA*	ESE	ICA*	ESE		
BS5	SH1301C	Transform and Differential Equations	3			3	15	15	10	60			100	3
MM1	IN1315/IN1316	Industrial Measurements I/Banking operation Management	3			3	15	15	10	60			100	3
PC3	IN1301	Sensor & Transducers I	3			3	15	15	10	60			100	3
PC4	IN1302	Electronic Devices & Circuits	3			3	15	15	10	60			100	3
PC5	IN1303	Digital Electronics	3			3	15	15	10	60			100	3
PC6	IN1304	Sensor & Transducers I Lab			2	2					25	25	50	1
VSE1	IN1305	Electronic Devices & Circuits Lab			2	2					25	25	50	1
VSE2	IN1306	Digital Electronics Lab			2	2					50		50	1
EM1	**IN1310**	**IDEA Lab**			**2**	**2**					**50**		**50**	**1**
Total			**15**	**0**	**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	IN1415/ IN1416	Industrial Measurement – II/Strategic Management & Innovation in banking	3			3	15	15	10	60			100	3
PC7	IN1401	Automatic Control System	3			3	15	15	10	60			100	3
PC8	IN1402	Linear Integrated Circuits	3			3	15	15	10	60			100	3
PC9	IN1403	Sensor & Transducers II	3			3	15	15	10	60			100	3
OE1	SH1401	Open Elective-I	3			3	15	15	10	60			100	3
PC10	IN1404	Automatic Control System Lab			2	2					50		50	1
PC11	IN1405	Linear Integrated Circuits Lab			2	2					50		50	1
VSE3	IN1406	Sensor & Transducers II Lab			2	2					25	25	50	1
CC1	SH1402	Co-curricular Course			4	4			20				20	2
Total			**15**	**0**	**10**	**25**	**75**	**75**	**70**	**300**	**125**	**25**	**670**	**20**
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Co-Curricular Course Activities minimum hours:2 hours per week or 24 hours Co-Curricular Course: Active Participation in Activities such as: Health and wellness, Sports, yoga education, Tech-fest, College Club Activity, University level/ college level cultural activities, Drama, painting, fine/ applied/ visual performing arts, annual day, department student's association/IE/ISTE/Any professional body, paper presentation, foreign language certificate, NCC, NSS etc. Co-Curricular Course Activities minimum hours: 2 hours per week or 24 hours."

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Direct Second Year [Instrumentation Engineering] admitted students have to earn additional IN 1221 course subject credit in NEP scheme in addition to regular courses

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	IN1415/ IN1416	Industrial Measurement –II/Strategic Management & Innovation in banking	3			3	15	15	10	60			100	3
PC7	IN1401	Automatic Control System	3			3	15	15	10	60			100	3
PC8	IN1402	Linear Integrated Circuits	3			3	15	15	10	60			100	3
PC9	IN1403	Sensor & Transducers II	3			3	15	15	10	60			100	3
OE1	SH1401	Open Elective-I	3			3	15	15	10	60			100	3
PC10	IN1404	Automatic Control System Lab			2	2					50		50	1
PC11	IN1405	Linear Integrated Circuits Lab			2	2					50		50	1
VSE3	IN1406	Sensor & Transducers II Lab			2	2					25	25	50	1
CC1	SH1402	Co-curricular Course			4	4			20				20	2
PC1	IN1407	Elements of Measurement	3			3	15	15	10	60			100	3#
Total			**18**	**0**	**10**	**28**	**90**	**90**	**80**	**360**	**125**	**25**	**770**	**23**
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#IN1407 to be completed by Direct Second year admitted students either in Online / Self Study mode equivalent to that of IN 1221 [Second Semester] Elements of Measurement [Ref APEC Meeting Date 05 Sept 2024]

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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	IN1411	IOT based Application									50		50	4
EX2	IN1412	PCB design & Circuit simulator									50		50	4
OR														
EX2	XX1413	Internship / Technical Project									100 @		100	8

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

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Equivalence Scheme Second Year

[Equivalence Old second year to NEP-Phase II new version]

Programme Name:-B. Tech. Instrumentation Engineering

Sr.	Course code & course Name Old[2019-2020]			Course code & course Name New NEP VII		
	Course Code	Course Name	Credits	Course Code	Course Name	Credits
ODD Semester						
1.	SHU321C SHU322C	Transform and Statistical Methods / Integral Calculus And Probability	4	SH1301(C)	Transform and Differential Equations	3
2.	INU321	Sensors and Transducers-I	3	IN1301	Sensor & Transducers I	3
3.	INU322	Electrical Measurement and Instrumentation	3	No equivalence		
4.	INU323	Electronics Devices and Circuits	3	IN1302	Electronics Devices and Circuits	3
5.	SHU325	Human values and ethics	0	No equivalence		
6.	INU324	Sensors and transducers-I Lab	1	IN1304	Sensors and transducers-I Lab	1
7.	INU325	Electrical	1	No equivalence		

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		Measurement and Instrumentation Lab				
8.	INU326	Electronics Devices and Circuits Lab	1	IN1305	Electronics Devices and Circuits Lab	1
9.	INU327	Computational Methods Lab	1	No equivalence		
10.	SHU232	Introduction to Constitution of India	0	No equivalence		
EVEN Semester						
1.	INU421	Sensors and Transducers-II	3	IN1403	Sensors and Transducers-II	3
2.	INU422	Linear Integrated Circuits	4	IN1402	Linear Integrated Circuits	3
3.	INU423	Control System Engineering	4	IN1401	Automatic Control System	3
4.	INU424	Signals and Systems	3	IN1501	Signals and Systems	3
5.	INU425	Digital Electronics	3	IN1303	Digital Electronics	3
6.	SHU422	Environmental Studies	0	No equivalence		
7.	INU426	Sensors and Transducers-II Lab	1	IN1304	Sensors and Transducers-II Lab	1
8.	INU427	Linear Integrated Circuits Lab	1	IN1405	Linear Integrated Circuits Lab	1
9.	INU428	Control System Engineering Lab	1	IN1404	Automatic Control System Lab	1

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10.	INU429	Signals and Systems Lab	1	No equivalence		
11.	INU430	Digital Electronics Lab	1	1306	Digital Electronics Lab	1

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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	IN1515/ IN1516	Control System Engineering / Security Analysis &Portfolio Management	3			3	15	15	10	60			100	3
PC12	IN1501	Signal & System	3			3	15	15	10	60			100	3
PC13	IN1502	Industrial Automation	3			3	15	15	10	60			100	3
PC14	IN1503	Unit Operations	3			3	15	15	10	60			100	3
PE1	IN1504	Program Elective 1	3	1		4	15	15	10	60			100	4
OE2	SH1501	Open Elective –II	3			3	15	15	10	60			100	3
VSE4	IN1505	Virtual Instrumentation Lab			4	4					50		50	2
PC15	IN1506	Industrial Automation Lab			2	2					25	25	50	1
CC2	SH1502	Co-curricular Course			4	4			20				20	2
MNC2	SH1503	Soft Skills	2			2			20				20	0
Total			**20**	**1**	**10**	**31**	**90**	**90**	**100**	**360**	**75**	**25**	**740**	**24**
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Co-Curricular Course Activities minimum hours:2 hours per week or 24 hours Co-Curricular Course: Active Participation in Activities such as: Health and wellness, Sports, yoga education, Tech-fest, College Club Activity, University level/ college level cultural activities, Drama, painting, fine/ applied/ visual performing arts, annual day, department student's association/IE/ISTE/Any professional body, paper presentation, foreign language certificate, NCC, NSS etc. Co-Curricular Course Activities minimum hours: 2 hours per week or 24 hours."

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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	IN1521	Neural Based Control (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10	60			100	3
PEH2	IN1522	Digital Image Processing (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10	60			100	3
	Total													**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	IN1531	Research Project Stage 1			08	08					100		100	4
Total					08	08					100		100	4

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ADDITIONAL CRITERIA FOR DOUBLE MINOR (INDUSTRIAL AUTOMATION)														
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	IN1541	Sensor Design	3				15	15	10	60			100	3
MN2	IN1542	Robotics and Control	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	CT 1	CT 2	TA *	ESE	ICA *	ESE		
MM4	IN1615/IN 1616	Industrial Automation / Spreadsheet based data analysis	3			3	15	15	10	60			100	3
PC16	IN1601	Process Control	3			3	15	15	10	60			100	3
PC17	IN1602	Digital Signal processing	3			3	15	15	10	60			100	3
PE2	IN1603	Program Elective II	3	1		4	15	15	10	60			100	4
PE3	IN1604	Program Elective III	3	1		4	15	15	10	60			100	4
PC18	IN1605	Process Control Lab			2	2					25	25	50	1
VSE5	IN1606	Digital Signal processing Lab			2	2					50		50	1
FP	IN1607	Minor Project			4	4					50		50	2
MNC3	IN1608	Program specific course PCB Design	2			2	15	15	20					0
MNC4	SH1601	NCC/NSS/ Community service etc.							20				20	0
Total			**17**	**1**	**8**	**27**	**90**	**90**	**90**	**300**	**125**	**25**	**670**	**21**
***: student will be assessed based on material presented in the form of assignment/practical journal through self learning mode**														

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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	IN1611	Skill Based Courses on Industrial Automation in any one process Industry									50		50	4
EX3	IN1612	Instrumentation System Design Lab									50		50	4
OR														
EX3	IN1613	Internship / Technical Project									100@		100	8

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

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Equivalence Scheme
[Equivalence Old Third year to NEP-new version]
Programme Name:-B. Tech. Instrumentation Engineering

Sr.	Course code & course Name Old [2019-2020]			Course code & course Name New NEP VER-II [w.e.f. 2025-2026]		
	Course Code	Course Name	Credits	Course Code	Course Name	Credits
FIFTH SEMESTER						
1	INU423	Control System Engineering	3	IN1515	Control system Engineering	3
2	No Equivalence			IN1516	Security analysis & Portfolio Management	3
3	INU424	Signals and System	3	IN1501	Signals & System	3
4	INU622	Industrial Automation	3	IN1502	Industrial Automation	3
5	INU522	Unit Operation	3	IN1503	Unit Operations	3
6	INU625	Biomedical Engineering		IN1504 A	Biomedical Engineering	4

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7	INU626 F	Mechatronics	3	IN1504 B	Mechatronics	4
8	No Equivalence			IN1504 C	Digital Control	4
9	No Equivalence			IN1505	Virtual Instrumentation Lab	2
10	INU628	Industrial Automation Lab	1	IN1506	Industrial Automation Lab	1
SIXTH SEMESTER						
1. 1	INU622	Industrial Automation	3	IN1615	Industrial Automation	3
2.				IN1616	Spreadsheet based data analysis	4
3.	INU621	Process Control	4	IN1601	Process Control	3
4.	INU524	Digital Signal Processing	3	IN1602	Digital Signal Processing	3
5.	INU521 E	Biomedical Signal Processing	3	IN 1603 A	Biomedical Signal Processing	4
6.	INU525	AnalyticalInstrumentation	3	IN 1603 B	AnalyticalInstrumentation	4
7.	INU723D	Process Modelling Optimization	3	IN 1603 C	Process Modelling Optimization	4

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8.	INU626 E	Biomedical ImageProcessing	3	IN 1604 A	Biomedical ImageProcessing	4
9.	INU724F	Building Automation	3	IN 1604B	BuildingAutomation	4
10.	INU724A	Neural FuzzyControl	3	IN 1604C	Neural FuzzyControl	4
11.	INU627	Process Control Lab	1	IN1605	Process Control Lab	1
12.	INU528	Digital Signal Processing Lab		IN1606	Digital Signal Processing Lab	1
13.	INU630	Minor Project	2	IN1607	Minor Project	2
14.	No Equivalence			IN1608	PCB Design	0

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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	IN1621	Speech and audio signal processing (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10	60			100	3
PEH4	IN1622	Wavelet Transform and its Application(Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10	60			100	3
	Total													**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	IN1631	Research Project Stage 2			12						100	100	200	6
Total					12						100	100	200	6

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ADDITIONAL CRITERIA FOR DOUBLE MINOR (INDUSTRIAL AUTOMATION)															
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	IN1641	Industrial Drives From Basket	3				15	15	10	60			100		3
MN4	IN1642	Advance Programming for various PLC/DCS/SCADA 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	CT 1	CT2	TA *	ESE	ICA *	ESE		
MM5	IN1715/ IN1716	Programming for PLC, DCS, SCADA / IT Operation & Management	2		1	3	15	15	10	60			100	2
PC19	IN1701	Instrument System Design	3			3	15	15	10	60			100	3
PE4	IN1702	Program Elective 4	3	1		4	15	15	10	60			100	4
PE5	IN1703	Program Elective 5	4			4	15	15	10	60			100	4
OE3	SH1701	Open Elective 3	2			2	15	15	10	60			100	2
VSE6	IN1704	Program Elective 4 Lab			2	2					25	25	50	1
VSE7	IN1705	Instrument System Design Lab			2	2					50		50	1
PR	IN1706	Project			8	8					50	50	100	4
MNC5	IN1707	Advance Sensor Technology in Instrumentation	2			2	15	15	20				50	0
Total			**17**	**1**	**12**	**30**	**90**	**90**	**70**	**300**	**125**	**75**	**750**	**21**
***: student will be assessed based on material presented in the form of assignment/practical journal through self learning mode**														

Note: Project Guide Teaching load: 8 hrs/week Students can register for the elective in seventh semester under Multidisciplinary Minor 4 using **SWAYAM/NPTEL** etc. portal. Courses will be of completely student's choice but approved by DFB of concerned department (other than MM1 to MM3) and should be **at least of 12 weeks** including tutorials, which will be considered as **4 credit course**.

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 VIIth semester.

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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			
PEH5	IN1721	Process Equipment Design (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10	60			100		3
PEH6	IN1722	Applied Instrumentation system design (Swayam/MOOCS/NPTEL/ Online) from Basket					15	15	10	60			100		3
	Total														**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	CT 1	CT2	TA	ESE	ICA	ESE			
PER3	IN1731	Research Project Stage 3			16	16					100	200	300		8
Total											100	200	300		8

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ADDITIONAL CRITERIA FOR DOUBLE MINOR (INDUSTRIAL AUTOMATION)														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT 2	TA	ESE	ICA	ESE		
MN5	IN1741	Minor Track Course 5 From Basket	3				15	15	10	60			100	3
MN6	IN1741	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	IN1801	Project Engg Management	3			3	15	15	10	60			100		3
IN	IN1802	Internship (Online reviews - one in each month)									100	200	300		12
		Total	7			7	30	30	20	120	100	200	500		19
***: student will be assessed based on material presented in the form of assignment/practical journal through self learning mode**															

Note: Internship Guide Teaching load: 4 hrs/week

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LIST OF PROGRAM ELECTIVES					
	PE1 IN1504	**PE2 IN1603**	**PE3 IN1604**	**PE4 IN1702**	**PE5 IN1703**
A	Biomedical Instrumentation	Biomedical Signal processing	Biomedical Image Processing	Biomedical Equipment Techniques	Rehabilitation Engineering
B	Mechatronics	Analytical Instrumentation	Building Automation	Modern Control Theory	Embedded Sensing, Actuation and Interfacing System
C	Digital Control	Process Modelling Optimization	Neural Fuzzy Control	Environmental Pollution Control	Adaptive & Optimum Control System
D	Network Analysis	Power Electronics	Power Plant Instrumentation	Electrical Machine	Cyber Security
	SWAYAM/NPTELetc related to vertical approved by DFB	**SWAYAM/NPTEL** etc related to vertical approved by DFB	**SWAYAM/NPTEL** etc. related to vertical approved by DFB	**SWAYAM/NPTEL** etc. related to vertical approved by DFB	**SWAYAM/NPTEL** etc related to vertical approved by DFB

SWAYAM/NPTEL 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 MULTIDISCIPLINARY 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 Technology (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 Mechatronics 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 Engineering(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 Foundation	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 Fundamentals 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
Appreciating Indian Music	**Environmental law**	Operational Research
Introduction to Human Psychology	**Cyber law**	Digital Marketing
Nanotechnology, Science and Application	**Introduction to Mass Communication**	Biology for Engineers
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	**Instrumentation and Control**
IN1521	Neural Based Control
IN1522	Digital Image Processing
IN1621	Speech and Audio Signal Processing
IN1622	Wavelet transform and Its Application
IN1721	Process Equipment Design
IN1722	Applied Instrumentation System Design

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LIST OF MINOR COURSES FOR DOUBLE MINOR (INDUSTRIAL AUTOMATION)							
COURSE CODE	**Civil Engineering**	**Mechanical Engineering**	**Electrical Engineering**	**Electronics Engineering**	**Computer Engineering**	**Information Technology**	**Instrumentation Engineering**
IN1541							Sensor Design
IN1542							Robotics and Control
IN1641							Industrial Drives
IN1642							Advance Programming for various PLC/SCADA /DCS system
IN1741							Process Equipment Design
IN1742							AI based Control applications

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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

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- 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

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SEMESTER –III

Course Code	SH1301(C)	Course category	BS
Course Name	TRANSFORM AND DIFFERENTIAL EQUATIONS		

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: Aim of the course is to:

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

II. To learn Laplace transform and its properties. Apply it to solve differential equation

III. To equip students with Vector spaces mostly used in varied applications in engineering and science.

IV. To learn inner product spaces and related processes.

V. To learn vector calculus and their applications

Course Contents

Partial differential equations and its applications:

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 :

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 equation

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Vector Spaces :

Vector spaces and Subspaces, Linear dependence and Independence of vectors, Bases and dimensions, Coordinate vectors, Linear transformation, Algebra of linear transformation, Representation of linear transformation of matrices relative to basis.

Random Variables and Probability Distributions:

Random variables, Discrete and Continuous random variables, Distribution functions, Probability distribution of continuous random variable. Joint distribution of discrete and continuous random variables, Conditional distribution, Mathematical expectation, Mean, moments and variance. Variance for joint distribution and Covariance

Vector Calculus:

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. Advanced 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 McGraw Hill Publishing company Ltd. New Delhi,2008, 6th edition.
3. Advanced Engineering mathematics, Reena Garg, Khanna book publishing company, 2021
4. Introduction to Probability Theory, P. G. Hoel, S. C. Port and C. J. Stone, Universal BookStall, 2003(Reprint).
5. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India,2002.
6. An Introduction to Probability Theory and its Applications, W. Feller, Vol. 1, 3rd Ed., Wiley,1968

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Course Outcomes:

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

1301C.1. Study solution of partial differential equations and apply it to solve wave and heat equations.

1301C.2. Study Laplace transform and its properties. Apply it to solve differential equation

1301C.3. Equip students with Vector spaces mostly used in varied applications in engineering and science.

1301C.4. Study inner product spaces and related processes.

1301C.5. Solve vector calculus problems and their applications

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

Course Outcome	Program Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
SH1301C.1	3	3	3	3	3	0	0	0	0	0	0	0	2	0	0
SH1301C.2	3	3	3	3	3	0	0	0	0	0	0	0	2	0	0
SH1301C.3	3	3	3	3	3	0	0	0	0	0	0	0	2	0	0
SH1301C.4	3	3	3	3	3	0	0	0	0	0	0	0	2	0	0
SH1301C.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

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcome	Program Outcome													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
SH1301C	3	3	3	3	3	0	0	0	0	0	0	2	0	0
SH1301C	3	3	3	3	3	0	0	0	0	0	0	2	0	0
SH1301C	3	3	3	3	3	0	0	0	0	0	0	2	0	0
SH1301C	3	3	3	3	3	0	0	0	0	0	0	2	0	0
SH1301C	3	3	3	3	3	0	0	0	0	0	0	2	0	0

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

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Course Code	IN1315							Course category			MM
Course Name	INDUSTRIAL MEASUREMENT-I										
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:

Aim of the course is to:

I. To provide the knowledge of fundamentals and types of all the sensors and Transducers
II. To understand the sensors and transducers concept and its applications in the process measurement
III. To describe, draw, classify and produced sketches, drawings to explain working principles of various sensors and transducers.
IV. To select transducers/sensors for specific applications

Course Contents:

Temperature Measurement :- Temperature scales, classification of temperature sensors, standards, working principle, types, materials, Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple, thermistor), radiation sensors (pyrometers), photo electric radiation thermometers, IC temperature transducers

Pressure measurement: Definition, pressure scale, standards, working principle, types, materials, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, capacitive (delta cell), high-pressure sensors, low-pressure sensors, Pressure Transmitter definition, two wire and four wire transmitters, I/P and P/I converters.

Flow Measurement: Essential principles of fluid mechanics and properties of fluid, types of fluid flow, continuity equation, Bernoulli's equation, Newtonian and non-newtonian fluids, Reynolds‟s number, laminar and turbulent flows, hydrostatic law and pascal's law, Selection criteria of flow sensors. Head Type Flow Meter: Orifice, venturi, nozzle, pitot tube, Variable

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Area Type Flow Meter: Rota-meter, Open Channel: Turbine, Target, Electro Magnetic, Ultrasonic, Vortex Shedding, Mass Flow Meter: Coriolis, Thermal & solid flow meters

Level measurement: Basic level measurement principals, Need for level measurement, types and classification, construction and working, selection criteria for level sensors. float, Bubblers, displacer (torque tube unit), capacitive, conductivity, Differential level sensor, float level sensor, Laser level sensor, microwave level switch, radar Laser (contact, non-contact – TDR / PDS), optical level devices, radiation level sensor, , Ultrasonic level Detector

Humidity, pH and Viscosity Measurement: Humidityterms - dry & wet bulb psychrometers - hot wire electrode type hygrometer, electrolytic hygrometer, Dewpoint hygrometer, Capacitive hygrometer, pH measurement :Nearnst equation, construction & working of pH sensor, temperature compensation, pH measurement electrodes, maintenance and applications, Viscosity terms, saybolt viscometer, rotometer type viscometer, Optical Hygrometer

Text Books:

1. Arun Ghosh, Introduction to Measurements and Instrumentation, PHI Learning Pvt. Ltd.
2. B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, Second ed., 2004.

Reference Books:

1. A. K. Sawhney, “Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai and Sons, Eleventh ed., 2000.
2. D.V.S. Murthi, “Instrumentation and Measurement Principles”, PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, Second ed., 2004.
4. E.O. Doebelin, “Measurement Systems”, McGraw Hill.
5. Bentley J. P., Principles of measurement systems, Third Edition, Pearson education Asia pvt.ltd, 2000
6. D. Patranabis, “Principle of Industrial Instrumentation”, Tata McGraw Hill, Second ed., 1999.
7. S. P. Venkateshan,” Mechanical Measurements”, Willy publication second edition. 2015

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Useful Link: Course name: Industrial Measurement-I course https://onlinecourses.nptel.ac.in/noc23_ee105/preview Name of Course offered by NPTEL: Transducers for Instrumentation By Prof. Ankur Gupta, IIT Delhi.

Course Outcomes:

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

IN1315.1 : Identification of sensors and transducer (Primary and secondary).

IN1315.2 : Demonstrate the working principles of various sensors and transducers

IN1315.3 : Evaluate and classify various sensors and transducers

IN1315.4 : Interpret the characteristics of the transducers/sensors

IN1315.5 : Demonstrate working principle of chemical sensors used in process industry

CO – PO – PSO Mapping as per Jan-2016 Format This subject is offered for other deptt. students, PSO is not considered

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IN1315.1	1	1	0	0	0	0	0	0	0	1	0	0
IN1315.2	1	1	1	2	0	0	0	0	0	0	0	0
IN1315.3	1	0	0	0	0	0	0	0	0	0	0	0
IN1315.4	1	0	1	0	0	0	1	0	0	0	1	0
IN1315.5	1	1	1	0	2	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 Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IN1315.1	1	1	0	0	0	0	0	0	0	1	0
IN1315.2	1	1	1	2	0	0	0	0	0	0	0
IN1315.3	1	0	1	2	0	0	0	1	0	0	0
IN1315.4	1	0	1	0	0	0	1	0	0	0	1
IN1315.5	1	1	1	0	2	0	0	0	0	0	0

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

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Course Code	IN1316						Course category		MM	
Course Name	BANKING OPERATION AND MANAGEMENT									
Teaching Scheme				Examination Scheme						Credits
				Theory				Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Course Objective :

Aim of the course is to :

This course aims at enabling the students to understand and to contribute to the strategic operational policies and practices of commercial banks management in a competitive environment

Introduction –Scheduled and non scheduled banks, origin and developments, evolution and growth of banking system in India, present structure of banking

Concept of Bank marketing, formulating and implementing marketing strategies for commercial bank ,relationship banking concept and strategy

Liquidity, purpose, sources, measurement, liquidity, profitability problems , theories of liquidity management, priorities in the employment of bank funds ,capital adequacy in banks

Credit Management: cardinal principal of sound bank lending, formulating loan policy, factors influencing loan policy, contents of loan policy ,evaluating credit applicant, loan supervision

Investment Management: Nature and significance of investment management in commercial banks, fundamental principles of security investment by commercial bank ,management of security investment ,reviewing investment portfolio, organization of investment function

Asset Liability Management and Non-performing asset : concept of Asset Liability Management ,objectives ,functions,processes,measurement and management risks, concept of NPAs, NPAs in Indian commercial banks, causes, suggestions and steps for containing NPAs, Prudential norms

Text Books

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1 Srivastava, Divya Nigam, Manageent of Indian financial Institutions, Himalaya Publishing house

2 M.Y.Khan,Indian Financial System,Tata Mc Graw Hill

Reference Books

1. Bharati Pathak,Indian Financial System
2. Gerald Halter,Bank Investments and Funds Management ,McMillan
3. Stigum,Managing Bank Assets and Liabilities,Dow-Jones Irwin
4. Dudley Luckett,Money and Banking ,Mc Graw Hill
5. Vasant Joshi ,VinayJoshi ,Managing Indian Banks, -Challenges Ahead Response Books
6. Journals: Professional Banker

Coure Outcome :

IN1316.1 Gain thorough understanding with fundamentals of Banking operation & Management

IN1316.2 Express the liquidity system in banking

IN1316.3 Explore the credit management system and loan system in banking

IN1316.4 Explore the investment portfolio with good strategy

IN1316.5 Identify the ALM and NPA in banking

CO – PO – PSO Mapping as per Jan-2016 Format This subject is offered for other deptt. students, PSO is not considered

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IN1316.1	3	0	0	0	0	0	0	0	0	0	0	0
IN1316.2	3	2	0	0	0	0	0	0	0	0	0	0
IN1316.3	3	0	0	0	0	0	0	0	0	2	0	0
IN1316.4	3	0	0	0	0	0	0	0	0	2	0	0
IN1316.5	3	0	0	0	0	0	0	0	0	2	0	0

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CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1316.1	3	0	0	0	0	0	0	0	0	0	0	3	0	0

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IN1316.2	3	2	0	0	0	0	0	0	0	0	0	3	0	0
IN1316.3	3	0	0	0	0	0	0	0	0	2	0	3	0	0
IN1316.4	3	0	0	0	0	0	0	0	0	2	0	3	0	0
IN1316.5	3	0	0	0	0	0	0	0	0	2	0	3	0	0

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Course Code	IN1301							Course category			PC
Course Name	SENSOR AND TRANSDUCER-I										
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:

Aim of the course is to:

I. To provide the knowledge of fundamentals and types of all the sensors and Transducers
II. To understand the sensors and transducers concept and its applications in the process measurement
III. To describe, draw, classify and produced sketches, drawings to explain working principles of various sensors and transducers.
IV. To select transducers/sensors for specific applications

Course Contents:

Temperature Measurement :- Temperature scales, classification of temperature sensors, standards, working principle, types, materials, Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple, thermistor), radiation sensors (pyrometers), photo electric radiation thermometers, IC temperature transducers, thermowell and its types

Pressure measurement: Definition, pressure scale, standards, working principle, types, materials, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, capacitive (delta cell), high-pressure sensors, low-pressure sensors, Pressure Transmitter definition, classification, pneumatic transmitter-force balance type, torque balance type, two wire and four wire transmitters, I/P and P/I converters.

Flow Measurement: Essential principles of fluid mechanics and properties of fluid, types of fluid flow, continuity equation, Bernoulli's equation, Newtonian and non-newtonian fluids, Reynolds‟s number, laminar and turbulent flows, hydrostatic law and pascal's law, Selection criteria of flow sensors. Head Type Flow Meter: Orifice, venturi, nozzle, pitot tube, Variable

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Area Type Flow Meter: Rota-meter, Open Channel: Turbine, Target, Electro Magnetic, Ultrasonic, Vortex Shedding, anemometers, Mass Flow Meter: Coriolis, Thermal & solid flow meters

Level measurement: Basic level measurement principals, Need for level measurement, types and classification, construction and working, selection criteria for level sensors. float, Bubblers, displacer (torque tube unit), capacitive, conductivity, Differential level sensor, float level sensor, Laser level sensor, microwave level switch, radar Laser (contact, non-contact – TDR / PDS), optical level devices, radiation level sensor, , Ultrasonic level Detector , vibrating level switch , solid level detectors and application.

Humidity, pH and Viscosity Measurement: Humidityterms - dry & wet bulb psychrometers - hot wire electrode type hygrometer, electrolytic hygrometer, Dewpoint hygrometer, Capacitive hygrometer, pH measurement :Nearnst equation, construction & working of pH sensor, temperature compensation, pH measurement electrodes, maintenance and applications, Viscosity terms, saybolt viscometer, rotometer type viscometer, Industrial consistencymeters Optical Hygrometer,oscillating Hygrometer

Text Books:

1. Arun Ghosh, Introduction to Measurements and Instrumentation, PHI Learning Pvt. Ltd.
2. B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, Second ed., 2004.

Reference Books:

1. A. K. Sawhney, “Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai and Sons, Eleventh ed., 2000.
2. D.V.S. Murthi, “Instrumentation and Measurement Principles”, PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, Second ed., 2004.
4. E.O. Doebelin, “Measurement Systems”, McGraw Hill.
5. Bentley J. P., Principles of measurement systems, Third Edition, Pearson education Asia pvt.ltd, 2000
6. D. Patranabis, “Principle of Industrial Instrumentation”, Tata McGraw Hill, Second ed., 1999.
7. S. P. Venkateshan,” Mechanical Measurements”, Willy publication second edition. 20

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Useful Link:

Course name: Sensor & Transducer-I course https://onlinecourses.nptel.ac.in/noc23_ee105/preview Name of Course offered by NPTEL: Transducers for Instrumentation By Prof. Ankur Gupta, IIT Delhi.

Course Outcomes:

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

IN1301.1 : Identify, list, define verity of sensors, transducer (Primary and secondary).

IN1301.2 : Describe, draw, classify and produce sketches, drawings to explain working principles of various sensors and transducers

IN1301.3 : Evaluate and monitor asses and compare of various sensors and transducers

IN1301.4 : Interpret the characteristics of the transducers/sensors

IN1301.5 : Demonstrate working principle of chemical sensors used in process industry

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1301.1	1	1	0	0	0	0	0	0	0	1	0	0	2	0	0
IN1301.2	1	1	1	2	0	0	0	0	0	0	0	0	1	0	0
IN1301.3	1	0	1	2	0	0	0	1	0	0	0	0	2	0	1
IN1301.4	1	0	1	0	0	0	1	0	0	0	1	0	2	1	0
IN1301.5	1	1	1	0	2	0	0	0	0	0	0	0	2	0	1

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

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1301.1	1	1	0	0	0	0	0	0	0	1	0	2	0	0
IN1301.2	1	1	1	2	0	0	0	0	0	0	0	1	0	0
IN1301.3	1	0	1	2	0	0	0	1	0	0	0	2	0	1
IN1301.4	1	0	1	0	0	0	1	0	0	0	1	2	1	0
IN1301.5	1	1	1	0	2	0	0	0	0	0	0	2	0	1

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Course Code	IN1302						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	00	00	03	15 15	10	60	2 hrs 30 min	00	00	100	04

Course Objectives:

Aim of the course is to:

I. Understand the structure of basic electronic devices.

II. Familiarize the operation and applications of transistor like BJT and FET.

III. Understand the operation of large signal amplifiers.

IV. Explore the characteristics of amplifier gain and frequency response.

V. Learn the required functionality of positive and negative feedback systems.

Course Contents:

Bipolar Junction Transistor: Transistor characteristics, Transistor amplifier characteristics, transistor biasing, different modes of operation and configurations,Transistor current components, thermal stability, thermal runway.DC analysis of BJT.

Transistors at high frequencies: Hybrid-pi CE transistor model, Hybrid-pi conductance and capacitance, validity at Hybrid-pi model, variation of Hybrid-pi parameters.

Amplifier configurations and comparison, multistage amplifier, amplifier noise and distortion, two stage RC Coupled amplifier, high input resistance transistor circuit.

Large signal amplifiers: Class A, B, AB, and C operations and their performance characteristics, push pull, complimentary symmetry amplifier.

Feedback amplifiers: Classification, feedback concept, transfer gain with feedback, general characteristics ofnegative feedback amplifier, Input and output resistance, method of analysis of feedbackamplifier, voltage-series, current-series, voltage–shunt, current-shunt feedback. Positivefeedback in amplifiersFeedback concept, transfer gain, general characteristics of negative feedback amplifier, methods of feedback and their effects.

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Oscillators: Barkhausen's criterion and stability of oscillatorsSinusoidal oscillator, resonant circuit, phase shift oscillator, wein bridge oscillator, crystal oscillator and frequency stability, collpitts oscillator, Hartley oscillator.

Introduction to Unipolar Devices: Ideal M/S diode, Si-SiO2 MOS diode, MOSFET, MOSFET structure, physical operation, current – voltage characteristics, DC circuit analysis, MOSFET as an amplifier and as a switch, FET, Basic device characteristics, Comparison of BJT and FET amplifier.Multistage Amplifiers and Differential Amplifier

Multistage amplifiers: BIMOS cascade amplifier, Differential amplifier– Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods.

Text Books: -

1. Integrated Electronics, Analog and Digital Circuits and Systems, Millman J.and Halkias C. C, 27th Edition, McGraw Hill, 1972
2. Electronics Principles, Malvino A.P, 6th Edition, Tata McGraw Hill New Delhi, 2001.

Reference Books: -

1. Electronic Devices and Circuit Theory, Boylestad and Nishelsky, 9th Edition, Prentice Hall of India, 2005
2. Electronics Devices, T. Floyd, 6th edition, Pearson.

Useful Link:

1. EDC course https://swayam.gov.in/nd1_noc20_ee77/preview
   Name of the course: Semiconductor Devices and Circuits, **Prof. Sanjiv Sambandan, IISc Banglore.**
2. https://swayam.gov.in/nd1_noc20_ee85/preview
   Name of the course: Microelectronics: Devices ToCircuitsBy Prof. Sudeb Dasgupta | IIT Roorkee

Course Outcomes:

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

IN1302.1 : Illustrate the structure and working operation of basic semiconductor devices.

IN1302.2 : Understand how complex devices such as transistors, FET, MOSFE are

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modeled.

IN1302.3 : Understand how the models are used in the design and analysis of useful circuits.

IN1302.4 :Choose and adapt the required components to construct an amplifier circuit.

IN1302.5 : Design and analysis of oscillators.

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Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1302.1	2	2	0	0	0	0	0	0	0	1	0	0	2	0	0
IN1302.2	2	2	1	2	0	0	0	0	0	0	0	0	1	0	0
IN1302.3	3	2	1	2	0	0	0	1	0	0	0	0	2	0	1
IN1302.4	3	2	1	0	0	0	1	0	0	0	1	0	2	1	0
IN1302.5	2	1	1	0	1	0	0	0	0	0	0	0	2	0	1

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

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1302.1	2	2	0	0	0	0	0	0	0	1	0	2	0	0
IN1302.2	2	2	1	2	0	0	0	0	0	0	0	1	0	0
IN1302.3	3	2	1	2	0	0	0	1	0	0	0	2	0	1
IN1302.4	3	2	1	0	0	0	1	0	0	0	1	2	1	0
IN1302.5	2	1	1	0	1	0	0	0	0	0	0	2	0	1

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Course Code	IN1303								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	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives:

Aim of the course is to:

I. To analyze logic processes and implement logical operations using combinational logic circuits.

II. To understand characteristics of memory and their classification .

III. To understand concepts of sequential circuits and to analyze sequential systems in terms of state machines.

IV. To understand concept of Programmable Devices, PLA, PAL, CPLD and FPGA .

V. To study the structure, function and characteristics of digital logic families .

Course Contents:

Digital Logic Families: Logic Gates, Fundamental concept of Boolean Algebra, Code Conversion, Digital IC specification terminology, different types of logic families, complementary metal oxide semiconductor logic, logic families interfacing - TTL driving CMOS, CMOS driving TTL, measurement of specification parameters of IC's, 5400 / 7400 series ICs, Tristate Logic, Comparison of Different logic families.

Combinational logic design: Switching algebra, combinational circuit analysis, combinational circuit synthesis, and combinational circuit minimization, K-Map of three, four, five variable functions, minimizing SOP and POS expressions. Arithmetic logic unit , design of encoders, decoders, tri-state devices, multiplexers, demultiplexers, comparators, arithmetic circuits– half and full adders, ripple adders, subtractors, carry look ahead adders, combinational multipliers, examples- barrel shifter, floating point encoder etc.

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Sequential logic design: Latches and flip flops, edge triggered and master slave flip flops (SR, JK, D, T etc), feedback sequential circuit design, sequential PLDs, Counters and shift registers, synchronous design methodology, clock skew, gating the clock, asynchronous inputs.

A/D and D/A Converters: Single slope, dual slope tracking and successive approximation type, Introduction to flash A/D converter, comparison of commercial IC's and Criteria for judging the performance. Binary weighted resister type D/A converter, R-2-R ladder type D/A converter.

Programmable Logic Devices I: Introduction to memories, Types of memories, Memory specification, Introduction to PAL, PLA, Configurable Programmable Logic Devices, Various types of CPLD's.

Programmable Logic Devices II: Introduction to FPGA and its various architectures. PLD Programming concepts, Introduction to PLD Programming languages

Text Books: -

1. Ronald J. Toccii, "Digital Systems: Principles and Applications", Pearson LPE, Fourth ed. 2009.
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Higher Education, Fourth ed., 2010.

Reference Books and Websites: -

1. Mano M.M, "Digital Logic and Computer Design", Pearson LPE, Fourth, ed., 2009.
2. Boyce J. C., "Digital Logic: Operation and Analysis", Prentice Hall, Second ed., 1982. .

Useful Link:

1. https://onlinecourses.nptel.ac.in/noc22_ee55/preview

Course Outcomes:

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

IN1303.1 :Explain logic processes and implement logical operations using combinational logic circuits
IN1303.2 : Explain characteristics of memory and their classification
IN1303.3 :Designconcepts of sequential circuits and to analyze sequential systems in terms of state machines.
IN1303.4 :Understand how to analyze and organize theProgrammable Devices, PLA, PAL, CPLD and FPGA.
IN1303.5 :Study the structure, function and characteristics of digital logic families.

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Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1303.1	2	2	0	0	0	0	0	0	0	1	0	0	2	0	0
IN1303.2	2	2	1	2	0	0	0	0	0	0	0	0	1	0	0
IN1303.3	3	2	1	2	0	0	0	1	0	0	0	0	2	0	1
IN1303.4	3	2	1	0	0	0	1	0	0	0	1	0	2	1	0
IN1303.5	2	1	1	0	1	0	0	0	0	0	0	0	2	0	1

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

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1303.1	2	2	0	0	0	0	0	0	0	1	0	2	0	0
IN1303.2	2	2	1	2	0	0	0	0	0	0	0	1	0	0
IN1303.3	3	2	1	2	0	0	0	1	0	0	0	2	0	1
IN1303.4	3	2	1	0	0	0	1	0	0	0	1	2	1	0
IN1303.5	2	1	1	0	1	0	0	0	0	0	0	2	0	1

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

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Course Code	IN1304						Course category		PC
Course Name	SENSOR AND TRANSDUCER-I 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:

Aim of the course is to:

I. To measure different physical parameters
II. To calibrate different type of transducers
III. To apply different methods of measurements

Minimum Eight Experiments to be performed covering the entire Syllabus of **IN1305 SENSORS AND TRANSDUCERS-I**. Representative list is as follows.

1. To determine RTD, thermister and thermocouple characteristics.
2. Measurement of Pressure using Bellows, Bourdon gauge, Diaphragm.
3. To determine performance of C-type bourdon gauge
4. Calibration of pressure gauge using dead weight pressure tester
5. Measurement of temperature using hot wire anemometer
6. Capacitive level measurement system.
7. To determine the LVDT characteristics
8. To humidity of given solutions
9. To determine flow using orifice or venturimeter or rotameter and compare the accuracy
10. Measurement of pH and conductivity of given solutions

Course Outcomes:

Upon Completion of this course, students will able to

IN1304.1 : To plot characteristics of various transducers and sensors

IN1304.2 : Analyze and interpret data of various measurement

IN1304.3 : Calibrate various type of transducers

Note:

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

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

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1304.1	1	0	0	0	0	1	1	0	0	0	1	3	2	0	1
IN1304.2	1	1	0	0	0	1	1	0	0	0	1	1	2	0	1
IN1304.3	1	1	0	0	0	1	1	0	0	0	1	1	2	0	1

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

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1304.1	1	0	0	0	0	1	1	0	0	0	1	2	0	1
IN1304.2	1	1	0	0	0	1	1	0	0	0	1	2	0	1
IN1304.3	1	1	0	0	0	1	1	0	0	0	1	2	0	1

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

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Course Code	IN1305						Course category		VSE
Course Name	ELECTRONIC DEVICES AND CIRCUITS LABORATORY								
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:

Aim of the course is to:

I. To identify and test various electronic components
II. To plot the characteristics of transistor and other devices.
III. To design and implement amplifier and oscillator circuits.
IV. To understand the devices in detail to use these devices for various application

Minimum Eight Experiments to be performed covering the Entire Syllabus of IN1306 Electronic Devices and Circuits Laboratory

Representative list is as follows.

1. To obtain characteristic of transistor as a switch circuit.
2. To obtain input and output characteristics and calculate gain of CE amplifier circuit.
3. To obtain input and output characteristics and calculate gain of CB amplifier circuit.
4. To obtain frequency response of single stage transistor amplifier.
5. To design and implement class AB push-pull power amplifier.
6. To obtain the transfer characteristics of JFET.
7. To study IV characteristics of JFET and MOSFET.
8. To study the effect of
   a. voltage series feedback on two stage amplifier
   b. current series feedback on single stage CE amplifier.
9. Determine the efficiency of push pull power amplifier
10. To implement RC phase shift, wein bridge oscillator.

Course Outcomes :

Upon Completion of this course, students will able to

IN1305.1: Analyse the transistor characteristics.
IN1305.2: Design and implement various amplifiers and analyse frequency responses
IN1305.3: Interpret the construction, operation and characteristics of JFET,MOSFET and oscillators.

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ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

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

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1305.1	2	0	0	0	0	1	1	0	0	0	1	2	2	0	1
IN1305.2	1	2	0	0	1	1	1	0	0	0	1	1	2	0	1
IN1305.3	1	1	0	0	0	0	0	0	0	0	0	1	1	0	1

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

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1305.1	2	0	0	0	0	1	1	0	0	0	1	2	0	1
IN1305.2	1	2	0	0	1	1	1	0	0	0	1	2	0	1
IN1305.3	1	1	0	0	0	0	0	0	0	0	0	1	0	1

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Course Code	IN1306						Course category			VSE
Course Name	DIGITAL ELECTRONICS LABORATORY									
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	-	50	00	50	01

Course objective:

Aim of the course is to:

I. To know the concepts of Combinational circuits.
II. To understand the concepts of flip-flops, registers and counters
III. To understand concepts of sequential circuits and to analyze sequential systems in terms of state machines.

Minimum Eight Experiments to be performed covering the entire Syllabus of **IN1307 DIGITAL ELECTRONICS**. Representative list is as follows.

1. Measurement of IC's parameters like rise time, fall time, propagation delays, and current and voltage parameters.
2. Design and implementation of arithmetic circuits
3. Design and implementation of various code converters and its applications
4. Design and implementation of multiplexer and demultiplexer and its applications
5. Design and implementation of encoders and decoders and its applications
6. Design and implementation of synchronous and asynchronous counters and its applications
7. Design and implementation of non sequential counters
8. Design and implementation of shift registers and its applications
9. Implementation and verifications of Combinational circuits on programmable logic devices
10. Implementation and verifications of sequential circuits on programmable logic devices

Course outcome: Upon Completion of this course, students will able to

IN1306.1: Design experimental setup for measurement of digital IC parameters & its verification.
IN1306.2: Design, realize and analyze various combinational and sequential circuits
IN1306.3: Select and use latest hardware and software tools for digital system realization

Note:
ICA- The Internal Continuous Assessment shall be based on the practical record and

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Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1306.1	2	0	0	0	0	1	1	0	0	0	1	2	2	0	1
IN1306.2	1	2	0	0	1	1	1	0	0	0	1	1	2	0	1
IN1306.3	1	1	0	0	0	0	0	0	0	0	0	1	1	0	1

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

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1306.1	2	0	0	0	0	1	1	0	0	0	1	2	0	1
IN1306.2	1	2	0	0	1	1	1	0	0	0	1	2	0	1
IN1306.3	1	1	0	0	0	0	0	0	0	0	0	1	0	1

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Course Code	IN1310							Course category			EM1
Course Name	IDEA LABORATORY										
Teaching Scheme				Examination Scheme							Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
-	-	02	02	-	-	-	-	-	50	-	50	01

Course Objectives: Aim of the course is to:

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:

IN1310.1 Gain knowledge of design thinking and innovation with the modern machines and devices available in the idea lab.
IN1310.2 Generate different ideas for innovative products through ideation and brainstorming.
IN1310.3 Identify, discuss and justify the technical aspects of the chosen idea with a comprehensive and systematic approach.


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IN1310.4 Design and develop innovative products for specific problems considering user- centric perspective and market.
IN1310.5 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
IN1310.1	3	0	1	0	2	0	0	0	0	0	0	0	0	0	0
IN 1310.2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
IN 1310.3	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0
IN 1310.4	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0
IN 1310.5	0	0	2	0		0	0	0	0	3	0	0	0	0	0

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SEMESTER –IV

Course Code	**IN1415**								**Course category**				**MM**
Course Name	**INDUSTRIAL MEASUREMENT-II**												
Teaching Scheme				**Examination Scheme**									**Credits**
				Theory					Practical		Total		
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE			
03	00	00	03	15	15	10	60	2hr30 min	00	00	100		03

Course Objectives :

Aim of the course is to:

I. To understand how physical quantities are measured and how they are converted to electrical or other forms

II. To have an adequate knowledge of change in resistance in various transducers

III. To develop the knowledge of inductance and capacitance transducers.

IV. To teach the design of signal conditioning circuits

Course Contents:

Displacement Measurement: Resistive (Potentiometer and Linear), Inductive(LVDT and Eddy current type) and capacitive(Capacitance principles Concept & variable capacitance due to change in dielectric media, area of the plate, distance between the plates) Displacement Sensors, Piezoelectric Transducers and Sensors, Time-of-Flight Ultrasonic Displacement Sensors, Optical Encoder Displacement Sensors, Hall effect transducers. Strain Gauge measurement : Loading Effect types of strain gauges, derivation of gauge factor, bridge configurations, compensation, applications of strain gauges

Velocity and speed measurement: Doppler Velocimeter, Doppler effect, Ultrasonic Doppler velocity meter, time of flight velocimeter Mechanical tachometer: centrifugal force tachometer, vibrating tachometer , Electrical Tachometer: Drag Cup Tachometer, AC-DC Tachogenerators, Photoelectric tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups, stroboscope

Vibration and acceleration measurement: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Absolute Accelerometer, Relative Accelerometer Piezoelectricaccelerometers ,Piezoresistive Accelerometers, Strain gauge accelerometer

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Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer, etc. Applications of Force and Torque sensors.

Design of signal conditioning circuit : Input Characteristics, Amplifiers, operational amplifiers Voltage Follower, various Converters, Sensor Connections, use of bridges, voltage generator, oscillators, Signal Conditioning for Resistive Sensors, Reactance Variation and Electromagnetic Sensors, Signal Conditioning for Reactance Variation Sensors, Self-Generating Sensors

Advances in sensors technology: Introduction to Smart sensors, MEMS, Nano sensors, Semiconductor sensors, Optical fiber sensors. Applications of these technologies in various industry sectors.

Text Books:

1. S. P. Venkateshan," Mechanical Measurements", Willy publication second edition. 2015
2. Ramon Palla¡ S-areny, John g. Webster, "sensors and signalconditioning" second edition, john wiley& sons, inc

Reference Books:

1. A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, Eleventh ed., 2000.
2. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. E.O. Doebelin, "Measurement Systems", McGraw Hill.

Useful Link:

1. **Course name: Industrial Measurement -II course** https://onlinecourses.nptel.ac.in/noc23_ee105/preview Name of Course offered by NPTEL: Transducers for Instrumentation By Prof. Ankur Gupta, IIT Delhi.

Course Outcomes:

Upon Completion of this course, students will able to

IN1415.1 Interpret the concepts of signal conditioning circuits for resistive sensors
IN1415.2 To demonstrate working of various resistive, inductive and capacitive
   i. transducers
IN1415.3 Illustrate the working principle of velocity and acceleration transducers

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IN1415.4 Apply the adequate knowledge of force transducers
IN1415.5 Provide exposure new trends in smart sensors.

CO – PO – PSO Mapping as per Jan-2016 Format This subject is offered for other deptt. students, PSO is not considered

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IN1415.1	1	1	0	0	0	0	0	0	0	1	0	0
IN1415.2	1	1	1	2	0	0	0	0	0	0	0	0
IN1415.3	1	0	1	2	0	0	0	1	0	0	0	0
IN1415.4	1	0	1	0	0	0	1	0	0	0	1	0
IN1415.5	1	1	1	0	2	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 Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IN1415.1	1	1	0	0	0	0	0	0	0	1	0
IN1415.2	1	1	1	2	0	0	0	0	0	0	0
IN1415.3	1	0	1	2	0	0	0	1	0	0	0
IN1415.4	1	0	1	0	0	0	1	0	0	0	1
IN1415.5	1	1	1	0	2	0	0	0	0	0	0

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Course Code	IN 1416							Course category			MM	
Course Name	STRATEGIC MANAGEMENT AND INNOVATION IN BANKING											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Course Objectives:

Aim of the course is to:

I. Acquire knowledge about the banking and strategy for changing environment
II. To introduce strategy asset management system
III. To understand management of technological innovation in banking
IV. Learn digital technology involved in banking.
V. To understand Corporate social responsibility in banking system

Course Contents:

Strategy and Strategic Leadership in dynamic times- Introducing Strategic Management, leading strategically through effective vision and mission, Strategic Thinking Meaning, Foundation of Strategy, Strategic Intelligence including strategy analytics, appreciation of conflicts including resources, Strategic Finance Management, Strategic Cost Management

Innovation and Technology Factor: Innovation, Strategic Management of Innovation and challenges, Strategy design process, Management of technological innovation and Challenges

Digital Factor: Digitalization, Payment System, Strategic Digital banking and Capabilities applied and required along the stages of the customer journey, big data, social media

Strategic Leadership-Innovation, and Change: Role of strategic leadership in innovation and transformation, Organizational ambidexterity and innovation typologies, managing resistance and enabling strategic renewal

Strategic Evaluation and Control Mechanisms: Designing strategic control systems, Key Performance Indicators (KPIs) and feedback loops, Corrective actions and continuous improvement, Strategic Corporate Social Responsibility (CSR)

Text/Reference Books:

1. Strategic management and Innovation in banking -Indian Institute of Banking and finance
2. Ethics in Banking - Indian Institute of Banking and finance

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3. John A Peace II ,RichardB ,AmitaMital ,Strategic Management planning for domestic andglobal competition ,Tata McGraw Hill

Course Outcomes:

IN1416.1Address the banking and strategy in the context of fast changing environment

IN1416.2 Analysis of the strategy asset management system

IN1416.3 Explore the management of technological innovation in banking

IN1416.4 Demonstrate the digital technology system in banking

IN1416.5 Explore the Corporate social responsibility in banking system

CO – PO – PSO Mapping: This subject is offered for other deptt. students, PSO is not considered

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IN1416.1	2	2	0	0	0	0	0	0	0	0	0	0
IN1416.2	1	0	0	0	0	0	0	0	0	0	0	0
IN1406.3	1	2	2	1	1	1	0	0	0	0	0	0
IN1406.4	2	1	2	2	0	0	0	0	0	0	0	0
IN1406.5	2	2	0	0	2	0	0	0	0	0	0	0

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcome										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IN1416.1	3	0	0	0	0	0	0	0	0	0	0
IN1416.2	3	2	0	0	0	0	0	0	0	0	0
IN1416.3	3	0	0	0	0	0	0	0	0	2	0
IN1416.4	3	0	0	0	0	0	0	0	0	2	0
IN1416.5	3	0	0	0	0	0	0	0	0	2	0
Average	3	2	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				IN1401					Course category			PC
Course Name				AUTOMATIC CONTROL SYSTEM								
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Course Objectives:

Aim of the course is to:

I. To impart the basic knowledge of fundamentals of control systems
II. To impart the knowledge of the mathematical model for different physical systems
III. To impart the knowledge of transfer function analysis for control system by BDR,SFG techniques
IV. To impart the knowledge of identifying performance characteristics of first and second-order systems for different standard inputs
V. To impart the knowledge of testing the stability of control system by RH Crietiron, time domain and frequency domain techniques, state space representation of control system

Course Contents:

Fundamentals of control systems: Introduction to need for automation and automatic control, Basic Components of a Control System, Concept of open loop and closed loop Systems, Examples of control system, Effects of Feedback, Types of Feedback Control Systems. Review of Laplace and inverse Laplace transform, Transfer functions.

Mathematical modeling: Mathematical modeling of: electrical systems, mechanical systems, electro-mechanical systems, Electrical analogues of dynamical systems, Block diagrams, Block diagram reductions, Signal flow graph, Mason's gain formula, Application of gain formula to block diagrams.

Time response analysis: Time response of system, Standard testsignals, Analysisof firstorder andsecond order systems, Time response specifications, Steady state errors and error constants.

Stability analysis: Stability of open loop and closed loop systems, Routh-Hurwitz criterion, Stability and Performance analysis, Root locus techniques, Root locus construction rules, Sketching of Root Locus.

Frequency response analysis: Frequency domain specifications, Correlation between time and frequency responses, Bode plots, Relative stability, Phase margin and Gain margin,

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Minimum and non-minimum phase systems, Introduction to polar plots, Nyquist plot, and Nyquist stability criterion.

Introduction to State Space : State Space Representation of the control system , State Variables representation ,conversion of transfer function to state variable model ,Representation of state equation .

Text Books:

1. Norman Nise, Control System Engineering, Wiley International, sixth edition, 2011.
2. Nagrath and Gopal, Control System Engineering-, New Age International Publication, fifth edition, 2003.

Reference Books:

1. C.H. Houpis, S.N. Sheldon, Linear Control System Analysis and Design with MATLAB, CRC Press; 6 edition.
2. G. Goodwin, S.Graebe, Mario Salgado, Control System Design, Pearson Education, edition.
3. G. Franklin, J.Powell, A. Naeini, Feedback Control of Dynamic Systems, Pearson, 6th edition.
4. K. Ogata, Modern Control Engineering, Prentice Hall Publications, fifth edition.
5. Dorf and Bishop, Modern Control Systems:, Addison Wesley, LPE, 9th Edition.
6. B. C. Kuo, Automatic control system, Prentice Hall of India, 7th Edition, 1995

Course Outcomes:

After completion of the course students will be able to

IN 1401.1 Classify open and closed control systems with their characteristics

IN1401.2 Develop the mathematical model of electrical, mechanical system and Derive the transfer function of given system by using BDR,SFG techniques

IN 1401.3 Analyse the response of first and second-order systems for different standard inputs

IN1401.4 Comment on the stability of control system by using RH Criterion, time domain and frequency domain techniques

IN 1401.5 Represent the control system in State space representation

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1401.1	3	0	0	0	0	0	0	0	0	0	0	0	3	0	0
IN1401.2	3	2	0	0	0	0	0	0	0	0	0	0	3	0	0
IN1401.3	3	0	0	0	0	0	0	0	0	2	0	0	3	0	0
IN1401.4	3	0	0	0	0	0	0	0	0	2	0	0	3	0	0
IN1401.5	3	0	0	0	0	0	0	0	0	2	0	0	3	0	0

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Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1401.1	3	0	0	0	0	0	0	0	0	0	0	3	0	0
IN1401.2	3	2	0	0	0	0	0	0	0	0	0	3	0	0
IN1401.3	3	0	0	0	0	0	0	0	0	2	0	3	0	0
IN1401.4	3	0	0	0	0	0	0	0	0	2	0	3	0	0
IN1401.5	3	0	0	0	0	0	0	0	0	2	0	3	0	0

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Course Code	IN1402								Course category				PC
Course Name	LINEAR INTEGRATED CIRCUITS												
Teaching Scheme				Examination Scheme									Credits
				Theory					Practical		Total		
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE			
03	00	00	03	15	15	10	60	2hr30 min	00	00	100		03

Course Objectives:

Aim of the course is to:

I. To understand the concepts of linear integrated circuits.
II. To understand the basic operation of operational amplifier.
III. To Design circuit using operational amplifier for various applications.
IV. Implement different linear and non- linear applications of operational amplifier for signal conditioning circuits.
V. Understand and demonstrate the functions of timer, voltage regulator, filters and oscillators.

Course Contents:

Operational Amplifiers Fundamentals: Characteristics of Op Amp, Noise figure, Types of Noise, Causes of Slew Rate, Concept of dB, Frequency response, Frequency/Phase Compensation Techniques. SR, CMRR, PSRR/SVRR. Offset adjustment techniques, Comparative study of different amplifier ICs such as LM 741, LM 324, OP 07.

Feedback amplifiers. Concept of feedback, positive and negative feedback amplifiers, voltage series feedback amplifier, Voltage shunt feedback amplifier and differential amplifier configuration and their special cases.

Linear Applications of op amp: Voltage Summing with averaging amplifier, Voltage subtractor, voltage follower, peak amplifier, analog adder, Current booster, Integrator and practical integrator, Differentiator and practical differentiator, Instrumentation Amplifier with three op-amp, Current to voltage and voltage to current converter, voltage to frequency converter, analog multipliers and dividers.

Non-linear Applications of Op-amp: Log/antilog amplifiers, Comparator characteristics, peak detectors, wave shaping circuits Schmitt's trigger, clippers and clampers, pulse generators, ZCD and it's application, Schmitt trigger with external bias, window detector. Precision half wave and full wave rectifiers with IC 741.

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Timers and Voltage regulators: Timers: Triggerable and retriggerable, IC 555, pin configuration and operation, design and application of monostable multivibrators and astable multivibrators. Voltage regulators : Linear and Switching DC Voltage regulators: Basic 78XX and 79XX voltage regulators, voltage regulator IC723.

Active filters and oscillators: First order and Second order active low pass, high pass filter, band pass filter, band stop/band reject, Notch filter, all pass filters, Introduction of butterworth, chebyshev , elliptic and Bessel filters. Sinusoidal oscillators using Op amp: Barkhausen criteria, Wein Bridge oscillator, RC phase shift oscillator. Hartley oscillator.

Text Books: -

1. Op-amp and Integrated circuits, Ramakant A. Gaikwad, 3rd Edition, PHI Publication, 2002
2. Integrated Circuits, K.R. Botkar, 9th Edition , Khanna Publisher, 2003

Reference Books :-

1. Operational Amplifiers and Linear ICs, D. A. Bell, Oxford University Press, 3rd edition, 2011
2. Design with Op-amp and Analog Integrated circuits, Sergio Franco, Tata McGraw Hill Edition, New Delhi, 1998.
3. Analog Electronics, L. K. Maheshwari and M.M.S. Anand, Prentice Hall of India, New Delhi.
4. Physics of Semiconductor Devices, S. M. Sze, 5th edition, John Wiley Publications.
5. Op-amp and Linear Integrated Circuits Theory and Applications, J. Fiore, Delmar Thompson Learning, 1st edition, 2001.
6. Operational Amplifiers and Linear Integrated Circuits, R. Coughlin, F. Driscoll, PHI, 6th edition, 2001

Useful Link:

Linear Integrated Circuits courseHttps://swayam.gov.in/nd1_noc19_ee39/preview
Name Of Course:Op-Amp Practical Applications: Design, Simulation and Implementation**, IISc Banglore , Prof. Hardik Pandya**

Course Outcomes:
Upon Completion of this course, students will able to

IN1402.1 :Understand the concepts of linear integrated circuits.
IN1402.2 : Understand the basic operation of operational amplifier.
IN1402.3 : Design circuit using operational amplifier for various applications.
IN1402.4 : Implement different linear and non- linear applications of operationalamplifier for signal conditioning circuits.
IN1402.5 : Understand and demonstrate the functions of timer, voltage regulator, filters and oscillators.

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Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1402.1	2	2	0	0	0	0	0	0	0	1	0	0	2	0	0
IN1402.2	2	2	1	2	0	0	0	0	0	0	0	0	1	0	0
IN1402.3	3	2	1	2	0	0	0	1	0	0	0	0	2	0	1
IN1402.4	3	2	1	0	0	0	1	0	0	0	1	0	2	1	0
IN1402.5	2	1	1	0	1	0	0	0	0	0	0	0	2	0	1

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CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1402.1	2	2	0	0	0	0	0	0	0	1	0	2	0	0
IN1402.2	2	2	1	2	0	0	0	0	0	0	0	1	0	0
IN1402.3	3	2	1	2	0	0	0	1	0	0	0	2	0	1
IN1402.4	3	2	1	0	0	0	1	0	0	0	1	2	1	0
IN1402.5	2	1	1	0	1	0	0	0	0	0	0	2	0	1

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Course Code	IN1403							Course category				PC
Course Name	SENSOR AND TRANSDUCER-II											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Course Objectives :

Aim of the course is to:

I. To understand how physical quantities are measured and how they are converted to electrical or other forms

II. To have an adequate knowledge of change in resistance in various transducers

III. To develop the knowledge of inductance and capacitance transducers.

IV. To teach the design of signal conditioning circuits

Course Contents:

Displacement Measurement: Resistive(Potentiometer and Linear), Inductive(LVDT and Eddy current type) and capacitive(Capacitance principles Concept & variable capacitance due to change in dielectric media, area of the plate, distance between the plates) Displacement Sensors, Piezoelectric Transducers and Sensors, Time-of-Flight Ultrasonic Displacement Sensors, Optical Encoder Displacement Sensors, Hall effect transducers. Strain Gauge measurement : Loading Effect types of strain gauges, derivation of gauge factor, bridge configurations, compensation, applications of strain gauges

Velocity and speed measurement: Doppler Velocimeter, Doppler effect, Ultrasonic Doppler velocity meter, time of flight velocimeter Mechanical tachometer: centrifugal force tachometer, vibrating tachometer , Electrical Tachometer: Drag Cup Tachometer, AC-DC Tachogenerators, Photoelectric tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups, stroboscope

Vibration and acceleration measurement: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Absolute Accelerometer, Relative Accelerometer Piezoelectricaccelerometers ,Piezoresistive Accelerometers, Strain gauge accelerometer

Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement. Applications of Force and Torque sensors.

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Design of signal conditioning circuit : Input Characteristics, Amplifiers, operational amplifiers Voltage Follower, various Converters, Sensor Connections, use of bridges, voltage generator, oscillators, Signal Conditioning for Resistive Sensors, Reactance Variation and Electromagnetic Sensors, Signal Conditioning for Reactance Variation Sensors, Self-Generating Sensors, Signal Conditioning for Self-Generating Sensors

Advances in sensors technology: Smart sensors, MEMS, Nano sensors, Semiconductor sensors, Optical fiber sensors. Applications of these technologies in various industry sectors.

Text Books:

1. S. P. Venkateshan," Mechanical Measurements", Willy publication second edition. 2015
2. Ramon Palla¡ S-areny, John g. Webster, "sensors and signalconditioning" second edition, john wiley& sons, inc

Reference Books:

1. A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, Eleventh ed., 2000.
2. D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
3. B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
4. E.O. Doebelin, "Measurement Systems", McGraw Hill.

Useful Link:

1. **Course name: Sensor & Transducer-I course** https://onlinecourses.nptel.ac.in/noc23_ee105/preview Name of Course offered by NPTEL: Transducers for Instrumentation By Prof. Ankur Gupta, IIT Delhi.

Course Outcomes:

Upon Completion of this course, students will able to

IN1403.1 Interpret the concepts of signal conditioning circuits for resistive sensors
IN1403.2 To demonstrate working of various resistive, inductive and capacitive transducers
IN1403.3 Illustrate the working principle of velocity and acceleration transducers
IN1403.4 Apply the adequate knowledge of force transducers
IN1403.5 Provide exposure new trends in smart sensors.

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Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1403.1	1	1	0	0	0	0	0	0	0	1	0	0	2	0	0
IN1403.2	1	1	1	2	0	0	0	0	0	0	0	0	1	0	0
IN1403.3	1	0	1	2	0	0	0	1	0	0	0	0	2	0	1
IN1403.4	1	0	1	0	0	0	1	0	0	0	1	0	2	1	0
IN1403.5	1	1	1	0	2	0	0	0	0	0	0	0	2	0	1

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Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1403.1	1	1	0	0	0	0	0	0	0	1	0	2	0	0
IN1403.2	1	1	1	2	0	0	0	0	0	0	0	1	0	0
IN1403.3	1	0	1	2	0	0	0	1	0	0	0	2	0	1
IN1403.4	1	0	1	0	0	0	1	0	0	0	1	2	1	0
IN1403.5	1	1	1	0	2	0	0	0	0	0	0	2	0	1

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Course Code	SH1401A								Course category			OE
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:

Aim of the course is to:

I. To familiarize students with the historical and cultural context of Indian Classical Music.
II. To introduce students to the fundamental concepts of raga, tala, and improvisation.
III. To develop students' listening skills through analysis and appreciation of classical music recordings.
IV. .To provide students with practical training in basic vocal or instrumental techniques.
V. 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, wadiswar, sanvadiswar,varjitswar, 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 Bhatkhandelipi), Different THAATs and their brief information, Definition of Raga, Sargamgeet, the concept of Khyal ,aalap and tana, Raga and Time Association, Basic ragas (Bhupali, Yaman, Bhimpalasi and Kedar) along with Aaroha, avaroha, pakad and sargamgeet and khya

Introduction to Taala:

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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 BhajniTheaka) Practical exercises in clapping and counting rhythms to internalize talas.

Introduction to Musical Instruments:

Classification of Indian Musical Instruments (String, wind, percussion and SolidInstruments), components parts of Indian classical instruments along with neat sketchBiography- UstadZakirHusen (Tabla), PanditAppaJalgaokar (Harmonium) Pandit Ravi Shankar (Sitar), PanditHari Prasad Chaurasiya (Flute), Dr. N Rajam (Violin)

Textbooks:

1. Indian Classical Music By Ravi S. Prasanna

2.Appreciating Indian MusicBy 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.

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Course Outcome	Program Outcomes														
	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

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Course Outcome	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
SH1401A.1	1	0	0	0	0	1	2	2	3	0	0	1	0	2
SH1401A.2	1	0	0	0	0	1	2	2	3	0	0	1	0	2
SH1401A.3	1	0	0	0	0	1	2	2	3	0	0	1	0	2
SH1401A.4	1	0	0	0	0	1	2	2	3	0	0	1	0	2
SH1401A.5	1	0	0	0	0	1	2	2	3	0	0	1	0	2

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Course Code	SH1401B							Course Category			OE
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:

Aim of the course is to:

I. Understandthehuman behaviour.
II. Helps humans in exerting more control over situations
III. Basic cognitive processes that guide human behaviours.
IV. Tackling everyday problems and attaining optimal solutions
V. 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

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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.

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Course Outcome	Program Outcomes														
	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

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Course Outcome	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
SH1401B.1	2	3	0	0	0	0	0	1	2	0	0	3	1	2
SH1401B.2	2	0	0	0	0	0	0	1	2	0	0	2	1	1
SH1401B.3	2	2	0	0	0	0	0	1	2	0	0	2	1	1
SH1401B.4	2	0	0	0	0	0	0	1	2	0	0	2	1	1
SH1401B.5	2	2	0	0	0	0	0	1	2	0	0	2	1	1

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Course Code	SH1401C	Course Category	OE
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	-	-	20	00

Course Objectives:

Aim of the course is to:

I. To understand the history, background and nature of Nano science and nanotechnology as well as the quantum and Nano sized scale effect on materials.
II. To acquire theoretical understanding of different types of nanostructure
III. To understand the synthesis technique and its types.
IV. To learn the different methods of characterization.
V. 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:

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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 NanodevicesVol 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:

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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.

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Course Outcome	Program Outcomes														
	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 Correlate

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcome	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
SH1401C.1	2	0	2	0	0	0	0	0	1	2	2	2	2	1
SH1401C.2	3	2	3	0	2	0	2	0	0	3	2	2	2	1
SH1401C.3	3	2	3	2	0	0	3	3	1	3	3	2	2	1
SH1401C.4	3	2	3	2	2	0	2	0	0	3	3	2	2	1
SH1401C.5	3	2	3	2	2	0	3	1	0	3	3	2	2	1

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Course Code	SH1401D							Course Category				OE1
Course Name	Geoinformatics											
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	-	-	20	00

Course Objectives

To make the students aware and understand:

1. The fundamental concepts of Geoinformatics, including Geographical Information Systems (GIS), Remote Sensing (RS), and Global Positioning Systems (GPS).
2. The functionalities and applications of various Remote Sensing and GIS software.
3. The importance of data acquisition, database development, and analysis in a GIS environment.
4. The significance of spatial data structures, GIS analysis, and pre-processing techniques.
5. The real-world applications of Geoinformatics in engineering fields through case studies.

Course Contents;

Fundamentals of Remote Sensing: Principles of Remote Sensing and Electromagnetic Radiation (EMR). Interaction mechanisms of EMR with the Earth's surface and image formation. Types and characteristics of sensors and platforms used in Remote Sensing.

Remote Sensing Data Analysis: Types of satellite data products in visible and other bands. Multiband concept and spectral signatures for different Earth features. Visual image interpretation and digital image processing methods. Basics of Photogrammetry and its Applications in Remote Sensing.

Global Positioning System: Fundamentals of GPS technology. Working principles of satellite-based navigation systems. Applications of GPS in mapping, navigation, and surveying.

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Geographic Information System (GIS): Components of GIS: Hardware, software, data, and users. Methods of spatial data acquisition and attribute data management. Pre-processing, storage, and database management in GIS. Raster and vector data structures and their significance. GIS analysis functions and spatial queries.

Applications of Geoinformatics in various fields of Engineering including hands on exercises.

Text Books:

1. James B. Cambell, 'Introduction to Remote Sensing', Taylor & Francis.
2. John R Jensen, 'Introductory Digital Image Processing: A Remote Sensing Perspective', Prentice Hall, New Jersey
3. M. Anji Reddy, 'Text book of Remote Sensing and GIS', BS Publications

Reference Books:

1. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman Remote Sensing and Image Interpretation, 7th Edition, Wiley Publication
2. George Dr. Joseph Fundamentals of Remote Sensing, University Press.

Course Outcomes (COs):

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

SH1401D.1	Explain the fundamental principles of Remote Sensing, GIS, and GPS
SH1401D.2	Apply knowledge of data acquisition, pre-processing, and GIS database management.
SH1401D.3	Utilize different Remote Sensing and GIS software for spatial analysis and visualization.
SH1401D.4	Analyses and interprets multispectral remote sensing data for practical applications.
SH1401D.5	Implement GIS-based solutions for various engineering applications including environmental monitoring, urban planning, and disaster management.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1401D.1	3	2	1	0	1	2	2	1	0	1	0	2
SH1401D.2	3	3	2	2	2	2	2	1	0	1	0	2
SH1401D.3	3	3	3	3	3	2	2	0	0	1	0	2
SH1401D.4	3	3	3	3	3	2	3	0	2	3	2	2
SH1401D.5	3	3	3	3	3	2	3	0	2	3	2	2

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Course Code	IN1404					Course category		PC		
Course Name	AUTOMATIC CONTROL SYSTEM LABORATORY									
Teaching Scheme				Examination Scheme						Credits
				Theory					Practical	Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	--	--	--	--	2hr30 min	50	00	50	01

Course Objectives:

Aim of the course is to:

I. To introduce the MATLAB software from control systems point of view.

II. To provide adequate knowledge in the time response of systems using Software.

III. To Show the Effect of addition of poles and zeros to forward path of an open loop and closed loop system using software.

Minimum Eight Experiments to be performed covering the Entire Syllabus of **INU1405 AUTOMATIC CONTROL SYSTEMLABORATORY** Representative list is as follows.

1. Plot the Transfer function and find the poles and zeros of the given TF

2. Use R-C/ R-L-C circuit to analyze the response of a second order system for standard test inputs.

3. Develop a Simulink model to find steady state error for a type 0, type 1 and type 2 systems.

4. Modeling of Physical Systems using Simulink.

5. Introduction to MATLAB, MATLAB's Simulink and control systems toolbox (with some examples) or any other control system related software package.

6. Study of time response characteristics of first/second order control system using Software.

7. Study and plot the unit step responses of addition of a pole and a zero to the closed loop transfer function

8. Use software to plot the Root Locus plot of given transfer functions and analyze the stability.

9. Use software to plot the Bode diagram of given transfer functions and analyze the stability.

10. Use Software to represent state space representation of given control system

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Course Outcomes: Upon Completion of this course, students will able to

INU1404.1: Plot the transfer function and calculate the Poles and Zeros of Transfer Function.

INU1404.2: Analyze the given systems using Time Domain and frequency domain analysiswith the help of software. [MatLab/SciLab]

INU1404.3: Develop mathematical model for electrical systems.

Note:

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1404.1	1	0	0	0	0	0	0	0	0	3	0	0	0	2	0
IN1404.2	1	0	0	0	0	0	0	0	0	3	0	0	0	2	0
IN1404.3	1	0	0	0	0	0	0	0	0	3	0	0	0	2	0

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CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1404.1	1	0	0	0	0	0	0	0	0	3	0	0	2	0
IN1404.2	1	0	0	0	0	0	0	0	0	3	0	0	2	0
IN1404.3	1	0	0	0	0	0	0	0	0	3	0	0	2	0

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Course Code	IN1405							Course category			PC
Course Name	LINEAR INTEGRATED CIRCUITSLABORATORY										
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	00	50	00	50	01

Course Objectives:

Aim of the course is to:

I. Acquire fundamental concepts of linear integrated circuits.

II. Design and implement inverting-non inverting and differential circuits with op-amp.

III. Become familiar with the applications of timers, Voltage regulators, filters and oscillators

Minimum Eight Experiments to be performed covering the Entire Syllabus of **IN1406 LINEAR INTEGRATED CIRCUITS LABORATORY** Representative list is as follows.

1. Measurement of op-amp parameters and comparison with op-amp data sheets.
2. Assembling of op-amp Inverting, Non inverting and differential circuits to measure an input in the range of mill volts to few volts.
3. Design of attenuator circuit using amplifier and testing for gain.
4. Design of voltage adder, voltage averaging, voltage subtractor circuits using op-amp.
5. Design of signal conditioning circuit to operate a relay or to generate timing delays (e.g.1 sec, 10 sec.) using IC 555.
6. Design of instrumentation amplifier using 3 op-amps and testing for gain, frequency response.
7. Design of a circuit to work as voltage regulator of 10 or 20 volts using IC 723.
8. Design Monostable, bistable, and astable multivibrators using timer IC 555.
9. Design of low and high pass filters with a cut off frequency of 1 kHz or 2 kHz and testing for frequency response.
10. Design of cascade amplifier system using op-amp and testing for gain and frequency response.


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11. Design of different types of oscillators using op-amp.
12. Design of band pass filter using op-amp and testing for frequency response.
13. Design of Clippers and Clampers.
14. Use of 565 PLL as a frequency multiplier

Course Outcomes:

Upon Completion of this course, students will able to

IN1405.1: Design and analyze concepts of linear integrated circuits.

IN1405.2: Develop linear and nonlinear applications of operational amplifier.

IN1405.3: Perform the basic operations of timer, voltage regulator, filter and oscillators.

Note :

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

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1405.1	1	0	0	0	0	1	1	0	0	0	1	3	2	0	1
IN1405.2	1	1	0	0	0	1	1	0	0	0	1	1	2	0	1
IN1405.3	1	1	0	0	0	1	1	0	0	0	1	1	2	0	1

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CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1405.1	1	0	0	0	0	1	1	0	0	0	1	2	0	1
IN1405.2	1	1	0	0	0	1	1	0	0	0	1	2	0	1
IN1405.3	1	1	0	0	0	1	1	0	0	0	1	2	0	1

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Course Code	IN1406							Course category			VSE
Course Name	SENSOR AND TRANSDUCER-II 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:

Aim of the course is to:

I. Acquire the knowledge of the constructions and working principle of differenttypes of sensors and transducers
II. Understand different techniques of measurement for physical parameters.
III. Design signal conditioning circuits for different sensors

The instructor may choose experiments as per his/her choice, so as to cover entire course contents of **IN1407SENSOR AND TRANSDUCER-II LABORATORY**. Minimum 8 experiments should be performed.Representative list is as follows.

1. Measurement of strain using strain gauge.
2. Loading effect of Potentiometer
3. Characteristics of Piezo-electric Transducer
4. Study of distance measurement using ultrasonic transducer.
5. Measurement of Displacement by (a) Piezoelectric pickup and (b) Light dependent resistor
6. Measurement of speed and torque using Opto Electronic Sensor
7. Characteristics of Hall effect sensor
8. Measurement of level using capacitive transducer.
9. Study of Differential Pressure Transducer & signal conditioning of output signal

Course Outcomes:

Upon Completion of this course, students will able to

IN1406.1 Examine the characteristics of different transducer
IN1406.2 Identify suitable instruments to meet the requirements of industrial applications
IN1406.3 Apply concepts and methods various measurements in IN1406 through experiments

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ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

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

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1406.1	1	0	0	0	0	1	1	0	0	0	1	3	2	0	1
IN1406.2	1	1	0	0	0	1	1	0	0	0	1	1	2	0	1
IN1406.3	1	1	0	0	0	2	1	0	1	0	1	1	1	0	1

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CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1406.1	1	0	0	0	0	1	1	0	0	0	1	2	0	1
IN1406.2	1	1	0	0	0	1	1	0	0	0	1	2	0	1
IN1406.3	1	1	0	0	0	2	1	0	1	0	1	1	0	1

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Course Code	IN1411							Course category			EX
Course Name	IOT BASED APPLICATIONS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
00	00	00	00	00	00	00	-	50	00	50	04

Course Objectives:

Aim of the course is to:

I. To study the structure, function and characteristics of Internet of Things
II. To identify the communication protocols.
III. To develop fundamentals of Arduino Uno
IV. To recognize various devices, sensors and applications
V. To explain the design of the various IoT Applications.

Course Contents:

Introduction to IoT: Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

IoT Protocol : IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks,IoT protocols: MQTT/MQTTS, CoAP, 6LoWPAN, like TCP, UDP, HTTP/S., Comparison of the different IoT protocols.

Data Analytics and Design : Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M,Design Methodology, Embedded computing logic, System on Chips, IoT system building blocks, Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board

Arduino Environment : Setup the IDE, Writing Arduino Software, Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED,LCD, push button ,buzzer ,Temperature, Humidity, Motion, Light and Gas Sensor,Actuators,Relay Switch and Servo Motor with Arduino

Case Studies/IndustrialApplications: IoT applications in home, infrastructures, buildings, security, Industries, Homeappliances, other IoT electronic equipments, Industry 4.0 concepts.

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Text Books: -

1. Internet of Things: A Hands-on Approach , Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015.
2. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017

Reference Books and Websites: -

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill HigherEducation
2. ArduinoUno:A Hands-On Guide for Beginner, Agus Kurniawan , 1st edition
3. Getting Started with the Internet of Things, Cuno Pfister, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1
4. Internet of Things (A Hands-onApproach)VijayMadisetti and Arshdeep Bahga, 1st Edition, VPT, 2014
5. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012
6. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence",Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.

Useful Link:

1. IOT course https://nptel.ac.in/courses/106105166 Name Of Course: Introduction to Internet of things, IIT Kharagpur ,Prof.Sudip Misra.

Course Outcomes:

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

IN1411.1 : Explain the structure, function and characteristics of Internet of Thing.
IN1411.2 : Identify the communication protocols.
IN1411.3 :Understand design methodology and hardware platforms involved in IoT.
IN1411.4 :Understand how to analyze and organize the data in IoT.
IN1411.5 : Compare IOT Applications in Industrial &realworld.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1411.1	2	2	0	0	0	0	0	0	0	1	0	0	2	0	0
IN1411.2	2	2	1	2	0	0	0	0	0	0	0	0	1	0	0
IN1411.3	3	2	1	2	0	0	0	1	0	0	0	0	2	0	1
IN1411.4	3	2	1	0	0	0	1	0	0	0	1	0	2	1	0
IN1411.5	2	1	1	0	1	0	0	0	0	0	0	0	2	0	1

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CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1411.1	2	2	0	0	0	0	0	0	0	1	0	2	0	0
IN1411.2	2	2	1	2	0	0	0	0	0	0	0	1	0	0
IN1411.3	3	2	1	2	0	0	0	1	0	0	0	2	0	1
IN1411.4	3	2	1	0	0	0	1	0	0	0	1	2	1	0
IN1411.5	2	1	1	0	1	0	0	0	0	0	0	2	0	1

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Course Code	IN1412							Course category			EX
Course Name	PCB DESIGN AND CIRCUIT SIMULATOR										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
00	00	00	00	00	00	100	-	50	00	50	04

Course Objectives:

Aim of the course is to:

I. To Acquire the basic level knowledge required to understand PCBs
II. To study the importance of manufacturing documents.
III. To Understand the basic concept of how to design PCB for Manufacturing and assembly point of view.
IV. To study the basic concept of fault finding /repair and rework methods in PCB.
V. To Understand the basic level knowledge required to understand assembly techniques for leaded and SMDs.

Course Contents:

Printed circuit Board Design: History of Printed Circuit Boards. Various types of Printed Circuit Boards-Single Sided Boards, Double Sided Plated through Hole Boards, multilayer Boards. Process of PCB design and product development flow.

PCB Layout Design: Study of technical terms in layout design. :-Board outline Design, components placement, Details of layers, Routing methods, Copper Pour, Adding reference texts, Build library parts (footprints, schematic symbols) Generation of various Manufacturing Documents/Output files generation (Gerber file generation) IPC standards for printed circuit board design.

PCB Manufacturing Techniques: Fabrication methods Film Master generation method :various material used in Manufacturing of Printed Circuit Boards and properties of material. Cleaning Method of base materials before pattern transfer. Manual and Mechanical Cleaning Methods Printed Circuit Board Manufacturing Methods : Method of Screen Printing for pattern transfer, Method of Wet film and Dry film for single and Double Sided Board Manufacturing. Method of Solder-mask and Legend Printings. Plating and Etching Techniques, Mechanical methods required in manufacturing of PCBs like punching, drilling, milling and routing.Study of-Fault Finding methods of PCBs, Repairing Techniques.Materials used in Soldering Process. Types of soldering techniques.De-soldering techniques.

PCB Assembly Techniques : Components Preparation Method, Lead identification of components ,Component mounting techniques ,Lead Forming methods, Leaded through hole

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assembly and Surface Mount Assembly. Mixed Assembly Techniques of through hole and SMDs. Manual Assembly method, Semiautomatic and automatic Assembly method. Tools used in assembly process. Introduction of SPICE simulation software like multisim.

Text Books:

1. "Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards (Electronics)" by Simon Mon
2. "PCB Design for Real-World EMI Control (The Springer International Series in Engineering and Computer Science)" by James Drewniak and Bruce R Archambeault.

Reference Books:

1. "PCB Design: Printed Circuit Board" by Michael Dsouza and Dsouza Michael
2. "PCB Design Using AutoCAD (EDN Series for Design Engineers)" by Chris Schroeder
3. "OSCAD: An Open Source EDA Tool for Circuit Design, Simulation, Analysis and PCB Design" by Save Yogesh
4. "Complete PCB Design Using OrCAD Capture and PCB Editor" by Kraig Mitzner
5. "PCB Design in EAGLE – Part 1: Learn about EAGLE's user interface, adding parts, schematics, and more!" by Andy Artes
6. "Designing Circuit Boards with EAGLE: Make High-Quality PCBs at Low Cost" by Matthew Scarpino

Useful link:

PCB design
https://hillmancurtis.com/nptel-pcb-design/#:~:text=The%20NPTEL%20PCB%20Design%20course%20is%20a%2012%2Dweek%20course,lectures%2C%20quizzes%2C%20and%20assignments.

Course Outcomes:

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

IN1412.1 Explain the basic level knowledge required to understand PCBs
IN1412.2 Identify importance of manufacturing documents.
IN1412.3 Understand the basic concept of how to design PCB for Manufacturing and assembly point of view.
IN1412.4 Interpret the basic concept of fault finding /repair and rework methods in PCB.
IN1412.5 Understand assembly techniques for leaded and SMDs.

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

Course Outcome	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1412.1	2	2	0	0	0	0	0	0	0	1	0	0	2	0	1
IN1412.2	2	2	1	0	0	0	0	0	0	0	0	0	1	0	0
IN1412.3	3	2	1	0	0	0	0	1	0	0	0	0	2	1	1
IN1412.4	3	2	1	0	0	0	1	0	0	0	1	0	2	1	0
IN1412.5	2	1	0	0	0	0	0	0	0	2	0	0	2	1	1

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Course Outcome	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1412.1	2	2	0	0	0	0	0	0	0	1	0	2	0	1
IN1412.2	2	2	1	0	0	0	0	0	0	0	0	1	0	0
IN1412.3	3	2	1	0	0	0	0	1	0	0	0	2	1	1
IN1412.4	3	2	1	0	0	0	1	0	0	0	1	2	1	0
IN1412.5	2	1	0	0	0	0	0	0	0	2	0	2	1	1

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

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SEMESTER –V

Course Code	IN 1515	Course category	MM
Course Name	CONTROL SYSTEM ENGINEERING		

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

Course Objectives: Aim of the course is to

I. Understand the basic knowledge of fundamentals of control systems
II. Gain the knowledge of the mathematical model for different physical systems
III. Find the transfer function for control system by BDR,SFG techniques
IV. Analyse the performance characteristics of first and second-order systems for different standard inputs
V. Determine the stability of control system by RH Criterion, time domain and frequency domain techniques, state space representation of control system

Course Contents:

Fundamentals of control systems: Basic components of a control System, Concept of open loop and closed loop systems, Effects of Feedback, Review of Laplace and inverse Laplace transform, Transfer functions.

Mathematical modelling: of electrical systems, mechanical systems, Electrical analogy of mechanical translational & rotational systems, Block diagrams of control system, Block diagram reductions, Signal flow graph, Mason's gain formula and its applications

Time response analysis: Time response of system, Standard test signals, Analysis of first order and second order systems, Time response specifications, Steady state errors and error constants.

Stability analysis: Stability of open loop and closed loop systems, Routh-Hurwitz criterion, Stability and Performance analysis, Root locus techniques, Root locus construction rules, Sketching of Root Locus.

Frequency response analysis: Frequency domain specifications, Correlation between time and frequency responses, Bode plots, Phase margin and Gain margin, Introduction to polar plots, Nyquist plots.

Introduction to state space: State Space Representation of the control system, State Variables representation, conversion of transfer function to state variable model, Representation of state equation.

Text Books:

3. Nagrath and Gopal, "Control System Engineering", New Age International Publication, 5th edition, 2003.

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4. Norman Nise, "Control System Engineering", Wiley International, 6th edition, 2011.

Reference Books:

7. C.H. Houpis, S.N. Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Press; 6th edition.
8. G. Franklin, J.Powell, A. Naeini, "Feedback Control of Dynamic Systems", Pearson, 6th edition.
9. K. Ogata, "Modern Control Engineering", Prentice Hall Publications,5th edition.
10. Dorf and Bishop, "Modern Control Systems", Addison Wesley, LPE, 9th Edition.
11. B. C. Kuo, "Automatic control system", Prentice Hall of India, 7th Edition, 1995

Course Outcomes:

After completion of the course students will be able to

INU1515.1 Classify open and closed control systems with their characteristics
INU1515.2 Derive the transfer function of electrical ,mechanical or any given system by using BDR, SFG techniques
INU1515.3 Obtain the response of first & second-order systems
INU1515.4 Determine the stability of control system by Time & frequency domain
INU1515.5 Represent the control system in State space representation

CO – PO – PSO Mapping as per Jan-2016 Format This subject is offered for other deptt. students, PSO is not considered

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IN1515.1	3	1	0	0	0	0	0	0	0	0	0	0
IN1515.2	3	2	0	0	0	0	0	0	0	0	0	0
IN1515.3	3	3	0	0	0	0	0	0	0	0	0	0
IN1515.4	3	2	1	0	2	0	0	0	0	0	1	1
IN1515.5	2	0	0	0	1	0	0	0	0	0	0	0

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

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IN1515.1	3	1	0	0	0	0	0	0	0	0	0
IN1515.2	3	2	0	0	0	0	0	0	0	0	0
IN1515.3	3	3	0	0	0	0	0	0	0	0	0
IN1515.4	3	2	1	0	2	0	0	0	0	1	1
IN1515.5	2	0	0	0	1	0	0	0	0	0	0

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

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Course Code	IN 1516						Course category		MM
Course Name	SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT								
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:

Aim of the course is to

I. Understand the meaning of investment, speculation and gambling
II. Analyse different alternatives for making efficient investment.
III. Understand the type of investor's mistake made by investors.
IV. Understand the concept of return and risk
V. Calculate the risk and return.

Course Contents:

Investment Management: Critical Differences between Investment and Speculation, Gambling, Investment Objectives, Investment Process, Investment Alternatives Evaluation, Common Investor Mistakes

Meaning and types of Financial Markets: How Do Financial Markets Work? Who Are the Main Participants in Financial Markets? Money and Capital Markets, Forex and Derivative markets

Fixed Income and Other Investment Alternatives: Bonds, Types of Bonds, Bond Pricing, Risk in Bonds, Alternative Investments

Risk and Return: The Concept of Return, the Concept of Risk, Quantification of Risk, The Variance & Standard Deviation

Fundamental Analysis: Understanding Fundamental Analysis Basics, Industry Analysis, Economic Analysis, Company Analysis

Portfolio Construction and Management: The Efficient Frontier, Portfolio risk, Portfolio return, Diversification- Meaning

Portfolio Evaluation and Revision: Need for Portfolio Revision, Evaluation, Passive vs. Active Portfolio Management

Text Books

1. K Sasidharan& Alex K Mathews,"Security Analysis And Portfolio Management",McGraw Hill Education
2. Pandian, Punithavathy, "Security Analysis and Portfolio Management", Vikas Publishing House.

Web Resources:

1. https://en.wikipedia.org/wiki/Securities_market\

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2. https://www.indiainfoline.com/knowledge-center/share-market/differencebetweenprimary-market-and-secondary-market
3. https://en.wikipedia.org/wiki/Stock_market
4. https://groww.in/blog/clearing-and-settlement-process-in-stock-market

Course Outcome:

After successful completion of this course, students will be able to:

IN1516.1 Explain the fundamental concepts of investment, financial markets, and various investment alternatives.

IN1516.2 Assess risk and return characteristics of individual securities and portfolios using various financial models.

IN1516.3 Apply valuation techniques for equity, bonds, and other financial instruments to determine their intrinsic value.

IN1516.4 Explain the Efficient Market Hypothesis (EMH) and its implications for investment strategies.

IN1516.5 Use fundamental and technical analysis tools to evaluate securities and make informed investment decisions.

CO – PO – PSO Mapping as per Jan-2016 Format This subject is offered for other deptt. students, PSO is not considered

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IN1515.1	3	1	0	0	0	0	0	0	0	0	0	0
IN1515.2	3	2	0	0	0	0	0	0	0	0	0	0
IN1515.3	3	3	0	0	0	0	0	0	0	0	0	0
IN1515.4	3	2	1	0	2	0	0	0	0	0	1	1
IN1515.5	2	0	0	0	1	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 Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IN1516.1	3	1	0	0	0	0	0	0	0	0	0
IN1516.2	3	2	0	0	0	0	0	0	0	0	0
IN1516.3	3	3	0	0	0	0	0	0	0	0	0
IN1516.4	3	2	1	0	2	0	0	0	0	1	1
IN1516.5	2	0	0	0	1	0	0	0	0	0	0

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

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Course Code			IN1501					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	00	00	03	15	15	10	60	2 hrs.30 min	00	00	100	03

Course Objectives:

Aim of the course is to**:**

I. Understand the fundamental characteristics of continuous time and discrete time signals and systems.
II. Understand signals and systems in terms of both the time and frequency transform domains.
III. Design and analyses linear time-invariant systems and compute its response.
IV. Analyze the spectral characteristics of signals using Fourier analysis.
V. Realize the FIR and IIR systems using Z-transform.

Course Contents:

Introduction to Signals and Systems: Introduction to Signals, Classification of Signals, Continuous Time and Discrete Time Signals, Step and Impulse Functions, Transformation of Independent Variable, Introduction to Systems, Classification of Systems, Properties of Systems, Normal Form of System Equation, Initial Conditions, Impulse Response of a Physical System, system Impulse Response.

Analysis of Systems: System characteristics, Introduction to Convolution, Convolution Sum, Linear and Circular Convolution, Sampling theorem, reconstruction, aliasing, sampling in the frequency domain, decimation and interpolation.

Continuous and DiscreteFourier Transform Analysis: Fourier analysis for Continuous time signals and systems, Continuous time Fourier series and its convergence, Continuous time Fourier Transform, its properties, frequency response.Discrete time Fourier series and its convergence, discrete time Fourier Transform, its properties, frequency response.

Z-Transform: Definition, properties of z-transform, z-transform of standard sequences, inverse Z-transform, relationship of z-transform with Fourier transform applications of Z-transform to solutions of difference equations, Properties and applications of Z transform.

FIR and IIR system: Introduction to FIR and IIR system, block diagram representation, cascade, parallel, and feedback interconnections, FIR and IIR system realization, Direct Form I, Direct Form II, cascade, parallel and transposed realization.

Text Books:

1. S. Salivahanan ,Digital Signal Processing, McGraw-Hill Education (India) Pvt. Limited, 2001
2. E. C. Ifeachor, B. W. Jarvis,Digital Signal Processing- A Practical Approach, , 2nd Edition, Pearson Education, New Delhi, 2002.

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Reference Books:

1. Digital Signal Processing- A Practical Approach, E. C. Ifeachor, B. W. Jarvis, 2nd Edition, Pearson Education, New Delhi, 2002.
2. Discrete time signal processing, A. V. Oppenheim, R. W. Schafer, 3rd Edition, Prentice-Hall of India, 2001.
3. Modern Digital signal processing , V Udayashankara, 2nd edition, Prentice-Hall of India, 2012
4. Understanding Digital Signal Processing, R. G. Lyons, Pearson Education, New Delhi, 1999.
5. http://www.nptel.iitm.ac.in

Course Outcomes: On Completion of this course, students will able to

IN1501.1 Understand the fundamental characteristics and types of signals and systems.
IN1501.2 Understand signals and systems in terms of both the time and frequency transform domains.
IN1501.3 Design and analyze linear time-invariant systems and compute its response.
IN1501.4 Analyze the spectral characteristics of signals using Fourier analysis.
IN1501.5 Realize the FIR and IIR systems using Z-transform.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1501.1	2	2	0	2	1	0	0	0	0	0	0	0	1	1	0
IN1501.2	2	2	1	2	2	0	0	0	0	0	0	0	1	0	0
IN1501.3	2	0	1	3	0	2	0	0	0	0	0	0	1	0	0
IN1501.4	1	3	2	2	2	0	0	0	0	0	0	0	1	0	0
IN1501.5	2	1	1	1	3	0	0	0	0	0	0	0	1	0	0

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1501.1	2	2	0	2	1	0	0	0	0	0	0	1	1	0
IN1501.2	2	2	1	2	2	0	0	0	0	0	0	1	0	0
IN1501.3	2	0	1	3	0	2	0	0	0	0	0	1	0	0
IN1501.4	1	3	2	2	2	0	0	0	0	0	0	1	0	0
IN1501.5	2	1	1	1	3	0	0	0	0	0	0	1	0	0

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

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Course Code	IN1502							Course category			PC
Course Name	INDUSTRIAL AUTOMATION										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT 1	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:

Aim of the course is to**:**

I. To introduce the fundamentals of Industrial Automation.
II. To introduce International Communication Standards and their practical applications.
III. To apply the knowledge of PLC, DCS and SCADA systems in various applications.
IV. To understand industrial safety and its management.
V. To apply communication protocol for any practical application developed by PLC, DC, ESD, F&G.

Course Contents:

Industrial Automation: Introduction to Instrumentation and Control (Block Diagram), Types of Automation, Role of Automation in Industries, Industrial Revolution 1, 2, 3, 4, Reference Architecture Model of Industry 4.0 (RAMI), Industrial Control **:**Programmable logic controllers (PLC): Introduction &Basic Architecture, Ladder diagrams and examples, PLC programming method: Function Block Diagram (FBD) as per IEC 61131-3, Distributed Control System (DCS): Basic Concept of DCS and its Architecture, Basic Comparison of Honeywell TDC3000 and Yokogawa Centum CS3000, Supervisory Control and Data Acquisition (SCADA):Introduction and Objectives of SCADA, SCADA in Process Control applications. Human Machine Interface (HMI) & Graphic Pages .Concept of Remote IO Modules (RIO), Concept of Remote Terminal Unit (RTU)

Industrial Safety: Introduction to Process Safety & Emergency Shutdown System (ESD), Safety Interlocks, Basics of Hazard Identification Study (HAZID) ,Hazard and Operability Study (HAZOP), Safety Integrity Levels (SIL),Introduction to IEC 61508 & 61511 standards for Functional safety, IEC 61508-1 :- Functional Safety of Electrical / Electronic/ Programmable Electronic Safety Related Systems – General Requirements, IEC 61511-1 Management of Functional Safety, Safety life-cycle requirements Introduction to Layers Of Protection & Safety Instrumented Systems, Fire & Gas System (F&G): Addressable and Non-Addressable F&G Devices, Concept of Addressable Loops, Introduction to Fire Alarm Control Panel (FACP)

Instrumentation Standard Communication Protocols: Basic understanding of communication, Open Systems Interconnection (OSI): Introduction to 7 Layers as per ISO/IEC7498-1. Definition of Protocols, RS232, RS485, Modbus:-Layers, Protocol Data Unit, Application Data Unit, IEC61158-1 :- Mapping onto OSI Basic Reference Model, Structure of IEC 61158, brief summary of the characteristics of service & protocol for each fieldbus type, concept of OPC (Object linking and embedding for Process Control), HART Protocol,

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Foundation Fieldbus :- Introduction, frame structure, implementation examples, advantages and limitations, basic comparison and applications of Foundation Fieldbus, Profibus, ControlNet, DeviceNet, Industrial Ethernet, Introduction to IIOT in Industrial Plants

Text Books: -

1. D. Eckman, "Process Control Instrument Engineers Handbook", X 3rd edition, Butterworth Heinemann Company, 1999
2. Programmable Logic Controllers by W. Bolton

Reference Books:

1. Johnson C. D., "Process Control Instrumentation Technology", 7th edition, Pearson Education, New Delhi, 2003.
2. Webb J. W. "Programmable Controllers: Principles and Applications", Mergy/publishing co.1988
3. Krishankant, "Computer Based Industrial Control", 7th edition, PHI, 2005,
4. MadhuchandraMitra,Samarjit Sen Gupta, "Programmable logic controllers and Industrial Automation An introduction" ,Penram publishing (India) Pvt Ltd,2009
5. http://www.nptel.iitm.ac.in (Industrial Automation And Control By Prof. Alokkanti Deb | IIT Kharagpur)

Web Resources:

1. https://prod-edam.honeywell.com/content/dam/honeywell-edam/hbt/en-us/documents/literature-and-specs/datasheets/hbt-fire-74-4034-16.pdf
2. https://www.nexinstrument.com/assets/images/02032017Honeywell/MT11-520.pdf
3. https://skoge.folk.ntnu.no/puublications_others/apc-book-papers/honeywell3000-AP09-600.pdf
4. https://web-material3.yokogawa.com/TI33Q01B10-01E.pdf
5. https://prod-edam.honeywell.com/content/dam/honeywell-edam/hbt/en-us/documents/literature-and-specs/datasheets/hbt-fire-74-4034-16.pdf
6. https://control.com/technical-articles/what-is-a-remote-terminal-unit-rtu/#:~:text=There%20are%2C%20however%2C%20several%20technical,with%20more%20features%20and%20functionalities.

Course Outcomes:

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

IN1502.1	Introduce the fundamentals of Industrial Automation.
IN1502.2	Understand concepts of International Communication Standards and their practical applications.
IN1502.3	Demonstrate an understanding the concept of PLC, DCS and SCADA systems in Industry.
IN1502.4	Study & Understand the industrial safety and its management
IN1502.5	Propose of the integration and communication of various Industrial Control

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and Safety systems (i.e. PLC, DCS, ESD, F&G),

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Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1502.1	2	2	0	0	0	0	0	0	0	0	0	0	1	2	1
IN1502.2	1	0	0	0	0	0	0	0	0	0	0	0	1	2	0
IN1502.3	3	2	1	1	3	1	0	0	0	0	0	0	3	3	1
IN1502.4	2	1	2	2	0	0	0	0	0	0	0	0	1	2	2
IN1502.5	2	2	0	0	2	0	0	0	0	0	0	0	2	2	1

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO – PO – PSO Mapping as per NBA Jul-2024 format [w.e.f. 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1502.1	2	2	0	0	0	0	0	0	0	0	0	1	2	1
IN1502.2	1	0	0	0	0	0	0	0	0	0	0	1	2	0
IN1502.3	3	2	1	1	3	1	0	0	0	0	0	3	3	1
IN1502.4	2	1	2	2	0	0	0	0	0	0	0	1	2	2
IN1502.5	2	2	0	0	2	0	0	0	0	0	0	2	2	1

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

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Course Code	IN1503						Course category		PC
Course Name	UNIT OPERATION								
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:
Aim of the course is to**:**

I. To get the knowledge of different heat exchanger equipments and effect of other parameters on them.
II. To demonstrate concepts of boiler and Evaporators.
III. To understand Distillation column, gas absorption, drying, crystallization processes.
IV. To distinguish various size reduction methods.
V. To use of various unit operations in different industries.

Course Contents:

Heat exchangers: Heat transfer fundamentals. General design requirements, Double pipe heat exchanger, shell and tube type, plate type heat exchangers, fundamental principal, applications. Condensers: type, working, application. Boilers: types, working, application, boiler accessories. Evaporators: types, working, application, components, multiple-effect evaporation.

Distillation Columns: Distillation boiling point diagram, laws of distillation, relative volatility, methods of distillation , continues &batch,Various plates used for phase conducting in distillation Bubble cap plate, sieve plate & valve plate, packed columns for distillation , Overall design aspect: material balance. Rectification, striping section & applications.

Gas absorption: Comparison of gas absorption and distillation, gas absorption equipments, Drying: batch and continuous drying, drying of solids.
Crystallization: Batch – Agitated tankcrystallizers,Continuous – SwensonWalkercrystallizer, working and applications.

Size reduction Methods: Selection criteria and considerations for equipment used for size reduction. Energy and power requirement in size reduction, laws in size reduction,
Pulverisation: Crushing (Jaw, Gyratory), grinding (Hammer and ball mill), screening (Grizzly, trommel, vibrating)

Unit operations in different industries: Unit operations used in different industries like sugar, cement, Urea fertilizer industry with help of process flow diagram.

Text Books: -

1. Warren L. McCabe, Julian C. Smith, Peter Harroitt, "Unit Operation in Chemical Engineering", McGraw Hill. 5th edition., 2005.

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2. W.L. Mccav & J.C. Smith, "Unit operations & chemical engineering", Tata McGraw Hill publications.

Reference Books :-

1. R.E. Treybl,"Mass transfer operations", 3rd edition, McGraw Hill publication
2. R.H.Perry, "Chemical Engineers Handbook", McGraw Hill publications.
3. K.A.Gavhane, "Unit Operation- I, II"by ,Nirali publication.

Web Resources: -

1. https://onlinecourses.nptel.ac.in/noc25_ch45/preview
2. https://www.youtube.com/watch?v=ajRUejrx6z0

Course Outcomes:

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

IN1503.1 Understand the concept of different heat exchanger equipments.
IN1503.2 Understand concepts of boiler and Evaporators.
IN1503.3 Understand the process of Distillation , gas absorption, drying and Crystallization.
IN1503.4 Select the appropriate size reduction equipment.
IN1503.5 Propose the unit operation sequence and equipment required in different industries.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1503.1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0
IN1503.2	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0
IN1503.3	2	1	0	0	0	0	0	0	0	0	0	0	1	1	0
IN1503.4	2	1	0	1	0	0	0	0	0	0	0	0	1	1	0
IN1503.5	3	2	0	1	0	0	1	0	0	0	1	0	1	1	2

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1503.1	1	1	0	0	0	0	0	0	0	0	0	0	1	0
IN1503.2	1	1	0	0	0	0	0	0	0	0	0	1	1	0
IN1503.3	2	1	0	0	0	0	0	0	0	0	0	1	1	0
IN1503.4	2	1	0	1	0	0	0	0	0	0	0	1	1	0
IN1503.5	3	2	0	1	0	0	0	0	0	1	0	1	1	2

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Course Code	IN1504[A]	Course category	PE
Course Name	BIO MEDICAL INSTRUMENTATION		

Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	15	15	10	60	2hr30 min	00	00	100	04

Course Objectives:

Aim of the course is to**:**

I. Introduce the Mechanisms, Anatomy and Physiology of Human body systems
II. Impart the knowledge of engineering principles applied to biomedical systems
III. Understand the principle of bio potentials, bioelectric signals, electrode systems
IV. Deduce the characteristics of the ECG, EMG, EEG Waveforms
V. Elaborate non electrical parameters measurement, safety aspects in BME and studyof evolution of imaging Techniques like X-ray,CT, MRI.

Course Contents:

Physiology and Bio potential Electrodes: Introduction to Biomedical Instrumentation, classification of biomedical Instruments,Physiology of cardiovascular system, respiratory system, nervous system, Resting and Action Potential, Electrode electrolyte interface, half-cell potential, Electrodes Limb electrodes, floating electrodes, pre-gelled disposable electrodes, needle and surface electrodes

Cardio Vascular system (**ECG**) Heart electro cardiogram, Measurement and analysis of EGG waveform, ECG recorder principles, block schematic of ECG recorder,introduction of defibrillators, phonocardiography, Advancement in ECG machines

Electrical activity of the brain (EEG)andNeuromuscular system(EMG):Sources of brain potential, generation of signals, EEG rhythm waves and its classification , EEG recording electrodes, 10-20 electrode system, ,muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, EMG and its waveforms.

Non-Electrical Parameter Measurements: Measurement of blood pressure, pulmonary function measurements, Body Plethysmography, measurement of blood pCO2, finger-tip oxymeter.

Modern imaging systems& Electrical Safety of equipments– Concepts of X ray machine, Computer tomography, Magnetic resonance imaging system, ultrasonic imaging systems.Electricalsafety in medical systems,Safety aspects, Macro/Micro shock,Ground loop and ground current, Design consideration for reducing electrical hazards

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Text Books:

1. Hand book of Biomedical Instrumentation, Khandpur R. S., 2nd edition, Prentice HallofIndiaPvt. Ltd, New Delhi, India, 2003.
2. Biomedical Instrumentation and measurement, Leslie Cromwell, 3rd edition, Prentice Hall of India, New Delhi, 1997.

Reference Books:

1. Biomedical Instrumentation, ster J. G., 4th edition, John Wiley and Sons, Hoboken, NJ, 2004.
2. Introduction to Biomedical Equipment Technology, Carr J.and Brown J., 4th edition, Pearson Education, 2000.
3. Biomedical Digital Signal Processing, Willis J. Tompkins, Prentice Hall of India Publications/ Eastern Economy Edition, 2nd Print, 2000

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

1504.1 Explain the anatomy & physiology of various systems of the Human body.
1504.2 Take the measurements and interprete the data from ECG, EMG, EEG .
1504.3 Measure the non electrical parameter Blood Pressure, O_2, lung parameters.
1504.4 Elaborate the evolution of imaging technique in biomedical Engineering.
1504.5 Categorize the biomedical equipmentswiththetechnical and safety aspects.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1504.1	2	0	0	0	0	1	0	2	0	0	0	0	2	3	1
IN1504.2	3	1	0	2	0	1	0	1	0	0	0	0	1	3	1
IN1504.3	2	1	0	2	0	1	0	1	0	0	0	0	2	2	1
IN1504.4	1	0	0	0	1	1	0	2	0	0	0	0	2	1	1
IN1504.5	2	0	0	0	0	1	0	2	0	0	0	0	1	0	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1504.1	2	0	0	0	0	1	2	0	0	0	0	2	3	1
IN1504.2	3	1	0	2	0	1	1	0	0	0	0	1	3	1
IN1504.3	2	1	0	2	0	1	1	0	0	0	0	2	2	1
IN1504.4	1	0	0	0	1	1	2	0	0	0	0	2	1	1
IN1504.5	2	0	0	0	0	1	2	0	0	0	0	1	0	1

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

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Course Code	IN1504(B)						Course category		PE
Course Name	INTRODUCTION TO MECHATRONICS								
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:

Aim of the course is to**:**

I. To introduce the basic elements of mechatronics.
II. To understand the Electrical, Mechanical Actuator systems.
III. To understand robotic systems.
IV. To study special purpose machines.
V. To illustrate case studies and examples in mechatronics.

Course Contents:

Fundamental of Mechatronics: Definition, concepts, scope, system component and key elements of mechatronics systems, comparison with conventional system, Need and Role of Mechatronics in Design, Advantage of Mechatronics

Electrical and Mechanical Actuator Systems: Introduction to Electrical actuator systems, Moving-iron transducers, Solenoids, Relays, Introduction to Mechanical actuator systems, Hydraulic and pneumatic systems, Mechanical elements, Kinematic chains, Cam mechanisms, Gears, Ratchet mechanisms, Flexible mechanical elements, Friction clutches, Design of clutches, Brakes.

Robotic systems: Definition, History and characteristics of Robot , classification of robots, Robotic arm terminology, Robotic arm configuration, Robot applications, Basic robotic systems, manipulator kinematics, Sensors in robotics (Proxy,Range,IR,US etc.) Robotic arm positioning concepts, Robotic arm path planning.

Mechatronics components for control: Mechatronics Systems in Control Architectures, Stepper motor, servo motor, Armature-Controlled DC/BLDC Motors, Open-Loop Response, Feedback Control of a DC Motor, Controller Empirical Design, Controller Implementation

Case studies and examples in Mechatronics:

Mechanically Controlled Robotic Arm, Mechatronics Design of a Coin Counter, Mechatronics Design of a Robotic Walking Machine, A PC-based computer numerically controlled (CNC) drilling machine, Manufacturing and FactoryAutomation.

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Text Books:

1. David Alciatore and Histand, "Introduction to Mechatronics and measurement system", TMH.
2. Godfrey Onwubolu "Mechatronics Principle and Applications", Elsevier Butterworth-Heinemann. 2005

Reference Books:

1. W. Bolton, "Mechatronics: Electronic Control Systems in mechanical and electrical Engineering", Third Edition, Pearson education (Singapore) Ltd., 2005.
2. M. D. Singh, J. G. Joshi, Mechatronics, PHI.
3. Dan Necsulescu, "Mechatronics", Pearson Education, Asia.

Course outcomes: On Completion of this course, students will able to

INU1504(B).1 Recalling the basic techniques, skills and modern tools in mechatronics engineering technology.

INU1504(B).2 Apply concepts of Electrical actuator systems, Hydraulic &Pneumatic Systems.

INU1504(B).3 Apply the robotic system of minor applications

INU1504(B).4 Understand the special purpose machine for various applications

INU1504(B).5 Illustrate Case studies.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1504(B).1	2	1	0	1	0	0	0	0	0	0	0	0	1	0	1
IN1504(B).2	2	2	2	1	0	0	1	0	0	0	0	0	1	1	0
IN1504(B).3	1	2	2	0	1	1	0	0	0	0	0	1	1	1	1
IN1504(B).4	2	2	2	2	1	1	0	0	0	0	0	0	0	1	0
IN1504(B).5	2	2	1	2	1	0	0	1	0	0	0	0	1	1	1

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1504(B).1	2	1	0	1	0	0	0	0	0	0	0	1	0	1
IN1504(B).2	2	2	2	1	0	0	0	0	0	0	0	1	1	0
IN1504(B).3	1	2	2	0	1	1	0	0	0	0	1	1	1	1
IN1504(B).4	2	2	2	2	1	1	0	0	0	0	0	0	1	0
IN1504(B).5	2	2	1	2	1	0	1	0	0	0	0	1	1	1

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Course Code	IN1504(C)		Course category	PE
Course Name	DIGITAL CONTROL			

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:

Aim of the course is to**:**

I. Understand fundamental concepts of discrete time control system.
II. Familiarize the Pulse Transfer Function, digital PID Controllers and filter.
III. Design the Discrete Time Control System.
IV. Learn the concept of state space analysis of Discrete Time Control System.
V. Design the control system by using concept of Pole Placement.

Course Contents:

Introduction to Discrete Time Control System: Basic building blocks of Discrete time Control system, Sampling Theorem, Z transform and Inverse Z transform for applications for solving differential equations, Mapping between the S-plane and the Z-plane, Impulse sampling ,Data Hold, zero order and first order hold.

Pulse Transfer Function and Digital PID Controllers: The pulse transfer function, pulse transfer function of Closed Loop systems, Pulse transfer function of Digital PID controller, Velocity forms of Digital PID Controller, Realization of Digital Controllers and digital filter, Infinite filter response filter and finite filter response filter.

Design of Discrete Time Control System: Stability analysis of close loop system in Z-plane, Jury stability criterion, Bi linear transformations, Design based on the root locus method, Design based on frequency response method ,Analytical Design Method.

State Space Analysis of Discrete Time Control System: State space representation of discrete time systems, Solution of discrete time state space equations, Pulse transfer function matrix, Eigen Values, Eigen Vectors and Matrix Diagonalization, Discretization of continuous time state space equations, Liapunov stability analysis

Pole Placement and Observer Design: Concept of controllability and Observability, Useful transformations in state space analysis and design, Stability improvement by state feedback, Design via pole placement, State observers.

Text Books:

1. K. Ogata, “Discrete Time Control Systems”, 2nd edition, Prentice Hall, January 2005.
2. M. Gopal, “Digital Control and State Variable Methods”, Tata McGraw Hill, 2008.

Reference Books:

1. G. F. Franklin, J. David Powell, Michael Workman, “Digital control of Dynamic Systems”, 3rd Edition, Addison Wesley, 2000.

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2. M. Gopal, "Digital Control Engineering", 3rdedition, Wiley Eastern Ltd.
3. Kannan Moudgalya, "Digital Control", 2nd edition, John Wiley and Sons, 2007.
4. Forsythe W. and Goodall R.N, "Digital Control", Palgrave Macmillan, 2000.
5. https://onlinecourses.nptel.ac.in/noc25_ee81/preview

Course Outcomes:

On Completion of this course, students will able to

IN1504(C).1 Illustrate the fundamental concepts of discrete time control system.
IN1504(C).2 Understand the Pulse Transfer Function , digital PID Controllers and digital filter.
IN1504(C).3 Design the Discrete Time Control System.
IN1504(C).4 Analyze the concept of state space analysis of Discrete Time Control System.
IN1504(C).5 Design the control system by using concept of Pole Placement.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
IN1504(C).1	3	2	1	0	0	0	0	0	0	0	0	0	1	0	0
IN1504(C).2	2	3	2	1	0	0	0	0	0	0	2	0	2	2	1
IN1504(C).3	3	1	3	0	0	2	0	0	0	1	0	1	1	3	1
IN1504(C).4	2	2	1	1	0	0	0	0	0	0	2	0	0	1	1
IN1504(C).5	3	2	1	2	0	0	0	0	0	2	0	1	1	2	1

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1504(C).1	3	2	1	0	0	0	0	0	0	0	0	1	0	0
IN1504(C).2	2	3	2	1	0	0	0	0	0	2	0	2	2	1
IN1504(C).3	3	1	3	0	0	2	0	0	1	0	1	1	3	1
IN1504(C).4	2	2	1	1	0	0	0	0	0	2	0	0	1	1
IN1504(C).5	3	2	1	2	0	0	0	0	2	0	1	1	2	1

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

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Course Code	IN1504(D)		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	01	00	04	15	15	10	60	2 hrs 30 min	00	00	100	04

Course Objectives:

To make the students aware and understand:
1. Analyze electrical network problems.

2. Understand first and second order differential equations for Series and parallel.

3. Determine transient and steady state behavior of the electrical networks.

4. Study of Electrical Circuit Analysis Using Laplace Transforms.

5. Estimate the parameters of two port networks.

Course Contents:

Network Theorems: Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

Solution of First and Second order networks : Solution of first and second order differential equations for Series and parallel R-L, R-C, R- LC circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Sinusoidal steady state analysis : Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Electrical Circuit Analysis Using Laplace Transforms : Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances.

Two Port Network and Network Functions: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

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Text books :

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.

2. D. Roy Choudhury "Networks and Systems", New Age International Publications, 1998.

Reference book:

1. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.

2. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.

3. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

4. Sudhakar Shyammohan, "Circuit and Network Analysis", Tata McGraw Hill 2005

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

IN1504(D).1 Apply network theorems for the analysis of electrical circuits.

IN1504(D).2 Obtain the transient and steady-state response of electrical circuits.

IN1504(D).3 Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).

IN1504(D).4 Understand circuits using Laplace transform.

IN1504(D).5 Analyze two port circuit behavior.

CO – PO – PSO Mapping:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
IN1504(D).1	2	1	1	0	0	0	0	0	0	0	0	0	1	0	0
IN1504(D).2	2	3	1	1	0	0	0	0	0	0	2	0	2	2	1
IN1504(D).3	3	1	1	0	0	2	0	0	0	1	0	1	1	0	1
IN1504(D).4	1	2	1	0	0	0	0	0	0	0	2	0	0	1	1
IN1504(D).5	3	2	1	0	0	0	0	0	0	2	0	1	1	2	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1504(D).1	2	1	1	0	0	0	0	0	0	0	0	1	0	0
IN1504(D).2	2	3	1	1	0	0	0	0	0	0	2	2	2	1
IN1504(D).3	3	1	1	0	0	2	0	0	0	1	0	1	0	1
IN1504(D).4	1	2	1	0	0	0	0	0	0	0	2	0	1	1
IN1504(D).5	3	2	1	0	0	0	0	0	0	2	0	1	2	1

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

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Course Code	SH1501 A							Course Category			OE
Course Name	ENVIRONMENTAL LAW										
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	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the basic concepts of environment, environmental studies, and the scope of environmental law.
2. To analyze how these principles are incorporated into Indian environmental legislation and upheld by the judiciary
3. To study the evolution of environmental protection from ancient, medieval, and modern India.
4. To analyze the role of the Indian Constitution in protecting the environment.
5. To critically analyze the role of the judiciary in interpreting and enforcing environmental laws.

Course Contents:

Introduction: Introduction to Environment and Environmental Law, Scope and Importance of Environmental Studies, Important Case Laws on Environmental Law.

Fundamental Principles of Environmental Law: Important Principles of Environmental Law, All about Public Trust Doctrine, incorporation of Precautionary Principle in Environmental Legislation, Application of Polluter Pays Principle In Indian Legal Jurisprudence, Role of Indian Judiciary in Upholding International Principles of Environmental Law, Sustainable Development.

History and Development of Environmental Law in India: History of Environment Protection Ancient, Medieval and Modern India, Efficacy of Environment Protection Act, 1986, Efficacy of Water Legislation in India,Efficacy of Air Legislation in India, Efficacy of Wildlife Protection Laws in India. Efficacy of Forest Legislation in India, Protection of Tribal Rights: An Effort


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through Environmental Legislation, A Critique on Criminal Law Provisions on Environment Protection.

Protection of Environment under the Indian Constitution: Protection of Environment under the Indian Constitution, Right to Clean and Healthy Environment under Indian Constitution: An Analysis.

Environment and the Judiciary: Section 133 CrPC: A Critical Analysis, Role of National Green Tribunal in Environment Protection, Role of Judiciary in Environment Protection, Role of Public Interest Litigation in Environmental Protection, Nature and Scope of Environmental Torts in India, The emergence of Noise Pollution Jurisprudence in India,Role of Judiciary in Preventing Noise Pollution, Role of Judiciary in Preventing Air Pollution.

Text Books:

1. Environmental Law by DrNishthaJaswal Dr. P S Jaswal
2. EBC Environmental Law S.C Shastri.
3. Introduction To Environmental Law by S. Shantakumar

Reference Books:

1. Lectures on Environmental Law by Rega Surya Rao
2. Environmental Laws Bare Act with Amendments
3. Universal's Environment Laws bare act (all acts)

Course Outcomes:

After successful completion of this course student will be able to:

SH1501A.1. Understand the basic Environmental law

SH1501A.2. Demonstrate a thorough understanding of the principles, laws, and policies governing Environmental protection in India.

SH1501A.3. Critically analyze the role of the judiciary, legislature, and other institutions in upholding environmental laws.

SH1501A.4. Apply legal principles to contemporary environmental issues and propose solutions.

SH1501A.5. Develop a nuanced perspective on the intersection of environmental law with constitutional rights, tribal rights, and criminal law.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501A.1	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.2	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.3	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.4	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.5	0	0	0	0	0	2	2	2	2	0	2	0

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CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501A.1	0	0	0	0	0	2	2	2	0	2	1
SH1501A.2	0	0	0	0	0	2	2	2	0	2	1
SH1501A.3	0	0	0	0	0	2	2	2	0	2	1
SH1501A.4	0	0	0	0	0	2	2	2	0	2	1
SH1501A.5	0	0	0	0	0	2	2	2	0	2	1

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

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Course Code	SH1501 B								Course Category			OE
Course Name	CYBER LAW											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the legal and regulatory frameworks governing cyberspace.
2. To familiarize students with key concepts such as cybercrime, data protection, intellectual property,
   and digital privacy.
3. To explore the ethical implications of technology and its impact on society.
4. To understand the role of national and international laws in addressing cyber threats and challenges.
5. To equip students with the knowledge to identify and mitigate legal risks in the development and
   deployment of technology.

Course Contents:

Introduction to Cyber Law

- Overview of Cyberspace and Cyber Law: Definition, scope, and importance.
- Evolution of Cyber Law: Historical development and global perspectives.
- Key Concepts: Jurisdiction, sovereignty, and challenges in cyberspace.
- Introduction to Cyber Ethics: Ethical issues in technology and digital behavior.

Cybercrime and Legal Frameworks

- Types of Cybercrimes: Hacking, phishing, identity theft, cyber terrorism, etc.
- Legal Frameworks for Cybercrime:
  Indian Context: Information Technology Act, 2000 (IT Act) and amendments.
  International Context: Budapest Convention on Cybercrime.
- Case Studies: Landmark cybercrime cases and their legal implications.
- Role of Law Enforcement Agencies: Cyber cells, CERT-In, and Interpol.

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Data Protection and Privacy Laws

- Concept of Data Privacy: Importance and challenges.
- Data Protection Laws:
  Indian Context: Personal Data Protection Bill (PDPB), IT Act provisions.
  Global Context: GDPR (General Data Protection Regulation), CCPA.
- Right to Privacy: Judicial interpretations and constitutional perspectives.
- Data Breaches and Legal Liabilities: Case studies and mitigation strategies.

Cybersecurity Laws and Regulations:

- Importance of Cybersecurity: Threats, vulnerabilities, and risk management.
- Legal Frameworks for Cybersecurity:
  Indian Context: National Cybersecurity Policy, IT Act provisions.
  Global Context: NIST Framework, EU Cybersecurity Act.
- Role of Organizations: CERT-In, NCIIPC, and international cybersecurity agencies.
- Compliance and Best Practices: Implementing cybersecurity measures in organizations.

Text Books:

1. "Cyber Law in India" by S. S. Jaswal.
2. "Information Technology Law and Practice" by Vakul Sharma.
3. "Cyber Law and Cyber Crimes" by Nandan Kamath.

Reference Books:

1. Information Technology Act, 2000 (India).
2. General Data Protection Regulation (GDPR).
3. "Cybersecurity and Cyber Law" by Nina Godbole.
4. "The Law of Cybercrimes and Their Investigations" by George Curtis.

Course Outcomes:

After successful completion of this course student will be able to:

SH1501B.1 Understand the legal and ethical dimensions of cyberspace.

SH1501B.2 Identify and analyze cybercrimes and their legal consequences.

SH1501B.3 Apply cyber law principles to real-world scenarios in technology development and usage.

SH1501B.4 Evaluate the impact of cyber security laws on businesses and individuals.

SH1501B.5 Develop strategies to comply with data protection and privacy regulations.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501B.1	2	2	2	2	2	2	0	2	2	2	1	1
SH1501B.2	2	2	2	2	2	2	0	2	2	2	1	0
SH1501B.3	2	2	2	2	2	2	0	2	2	2	1	2
SH1501B.4	2	2	2	2	2	2	0	2	2	2	1	2
SH1501B.5	2	2	2	2	2	2	0	2	2	2	1	2

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501B.1	2	2	2	2	2	2	2	2	2	2	1
SH1501B.2	2	2	2	2	2	2	2	2	2	2	1
SH1501B.3	2	2	2	2	2	2	2	2	2	2	1
SH1501B.4	2	2	2	2	2	2	2	2	2	2	1
SH1501B.5	2	2	2	2	2	2	2	2	2	2	1

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Course Code	SH1501 C								Course Category			OE
Course Name	INTRODUCTION TO MASS COMMUNICATION											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the basic concepts, theories, and models of mass communication.
2. To explore the role of mass media in shaping public opinion, culture, and society.
3. To familiarize students with the various forms of mass media (print, electronic, digital, and social media).
4. To examine the ethical and legal issues in mass communication.
5. To develop critical thinking and analytical skills in evaluating media content and provide hands-on experience in creating basic media content.

Course Contents:

Introduction to Mass Communication

- Definition and Scope: What is mass communication?
- Elements of Mass Communication: Sender, message, channel, receiver, feedback, and noise.
- Functions of Mass Media: Information, education, entertainment, and persuasion.
- Theories of Mass Communication: Hypodermic Needle Theory, Two-Step Flow Theory, Agenda-Setting Theory, and Uses and Gratifications Theory.

Forms of Mass Media

- Print Media: Newspapers, magazines, and books.
- Electronic Media: Radio, television, and cinema.
- Digital Media: Internet, websites, and blogs.
- Social Media: Platforms, trends, and impact.
- Comparative Analysis: Strengths and limitations of each medium.

Role of Mass Media in Society

- Media and Public Opinion: Shaping perceptions and attitudes.


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- Media and Culture: Influence on language, traditions, and values.
- Media and Democracy: Role in elections, governance, and accountability.
- Media and Globalization: Cross-cultural communication and global trends.

Media Ethics and Laws

- Ethical Issues in Mass Communication: Bias, sensationalism, and privacy concerns.
- Media Laws and Regulations: Freedom of speech, censorship, and regulatory bodies.
- Case Studies: Ethical dilemmas and legal controversies in media.

Technology and Mass Communication

- Impact of Technology on Media: Digital transformation and convergence.
- Emerging Trends: Artificial Intelligence, Virtual Reality, and Augmented Reality in media.
- Social Media Algorithms: How they shape content consumption.
- Fake News and Misinformation: Challenges and solutions.

Text Books:

1. "Mass Communication in India" by Keval J. Kumar.
2. "Introduction to Mass Communication" by Stanley J. Baran.
3. "Media and Communication Studies: An Introduction" by James Watson and Anne Hill.

Reference Books:

1. "Understanding Media: The Extensions of Man" by Marshall McLuhan.
2. "Media and Society: Power, Platforms, and Participation" by Nicholas Carah.
3. "The Elements of Journalism" by Bill Kovach and Tom Rosenstiel.

Course Outcomes:

After successful completion of this course student will be able to:

SH1501C.1 Understand the fundamentals of mass communication and its role in society.
SH1501C.2 Analyze the impact of mass media on individuals, communities, and cultures.
SH1501C.3 Identify the strengths and limitations of different forms of mass media.
SH1501C.4 Critically evaluate media content for bias, accuracy, and ethical considerations.
SH1501C.5 Create basic media content using simple tools and techniques and appreciate the intersection of technology and mass communication.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501C.1	1	0	0	1	1	0	0	0	1	0	0	1
SH1501C.2	0	1	1	0	2	0	0	0	1	0	0	1
SH1501C.3	1	1	1	0	1	0	0	0	0	0	0	1
SH1501C.4	1	0	1	1	0	0	0	0	1	0	0	1
SH1501C.5	1	0	1	1	3	0	0	0	1	0	0	1

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CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501C.1	1	0	0	1	0	0	0	0	1	0	1
SH1501C.2	0	1	1	0	0	0	0	0	2	0	1
SH1501C.3	1	1	1	0	0	0	0	0	1	0	1
SH1501C.4	1	0	1	1	0	0	0	0	0	0	1
SH1501C.5	1	0	1	1	0	0	0	0	3	0	1

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Course Code	SH1501 D								Course Category			OE
Course Name	BASIC GERMAN LANGUAGE A1											
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	3

Course Objectives: To make the student aware and understand:

1. To introduce students to the basics of the German language, including pronunciation, grammar, and vocabulary.
2. To develop basic communication skills in German for everyday situations.
3. To familiarize students with German culture, traditions, and etiquette.
4. To prepare students for further language learning and potential opportunities in German-speaking countries.
5. To enhance students' global competence and intercultural communication skills.

Course Contents:

Introduction to German Language and Culture

- Alphabet and Pronunciation: German alphabet, sounds, and basic pronunciation rules.
- Greetings and Introductions: Common greetings, introducing oneself, and basic polite expressions.
- Numbers and Dates: Counting, telling time, and discussing dates.
- Cultural Insights: Overview of German-speaking countries, traditions, and etiquette.

Basic Grammar and Sentence Structure

- Articles and Gender: Definite and indefinite articles (der, die, das).
- Nouns and Plurals: Basic noun forms and pluralization rules.
- Pronouns: Personal pronouns (ich, du, er/sie/es, etc.).
- Basic Sentence Structure: Subject-verb-object order and forming simple sentences.

Everyday Communication

- Asking for Directions: Common phrases for navigating and understanding directions.
- Shopping and Ordering: Vocabulary for shopping, ordering food, and making payments.
- Daily Activities: Talking about daily routines, hobbies, and free time.
- Role-Playing: Simulating real-life situations (e.g., at a café, market, or train station).

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Vocabulary Building

- Family and Friends: Vocabulary for describing family members and relationships.
- Food and Drink: Common food items, meals, and dining vocabulary.
- Travel and Transportation: Vocabulary for travel, public transport, and booking tickets.
- Practice Sessions: Interactive activities to reinforce vocabulary

Reading and Writing in German

- Reading Simple Texts: Short dialogues, signs, and advertisements.
- Writing Practice: Filling out forms, writing short messages, and emails.
- Listening Comprehension: Understanding slow and clear spoken German.
- Speaking Practice: Participating in simple conversations and role-plays.

Cultural Immersion and Practical Applications

- German Culture: Festivals, traditions, and cultural norms.
- Engineering and Technology in Germany: Overview of Germany's role in engineering and innovation.
- Opportunities in German-Speaking Countries: Study, work, and internship opportunities.
- Final Project: Presenting a short dialogue or skit in German.

Text Books:

1. "Netzwerk A1" by Stefanie Dengler et al.
2. "Menschen A1" by Sandra Evans et al.
3. "Schritte International A1" by Daniela Niebisch et al.

Reference Books:

1. "German for Dummies" by Paulina Christensen et al.
2. "Practice Makes Perfect: Basic German" by Jolene Wochenske.
3. "Langenscheidt German-English Dictionary".

Course Outcomes:

After successful completion of this course student will be able to:

SH1501D.1 Understand and use familiar everyday expressions and basic phrases.
SH1501D.2 Introduce themselves and others, and ask and answer questions about personal details.
SH1501D.3 Interact in a simple way, provided the other person speaks slowly and clearly.
SH1501D.4 Read and write simple texts in German.
SH1501D.5 Appreciate German culture and its relevance in a global context.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501D.1	1	0	0	0	0	0	1	0	3	0	0	0
SH1501D.2	0	1	1	0	0	0	1	0	3	0	0	0
SH1501D.3	1	1	1	0	0	0	1	0	3	0	0	0
SH1501D.4	1	0	1	0	0	0	1	0	0	0	0	0
SH1501D.5	1	0	1	0	0	0	1	0	3	0	0	0

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501D.1	1	0	0	1	0	0	0	0	0	0	0

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SH1501D.2	0	1	1	0	0	0	0	0	0	0	0
SH1501D.3	1	1	1	0	0	0	0	0	0	0	0
SH1501D.4	1	0	1	1	0	0	0	0	0	0	0
SH1501D.5	1	0	1	1	0	0	0	0	0	0	0

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Course Code	IN1505							Course category			VSE
Course Name	VIRTUAL INSTRUMENTATIONLAB										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT	TA	ESE	ESE Duration	ICA	ESE		
00	00	04	04	00	00	00	-	50	-	50	02

Course Objectives:-

Aim of the course is to**:**
I. Develop program for specific application using Virtual Instrument software.
II. Acquire, analyze and display the throughput of any compatible system.
III. Interface hardware and software using Virtual Instrument.

Minimum Eight Experiments should be conducted from the sample list given below.
1. Introduction to VI, Basic Operations, Controls, Indicators and Structures.
2. To perform basic Arithmetic Operations using VI.
3. To perform Boolean operations using VI.
4. Preparing simple VIs for temperature control, level control, flow control etc applications.
5. To perform convolution of two signals using VI.
6. To apply filtering technique for a given input signal.
7. Generate signals such as Sine, Square, and Triangular using VI.
8. Developing simulation examples using the VI.
9. Simulation of PID Controller using VI.
10. Developing VI using signal processing toolkit.
11. Developing VI using Control system toolkit.
12. Developing VI using DSP toolkit.
13. Hardware-Software interfacing using VI.
14. Developing Web based application using VI.
15. Creating Sub VI.and Its usage in High Level Applications Syllabus of B. E.
16. Data Acquisition in VI.

Note:
ICA- The Internal Continuous Assessment shall be based on the practical record and knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.
ESE- The End Semester Exam 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:

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IN1505.1 Develop program for specific application using Virtual Instrument software.
IN1505.2 Acquire, analyze and display the throughput of any compatible system.
IN1505.3 Interface hardware and software using Virtual Instrument.

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

:

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1505.1	2	2	2	1	1	0	1	0	0	0	2	1	1	0	0
IN1505.2	2	3	1	0	0	0	0	0	1	0	1	0	2	2	1
IN1505.3	3	1	1	1	0	2	0	0	0	0	1	1	1	1	1

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CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO1	PSO 2	PSO3
IN1505.1	2	2	2	1	1	0	0	0	0	2	1	1	0	0
IN1505.2	2	3	1	0	0	0	0	1	0	1	0	2	2	1
IN1505.3	3	1	1	1	0	2	0	0	0	1	1	1	1	1

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Course Code	IN1506					Course category		PC	
Course Name	INDUSTRIAL AUTOMATION LAB								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT	TA	ESE	ESE Duration	ICA	ESE		
00	00	02	02	00	00	00	-	25	25	50	01

Course objectives:
Aim of the course is to**:**

I. Knowledge of PLC components, configuration and programming concepts.
II. Study of role and applications of PLC to various processes.
III. To explore and understand industry grade virtual automation software.

Minimum 8 Experiments should be conducted from the Representative / sample list given below.

1. Programming Logic Gates Function in PLC
2. Connect PLC to PC and test execution of ladder programs for basic logic operations using two input switches and one output indicating lamp
3. Develop /Execute a ladder program for the given application using following:- timer, counter, comparison, logical, arithmetic instruction.
4. Develop/ test ladder program for automated car parking system.
5. Develop/ test ladder program for automated elevator control.
6. Develop Ladder Logic for counting the objects
7. Develop a simple program for comparison instructions.
8. Execute a PLC program by using timer to turn on a lamp 10 seconds after a push button press.
9. Implementation of Mathematical Operations in PLC
10. Develop Ladder Logic for Jump-to-subroutine & return operations in PLC
11. Develop Ladder Logic PLC Exercises:- 1. Traffic Light Control and Filling/Draining Control Operation
12. Develop Ladder Logic PLC Exercise: 1. Reversal of DC Motor Direction 2. ON/OFF Controller for Thermal Process
13. PC based control of Level Process
14. On-line Monitoring and Control of a Pilot plant using DCS
15. Speed control of AC servo motor using PLC
16. Develop /Execute a ladder program for the given application using following:- timer, counter, comparison, logical, arithmetic instruction.

Note

ICA-The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE-The End Semester Exam shall be based on performance of experiments based on

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File/journal submitted by students and /or viva.

Course Outcomes:

On completion of the course, students will be able to

INU1506.1 Identify and configure various modules of PLC
INU1506.2 Develop programs using PLC
INU1506.3 Develop programs using Industrial automation software

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1506.1	2	2	3	1	2	0	0	0	2	2	0	2	1	0	0
IN1506.2	2	2	2	1	1	3	0	0	0	2	0	2	0	1	1
IN1506.3	2	1	3	2	3	1	1	1	0	0	0	2	0	1	1

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CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]

Course Outcomes	Program Outcomes													
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO1 0	PO11	PSO 1	PSO 2	PSO 3
IN1506.1	2	2	3	1	2	0	0	2	2	0	2	1	0	0
IN1506.2	2	2	2	1	1	3	0	0	2	0	2	0	1	1
IN1506.3	2	1	3	2	3	1	1	0	0	0	2	0	1	1

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

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Course Code	SH1503							Course Category			MNC2
Course Name	SOFT SKILLS										
Teaching Scheme				Examination Scheme							Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
02	-	-	02	-	-	20	-	-	-	-	20	2

Course Objectives:

To make the student aware and understand:

3. Develop essential soft skills for academic, professional, and personal growth.
4. Enhance communication, teamwork, leadership, and emotional intelligence.
3. Provide hands-on training through interactive activities and real-world scenarios.
4. Improve employability and workplace readiness.

Course Contents:

Introduction to Soft Skills:

- Definition and importance of soft skills
- Difference between hard skills and soft skills
- Self-assessment: Identifying strengths and areas for improvement

Effective Communication:

- Verbal & Non-verbal communication
- Active listening & feedback techniques
- Public speaking & presentation skills
- Business email etiquette

Interpersonal & Teamwork Skills:

- Building rapport & networking
- Conflict resolution & negotiation
- Collaboration & team dynamics

Emotional Intelligence:

- Self-awareness & self-regulation
- Empathy & social skills
- Stress management & resilience

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Leadership & Professional Ethics:

- Traits of effective leaders
- Decision-making & problem-solving
- Workplace ethics & professionalism

Time Management & Adaptability:

- Prioritization & goal setting
- Handling multitasking & deadlines
- Adapting to change & workplace challenges

Career Readiness:

- Resume writing & interview skills
- Personal branding (LinkedIn, networking)
- Workplace etiquette & corporate culture

Text Books:

4. Text Book of Soft Skills (Paperback, Paul Martin, Kavita Krishnamurthi)
5. How to Win Friends & Influence People (Dale Carnegie), Emotional Intelligence 2.0 (Travis Bradberry)
6. Soft Skills Unleashed By Krishna Suresh

Reference Books:

1. "Personality Development and Soft Skills (Old Edition)" by Barun K Mitra
2. "Soft Skills - Enhancing Employability: Connecting Campus with Corporate" by M S Rao
3. "communication and soft skill development (first edition)" by career publications and Ashwini Deshpande
4. "Soft Skills Training: A Workbook to Develop Skills for Employment" by Frederick H Wentz

Course Outcomes:

After successful completion of this course student will be able to:

SH1503.1. Understand the importance of soft skill.
SH1503.2. Communicate confidently in professional settings.
SH1503.3. Work effectively in teams with strong interpersonal skills.
SH1503.4. Demonstrate leadership and problem-solving abilities.
SH1503.5. Be better prepared for job interviews and workplace challenges.

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CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1503.1	0	1	0	0	0	1	2	2	2	0	2	0
SH15032	0	0	0	0	0	1	2	2	2	0	2	0
SH1503.3	0	1	0	0	0	1	2	2	2	0	2	0
SH1503.4	0	0	0	0	0	1	2	2	2	0	2	0
SH1503.5	0	1	0	0	0	1	2	2	2	0	2	0

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1503.1	0	0	1	0	0	2	0	2	0	2	1
SH15032	0	0	1	0	0	2	0	2	0	2	1
SH1503.3	0	0	1	0	0	2	0	2	0	2	1
SH1503.4	0	0	1	0	0	2	0	2	0	2	1
SH1503.5	0	0	1	0	0	2	0	2	0	2	1

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Course Code	IN1521						Course category		PEH
Course Name	NEURAL NETWORK BASED CONTROL								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory					Total	
				CT-I	CT-II	TA	ESE	ESE Duration		
03	00	00	03	15	15	10	60	2hr30 min	00	03

Course Objectives:

Aim of the course is to**:**

I. Understand the concept intelligent control.
II. Understand the architecture of Artificial Neural Networks.
III. Study different data processing techniques in neural networks.
IV. Study case studies of different neural network based controllers.
V. Understand applications of neural networks in process control.

Course Contents:

Introduction: Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge presentation. Expert systems.

Artificial Neural Networks: Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Different Networks: Hopfield network, Self-organizing network and Recurrent network.

Adaptive Resonance Theory (ART): Architecture of Adaptive resonance theory, Algorithm for training of ART, Applications.

Neural Network based controller Case studies: Identification and control of linear and nonlinear dynamic systems using MatLAB-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems.

Neural Network in Process Control: Overview of process control applications; need of neural networks in process control, Process Modeling by neural network; Direct Adaptive Control; Self Tuning Controller; Indirect Adaptive Control; Model Reference Adaptive Control; Internal Model Control; Model Predictive Control; Cascade Control.

Text Books:

1. J.M. Zurada, “Introduction to Artificial Systems”, Singapore: Info Access and distribution, 1992.
2. James A. Anderson, “An introduction to neural networks”, Prentice Hall of India, Private limited,New Delhi, 1999.

Reference Books:

1. S. Haykin, “Neural Networks: A Comprehensive Foundation”, Macmillan College Publishing Company, 1994.

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2. Charu C Agrawal, "Neural Networks and Deep Learning", Springer International Publishing 2018

Course Outcome:

After successfully completing the course students will be able,

INU1521.1	To understand the concept intelligent control.
INU1521.2	II. To understand the architecture of Artificial Neural Networks.
INU1521.3	To study different data processing techniques in neural networks.
INU1521.4	To study case studies of different neural network based controllers.
INU1521.5	To understand applications of neural networks in process control.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1521.1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1
IN1521.2	2	1	1	0	0	0	0	0	0	0	0	0	1	2	1
IN1521.3	2	2	1	0	0	0	0	0	0	2	0	0	1	2	1
IN1521.4	2	2	1	0	0	0	0	0	0	2	0	0	1	3	1
IN1521.5	2	2	2	1	0	0	0	0	0	2	0	0	1	3	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1521.1	1	1	1	0	0	0	0	0	0	0	0	1	1	1
IN1521.2	2	1	1	0	0	0	0	0	0	0	0	1	2	1
IN1521.3	2	2	1	0	0	0	0	0	0	2	0	1	2	1
IN1521.4	2	2	1	0	0	0	0	0	0	2	0	1	3	1
IN1521.5	2	2	2	1	0	0	0	0	0	2	0	1	3	1

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Course Code	IN 1522			Course category			PEH	
Course Name	DIGITAL IMAGE PROCESSING							
Teaching Scheme				Examination Scheme				Credits
				Theory			Practical	Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Course Objectives:

Aim of the course is to**:**

I. Overview of image processing systems, Image formation and perception, digital image representation
II. Analyse image enhancement by spatial domain filtering and its applications
III. Analyse image enhancement frequency domain filtering and its applications
IV. Apply the methodologies for image restoration techniques
V. Apply the methodologies for image segmentation techniques

Course Contents:

Digital Image Fundamentals: Origin and examples of fields using DIP, fundamentals steps and component of an Image Processing system, Element of visual perception with respect to image processing, image sensing and acquisition, sampling and quantization. basic relationship between pixels.

Image enhancement in the spatial domain: Basic Gray level transformation, Histogram processing, enhancement using arithmetic/logic operation, Basics of spatial filtering, smoothing spatial filters, Sharpening spatial filters.

Image enhancement in Frequency Domain: Review of Fourier transform and frequency domain, Smoothing frequency domain filters. Sharpening frequency domain filters. Homomorphic filtering.

Image restoration: Model of the image degradation /Restoration process, Noise models, Restoration in presence of noise –only-spatial filtering. Periodic noise reduction by frequency domain filtering..Estimation of degradation function .Inverse filtering. Wiener filtering, Geometric transformations: Spatial and gray level interpolation

Image Segmentation: Detection of discontinuities, edge linking and boundry detection, thresholding, region based segmentation Introduction to image compression, introduction to color image processing

Text Books:

1. “Gonzalez R.C. and Woods R.E” ,Digital Image Processing, 2nd edition, Pearson education,2002

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2. Chanda B. and Majumdar D., "Digital Image Processing and Analysis", PHI2nd edition, 2000

Reference Books:

1. A K Jain," Digital Image Processing", 3rd edition, John Wiley Eastern publication 1998

2. Schalkoff R.J., "Digital Image Processing and Computer Vision", John Wiley and sons, 1989

3 Umbaugh," Computer Vision and Image Processing", 2nd edition, CRC Press, 2011

Course Outcomes :

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

IN1522.1	Explainthe fundamental steps of a digital image processing system
IN1522.2	Analyse image enhancement by spatial domain filtering and its applications
IN1522.3	Analyse image enhancement by frequency domain filtering and its applications
IN1522.4	Apply the image restoration technique to the images and analyse the images
IN1522.5	Apply the image Image segmentation and analyse the images

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1522.1	3	0	0	0	0	0	0	0	0	0	0	0	1	3	1
IN1522.2	2	3	0	0	3	0	0	0	0	0	0	0	1	2	1
IN1522.3	2	3	0	0	3	0	0	0	0	0	0	0	1	2	1
IN1522.4	2	1	0	0	2	0	0	0	0	0	0	0	1	3	1
IN1522.5	2	2	0	0	2	0	0	0	0	0	0	0	1	1	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1522.1	3	0	0	0	0	0	0	0	0	0	0	1	3	1
IN1522.2	2	3	0	0	3	0	0	0	0	0	0	1	2	1
IN1522.3	2	3	0	0	3	0	0	0	0	0	0	1	2	1
IN1522.4	2	1	0	0	2	0	0	0	0	0	0	1	3	1
IN1522.5	2	2	0	0	2	0	0	0	0	0	0	1	1	1

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

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Course Code	IN1541								Course category			MN
Course Name	SENSOR DESIGN											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives:

Aim of the course is to**:**

I. Acquire knowledge about the basic constraints of sensor design
II. Emphasis on characteristics and response of micro sensors
III. Understand basic techniques of design optimization
IV. Learn about compressive sensing
V. Identify different noise detection techniques in sensor design

Course Contents:

Introduction: Sensing as a Cognitive Process, Aiming at a General Definition of Electronic Sensors Signals and Information, Case of an Analog-to-Digital Interface, The Role of Errors, Essential Building Blocks of Electronic Sensors, At the Origin of Uncertainty: Thermal Agitation, Basic Constraints of Electronic Sensor Design

Sensor Characterization: Signal Characterization (Limits of the Quasi static Characteristic and Frequency Domain Representation and Energetic Properties of Signals), Time and Amplitude Quantization, Deviations from Ideality: The Real Characteristic and Saturation and errors

Sensor Design Optimization: Reduction of Random Errors by Averaging, Reduction of Systematic Errors, Role of Information in Sensor Acquisition Chains, Resolution in Acquisition Chains, Sampling, Under sampling, Oversampling, and Aliasing Filters

Compressive Sensing: Introduction, Compressive Sensing, Applications

Noise Detection techniques in Electronic Devices and Circuits: Resistance Sensing, Capacitive Sensing, The Lock-In Technique, Oscillator-Based Sensing

Text Books:

1. Marco Tartagni, “Electronic Sensor Design Principles”, Cambridge University Press, 2021
2. Jacob Fraden,“ Modern Sensors: Physics, Design And Application”, Springer, fourth edition,
2010

Reference Books:

1. Sabrie Soloman, “Sensors Handbook” , McGraw Hill,Second Edition, 2010

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Course Outcomes:
On Completion of this course, students will able to

IN1541.1	Understand basic knowledge of sensor design
IN1541.2	Demonstrate an understanding the concept sensor characterization
IN1541.3	Comprehend and analyze design optimisation methods
IN1541.4	Gain knowledge about compressive sensing
IN1541.5	Apply various noise detection techniques in electronic devices & circuits

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1541.1	1	0	1	1	0	0	0	0	0	0	0	0	1	1	0
IN1541.2	1	2	1	1	0	0	1	0	0	0	0	0	1	0	0
IN1541.3	2	2	3	2	1	0	0	1	0	0	0	0	0	0	1
IN1541.4	1	2	1	1	1	0	0	0	0	0	0	0	0	0	0
IN1541.5	2	1	2	2	1	0	0	0	0	0	0	0	1	0	0

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1541.1	1	0	1	1	0	0	0	0	0	0	0	1	1	0
IN1541.2	1	2	1	1	0	0	0	0	0	0	0	1	0	0
IN1541.3	2	2	3	2	1	0	1	0	0	0	0	0	0	1
IN1541.4	1	2	1	1	1	0	0	0	0	0	0	0	0	0
IN1541.5	2	1	2	2	1	0	0	0	0	0	0	1	0	0

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

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Course Code	IN1542							Course category			MN
Course Name	ROBOTIC AND CONTROL										
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:
Aim of the course is to**:**

I. Introduce the fundamentals of robot anatomy.
II. Explore various machine vision techniques.
III. Understand various robotic control methods.
IV. Acquire knowledge about autonomous mobile robots.
V. Study application of robots in automatic operations

Course Contents:

Robot anatomy & Sensors in Robotics: Definition, law of robotics, History and Terminology of Robotics. Important characteristics of Robots (Cycle time concepts). Specifications of Robot (Drives, joints and links, sensors). Robot classifications-Architecture of robotic systems. ROI Robot System Value Calculator (Robotic Industries Association). Transducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors, uses of sensors in robotics

Machine Vision: Introduction to machine vision, Low level & High level vision, Sensing & Digitizing, Image processing & analysis, Segmentation, Edge detection, Applications, training the vision system, robotic applications.

Kinematics, dynamics and control: Object location, three dimensional transformation matrices, inverse transformation, kinematics and path planning, Jacobian work envelope, manipulator dynamics, dynamic stabilization, position control and force control.

Autonomous Mobile Robots: Introduction, Planning & Navigation Introduction, basic control scheme for mobile robots (basic understanding of perception, localization, cognition path planning, motion control). Planning & Navigation: Introduction, competences for navigation, path planning, obstacle avoidance, navigation architectures.

Robots in Automatic Processing: Operations, Assembly & Inspection Introduction, spot welding, continuous arc welding, sprays coating, other processing operations. Assembly and robotic assembly automation, parts presentation methods, assembly operations, compliance and remote centre compliance (RCC) device, assembly system configurations, adaptable programmable assembly system, designing for robotic assembly, inspection automation.

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Text Books:

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta, "Industrial Robotics: Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill, 2012.
2. Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, "Introduction to Autonomous Mobile Robots" , 2nd Edition, PHI, 2011.

Reference Books:

1. Bijoy K. Ghosh, "Control in Robotics and Automation: Sensor Based Integration", Allied Publishers, Chennai, 1998.

Course Outcomes:

On Completion of this course, students will able to,

IN1542.1 Understand fundamentals of robot anatomy
IN1542.2 Evaluate various processes of machine vision
IN1542.3 Demonstrate kinematics, dynamics and control of robots
IN1542.4 Gain knowledge about autonomous robots
IN1542.5 Understand application of robots in automatic operations

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1542.1	1	0	1	1	0	0	0	0	0	0	0	0	1	1	1
IN1542.2	1	2	0	1	1	1	0	0	0	0	0	0	1	0	0
IN1542.3	2	1	2	1	1	0	0	0	0	0	0	0	0	1	1
IN1542.4	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0
IN1542.5	2	1	2	2	1	0	0	0	0	0	0	0	1	0	0

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1542.1	1	0	1	1	0	0	0	0	0	0	0	1	1	1
IN1542.2	1	2	0	1	1	1	0	0	0	0	0	1	0	0
IN1542.3	2	1	2	1	1	0	0	0	0	0	0	0	1	1
IN1542.4	2	2	1	1	1	0	0	0	0	0	0	0	0	0
IN1542.5	2	1	2	2	1	0	0	0	0	0	0	1	0	0

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

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Course Code	IN 1531	Course category	PER
Course Name	RESEARCH PROJECT STAGE 1		

Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	08	08						100	00	100	04

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.

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

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SEMESTER –VI

Course Code	IN1615							Course category			MM
Course Name	INDUSTRIAL AUTOMATION										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2 hrs 30 min	00	00	100	03

Course Objectives:

Aim of the course is to**:**

I. Introduce the fundamentals of Industrial Automation.
II. Introduce International Communication Standards and their practical applications.
III. Apply the knowledge of PLC, DCS and SCADA systems in various applications.
IV. Understand industrial safety and its management.
V. Apply communication protocol for any practical application developed by PLC, DC, ESD, F&G.

Course Contents:

Industrial Automation: Introduction to Instrumentation and Control (Block Diagram), Types of Automation, Role of Automation in Industries, Industrial Revolution 1, 2, 3, 4, Reference Architecture Model of Industry 4.0 (RAMI), Industrial Control **:**Programmable logic controllers (PLC): Introduction &Basic Architecture, Ladder diagrams and examples, PLC programming method: Function Block Diagram (FBD) as per IEC 61131-3, Distributed Control System (DCS): Basic Concept of DCS and its Architecture, Basic Comparison of Honeywell TDC3000 and Yokogawa Centum CS3000, Supervisory Control and Data Acquisition (SCADA):Introduction and Objectives of SCADA, SCADA in Process Control applications. Human Machine Interface (HMI) & Graphic Pages .Concept of Remote IO Modules (RIO), Concept of Remote Terminal Unit (RTU)

Industrial Safety: Introduction to Process Safety & Emergency Shutdown System (ESD), Safety Interlocks, Basics of Hazard Identification Study (HAZID) ,Hazard and Operability Study (HAZOP), Safety Integrity Levels (SIL),Introduction to IEC 61508 & 61511 standards for Functional safety, IEC 61508-1 :- Functional Safety of Electrical / Electronic/ Programmable Electronic Safety Related Systems – General Requirements, IEC 61511-1 Management of Functional Safety, Safety life-cycle requirements Introduction to Layers Of Protection & Safety Instrumented Systems, Fire & Gas System (F&G): Addressable and Non-Addressable F&G Devices, Concept of Addressable Loops, Introduction to Fire Alarm Control Panel (FACP)

Instrumentation Standard Communication Protocols: Basic understanding of communication, Open Systems Interconnection (OSI): Introduction to 7 Layers as per ISO/IEC7498-1. Definition

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of Protocols, RS232, RS485, Modbus:-Layers, Protocol Data Unit, Application Data Unit, IEC61158-1 :- Mapping onto OSI Basic Reference Model, Structure of IEC 61158, brief summary of the characteristics of service & protocol for each fieldbus type, concept of OPC (Object linking and embedding for Process Control), HART Protocol,

Foundation Fieldbus :- Introduction, frame structure, implementation examples, advantages and limitations, basic comparison and applications of Foundation Fieldbus, Profibus, ControlNet, DeviceNet, Industrial Ethernet, Introduction to IIOT in Industrial Plants

Text Books: -

1. D. Eckman, "Process Control Instrument Engineers Handbook", X 3rd edition, Butterworth Heinemann Company, 1999
2. W. Bolton "Programmable Logic Controllers", Newnes Publications, 4th edition

Reference Books:

1. Johnson C. D., "Process Control Instrumentation Technology", 7th edition, Pearson Education, New Delhi, 2003.
2. Webb J. W. "Programmable Controllers: Principles and Applications", Mergy/publishing co.1988.
3. Krishankant, "Computer Based Industrial Control", 7th edition, PHI, 2005.
4. MadhuchandraMitra,Samarjit Sen Gupta, "Programmable logic controllers and Industrial Automation An introduction" ,Penram publishing (India) Pvt Ltd,2009.
5. http://www.nptel.iitm.ac.in (Industrial Automation And Control By Prof. Alokkanti Deb | IIT Kharagpur)

Web Resources:

1. https://prod-edam.honeywell.com/content/dam/honeywell-edam/hbt/en-us/documents/literature-and-specs/datasheets/hbt-fire-74-4034-16.pdf
2. https://www.nexinstrument.com/assets/images/02032017Honeywell/MT11-520.pdf
3. https://skoge.folk.ntnu.no/puublications_others/apc-book-papers/honeywell3000-AP09-600.pdf
4. https://web-material3.yokogawa.com/TI33Q01B10-01E.pdf
5. https://prod-edam.honeywell.com/content/dam/honeywell-edam/hbt/en-us/documents/literature-and-specs/datasheets/hbt-fire-74-4034-16.pdf
6. https://control.com/technical-articles/what-is-a-remote-terminal-unit-rtu/#:~:text=There%20are%2C%20however%2C%20several%20technical,with%20more%20features%20and%20functionalities.

Course Outcomes:

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

IN1615.1 Introduce the fundamentals of Industrial Automation.
IN1615.2 Understand concepts of International Communication Standards and their practical applications.
IN1615.3 Demonstrate an understanding the concept of PLC, DCS and SCADA systems in Industry.

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IN1615.4 Study & Understand the industrial safety and its management.
IN1615.5 Propose of the integration and communication of various Industrial Control and Safety systems (i.e. PLC, DCS, ESD, F&G) and introduction to the current trends in Industrial Automation.

CO – PO – PSO Mapping as per Jan-2016 Format :This subject is offered for other deptt. students, PSO is not considered

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IN1615.1	2	2	0	0	0	0	0	0	0	0	0	0
IN1615.2	1	0	0	0	0	0	0	0	0	0	0	0
IN1615.3	3	2	1	1	3	1	0	0	0	0	0	0
IN1615.4	2	1	2	2	0	0	0	0	0	0	0	0
IN1615.5	2	2	0	0	2	0	0	0	0	0	0	0

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IN1615.1	2	2	0	0	0	0	0	0	0	0	0
IN1615.2	1	0	0	0	0	0	0	0	0	0	0
IN1615.3	3	2	1	1	3	1	0	0	0	0	0
IN1615.4	2	1	2	2	0	0	0	0	0	0	0
IN1615.5	2	2	0	0	2	0	0	0	0	0	0

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

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Course Code	IN 1616						Course category		MM
Course Name	SPREADSHEET BASED DATA 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:

Aim of the course is to**:**

I. Introduce students to the use of spreadsheets for financial data analysis and decision-making.

II. Develop proficiency in financial modelling, forecasting, and investment analysis using spreadsheet tools.

III. Enable students to apply statistical and financial functions for data-driven decision-making.

IV. Equip students with skills in financial reporting, budgeting, and risk analysis.

V. Enhance problem-solving skills through hands-on exercises and real-world case studies.

Course Contents:

Introduction to Spreadsheet for Financial Analysis

Overview of spreadsheet tools (MS Excel, Google Sheets), Basic operations: Data entry, formatting, and conditional formatting, Importance of spreadsheets in financial decision-making

Basic Financial Functions & Formulas

Arithmetic and logical operations, Cell referencing (absolute, relative, mixed), Common financial functions: SUM, AVERAGE, MIN, MAX, ROUND, Text functions useful for financial reporting

Time Value of Money & Financial Functions

Present Value (PV) and Future Value (FV) functions, Net Present Value (NPV) and Internal Rate of Return (IRR), Payment (PMT) function for loan and mortgage calculations, Depreciation calculations (SLN, DB, DDB)

Financial Statement Analysis

Understanding balance sheets, income statements, and cash flow statements, Ratio analysis: Liquidity, profitability, and solvency ratios, Trend analysis using spreadsheets, Common size analysis and financial forecasting

Budgeting and Forecasting

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Creating dynamic budgets in spreadsheets, Forecasting revenue and expenses using moving averages, Break-even analysis using Goal Seek and Solver

Data Analysis & Visualization for Finance

Creating financial charts (line graphs, bar charts, waterfall charts), Pivot tables for financial data analysis, Dynamic dashboards for financial reporting, Conditional formatting for financial insights

Investment Analysis & Portfolio Management

Risk and return analysis using spreadsheet functions, Portfolio optimization using Solver, Capital Asset Pricing Model (CAPM) in Excel, Scenario and sensitivity analysis for investment decisions

Reference Books:

1. Simon Benninga," Financial Modelling" MIT Press
2. Craig W. Holden," Spread sheet Modelling in Corporate Finance" –

Course Outcomes

By the end of the course, students will be able to:

IN1616.1 Apply spreadsheet tools for financial data entry, analysis, and reporting.
IN1616.2 Use basic and advanced financial functions to evaluate investments and business decisions.
IN1616.3 Create financial models for cash flow analysis, budgeting, and forecasting.
IN1616.4 Analyze financial statements and performance metrics using Excel.
IN1616.5 Perform sensitivity and scenario analysis for risk assessment.

CO – PO – PSO Mapping as per Jan-2016 Format :This subject is offered for other deptt. students, PSO is not considered

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IN1616.1	2	3	1	0	0	0	0	0	0	0	0	0
IN1616.2	2	3	1	0	0	0	0	0	0	0	0	0
IN1616.3	1	1	3	1	3	0	0	0	0	0	0	0
IN1616.4	1	3	2	2	2	0	0	0	0	0	0	0
IN1616.5	1	3	1	0	3	0	0	0	0	0	0	0

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
IN1616.1	2	3	1	0	0	0	0	0	0	0	0

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IN1616.2	2	3	1	0	0	0	0	0	0	0	0
IN1616.3	1	1	3	1	3	0	0	0	0	0	0
IN1616.4	1	3	2	2	2	0	0	0	0	0	0
IN1616.5	1	3	1	0	3	0	0	0	0	0	0

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

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Course Code	IN1601						Course category		PC
Course Name	PROCESS CONTROL								
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 Objective:

Aim of the course is to**:**

I. Learn the fundamentals of Process dynamics.
II. Understand the basic construction of Final Control Element.
III. Familiarize the Pneumatic and Hydraulic systems.
IV. Analyze and design PID Controllers used in processes.
V. Understand the concept of Advanced process control systems.

Course Contents:

Introduction to Process control: Types of processes, basic components of process control Process characteristics, manipulated and measured variable,self regulating and non self regulating processes, interacting & non-interacting processes. Relative gain array & it's analysis, degree of freedom for process control,Outline of design problems; simple performance criteria, time integral performance content, selection of a feedback controller.

Control Valve as Final Control Element: Introduction of control valve, Main components of valve, Valve types, Valve characteristics, selection of control valves, concept of Cv, calculation of Cv and trim size, cavitation and flashing, noise in control valves, testing of control valve, valve positioners, necessity of positioners.

Pneumatic and Hydraulic Systems : Basic Principle and law's of Pneumatic and Hydraulic system, Pneumatic and Hydraulic Supply and its components: Filter Regulator Lubricator (FRL), Pneumatic and Hydraulic actuators, I/P and P/I converter, Flapper nozzle system, Operation of Direction Control valves. Pneumatic and Hydraulic Circuits:-Standard Symbols for pneumatic and Hydraulic circuits , Basic Pneumatic and Hydraulic Circuits, Sequence diagram (step-displacement) for implementing pneumatic circuits.

Controllers: Control Action:- Discontinuous controller-ON OFF type, Continuous controller - P, PI, PID Controller, Tuning of PID controller using Cohen-Coon method, Ziegler-Nichols Turning Technique, frequency response method. Different version of PID controller, electronic/pneumatic/hydraulic controller.

Analysis of Advanced Control systems: Feedback control systems with large dead time, feed forward control, Cascade control, ratio control, auto selective control, Split range Control, adaptive control system, inferential control system.

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Text Books:

1. F. G. Shinskey,“ Process Control System”, McGraw-Hill Education; 4th edition 1996
2. George Stephanopoulos, “Chemical process control”, Prentice-Hall of India, 2003.

Reference Books:

1. Bela G. Liptak,“ Process Control Handbook”, Chilton Book Company, 2001.
2. Krishnakant, “Computer Based Industrial Control”, Prentice-Hall of India, 2nd Revised edition 2011
3. Majumdhar, “Pneumatic Instrumentation”, Tata McGHrawHill
4. Instrumentation for Process Measurement & Control, Norman A. Anderson, 3rd Edition.
5. https://nptel.ac.in/courses/103105064

Course Outcomes:

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

IN1601.1 Learn the fundamentals of Process characteristics.
IN1601.2 Draw and Explain the basic construction of Final Control Element.
IN1601.3 Understand the concepts of Pneumatic and Hydraulic Systems.
IN1601.4 Analyze and design PID Controllers used in processes.
IN1601.5 Understand the concept of Advanced Control systems.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1601.1	2	1	1	0	0	0	0	0	0	0	0	0	1	1	1
IN1601.2	2	2	2	0	0	0	0	0	0	0	1	0	1	2	1
IN1601.3	2	1	3	1	0	0	0	0	0	0	1	0	1	2	1
IN1601.4	3	2	3	3	0	0	0	0	0	0	2	0	2	2	0
IN1601.5	2	1	1	0	0	0	0	0	0	0	1	0	1	1	0

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1601.1	2	1	1	0	0	0	0	0	0	0	0	1	1	1
IN1601.2	2	2	2	0	0	0	0	0	0	1	0	1	2	1
IN1601.3	2	1	3	1	0	0	0	0	0	1	0	1	2	1
IN1601.4	3	2	3	3	0	0	0	0	0	2	0	2	2	0
IN1601.5	2	1	1	0	0	0	0	0	0	1	0	1	1	0

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

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Course Code	IN1602					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:

Aim of the course is to**:**

I. Understand the concept of Fourier Transform (FT),Discrete Fourier Transform (DFT) Short time Fourier Transform (STFT) and wavelet transform (WT)
II. Find DFT using FFT algorithms.
III. Design FIR filter using windowing technique.
IV. Design IIR Butterworth filter.
V. Use of DSP processors.

Course Contents:

Introduction to signal processing: Introduction to Fourier Transform (FT),Discrete Fourier Transform (DFT) Short time Fourier Transform (STFT) and wavelet transform (WT), advantages and limitations of digital signal processing.

Algorithm implementation: properties of DFT**,** Computation of DFT, FFT algorithms, Decimation in time, Decimation in Frequency, Different algorithms of FFT such as DIT and DIF where input and output is in order, radix-n algorithms.

FIR Filter design techniques: FIR filter specifications, Linear phase in FIR filters ,Linear phase FIR filter design using windowing technique, Linear phase FIR filter design using frequency sampling method.

IIR Filter design techniques: Introduction, Design of IIR filters from analog filters-Impulse invariant transformation, Bilinear transformation, Design of digital low pass Butterworth filter, Chebyshev filter ,Design of IIR filters from normalized Low pass IIR filters.

Introduction to DSP Processors: Introduction to fixed point and floating point DSP processors, architectural features of TMS320C67XX, applications of DSP processors.

Text Books:

1. S. Salivahanan, "Digital Signal Processing" McGraw-Hill Education (India) Pvt Limited, 2001
2. S. K. Mitra,"Digital signal processing- A computer based approach", 2nd Edition, Tata McGraw Hill, 2002.
3. J. G. Proakis, D. G. Manolakis," Digital signal processing –Principles, algorithms and applications", , 3rd Edition, Prentice Hall of India, 2002.

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Reference Books:

6. Digital Signal Processing- A Practical Approach, E. C. Ifeachor, B. W. Jarvis, 2nd Edition, Pearson Education, New Delhi, 2002.
7. Discrete time signal processing, A. V. Oppenheim, R. W. Schafer, 3rd Edition, Prentice-Hall of India, 2001.
8. Modern Digital signal processing , V Udayashankara, 2nd edition, Prentice-Hall of India, 2012
9. Understanding Digital Signal Processing, R. G. Lyons, Pearson Education, New Delhi, 1999.
10. http://www.nptel.iitm.ac.in

Course Outcomes:

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

IN1602.1 Understand the concept of Fourier Transform (FT),Discrete Fourier Transform (DFT) Short time Fourier Transform (STFT) and wavelet transform (WT)
IN1602.2 Find DFT using FFT algorithms.
IN1602.3 Design FIR filter using windowing technique.
IN1602.4 Design IIR butterworth filter.
IN1602.5 Use of DSP processors.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1602.1	2	0	0	0	0	0	0	0	0	0	0	0	1	1	1
IN1602.2	3	2	2	2	2	0	0	0	0	0	0	0	2	1	1
IN1602.3	3	2	3	2	2	0	0	0	0	0	0	0	2	1	0
IN1602.4	3	2	3	2	2	0	0	0	0	0	0	0	2	1	0
IN1602.5	1	1	0	0	0	0	1	0	0	0	0	0	1	0	0

0 - Not correlated1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1602.1	2	0	0	0	0	0	0	0	0	0	0	1	1	1
IN1602.2	3	2	2	2	2	0	0	0	0	0	0	2	1	1
IN1602.3	3	2	3	2	2	0	0	0	0	0	0	2	1	0
IN1602.4	3	2	3	2	2	0	0	0	0	0	0	2	1	0
IN1602.5	1	1	0	0	0	0	0	0	0	0	0	1	0	0

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

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Course Code	IN 1603(A)	Course category	PE
Course Name	BIO MEDICAL SIGNAL PROCESSING		

Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	15	15	10	60	2hr30 min	00	00	100	04

Course Objectives:

Aim of the course is to**:**

I. To give the basic knowledge of signal processing on biomedical signals
II. Tounderstand about events detection (viz. P, QRS and T wave in ECG)
III. Tostudy the filtering techniques in EEG
IV. Toapply The adaptive filter techniques in biomedical application
V. To study the various biomedical signal Data compression techniques

Course Contents:

Introduction to biomedical signals: The nature of biomedical signals, Examples of Biomedical signals, objectives of biomedical signal analysis, Sources of noise in biomedical signal recordings, Difficulties in biomedical signal analysis

Cardiological signal processing: Basic electrocardiography, ECG signal characteristics, Powers spectrum of ECG, Band pass filtering technique, Differentiation technique, Template matching, approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection, Dicrotic Notch Detection, Correlation coefficients.

Neurological Signal Processing: The brain and its potentials, the electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis Introduction to auto Regressive (A.R.)modelling, Sleep Stage analysis

Adaptive Filters: Basics of signal averaging, signal averaging as a digital filter, principal noise canceller model, 60 Hz adaptive cancelling using sine wave model, applications of adaptive filtering removal of artifacts of one signal embedded in another 0Maternal0Fetal ECG.

Data Reduction Techniques: Lossy and Lossless data reduction Algorithms, Direct ECG data compression techniques, Turning point algorithm, AZTEC Algorithm, Fan algorithm, Huffman coding.

Text Books:

1. Willis J. Tompkins,,"Biomedical Digital Signal Processing", Prentice Hall of India publications/ Eastern Economy Edition, 2nd Print, 2000.

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2. Rangaraj M. Rangayyan, "Biomedical Signal Analysis-A case study approach", John Wiley,2002.

Reference Book:

1. D. C. Reddy, "Biomedical Signal Processing Principles and Techniques", Tata McGraw Hill, 2005.
2. L. Cromwell, F. Weibell," Biomedical Instrumentation and Measurements", Prentice Hall of India Pvt. Ltd publication, 1979.
3. Khandpur R. S.," Hand book of Biomedical Instrumentation", 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi, India, 1999

Course Outcomes:

Upon successful completion of this course, students will be able to

INU 1603A.1 Describe the origin, source and characteristics of biomedical signals,
INU 1603A.2 Demonstrate proficiency in using the QRS detection algorithm
INU 1603A.3 Describe the techniques for EEG waveform signal analysis
INU 1603A.4 Apply signal averaging and adaptive filtering technique in biomedical signal
INU 1603A.5 Compare the data reduction techniques

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1603A.1	3	1	0	0	0	0	0	0	0	0	0	0	2	1	3
IN1603A.2	3	3	3	1	2	0	0	0	0	0	0	0	2	1	3
IN1603A.3	3	1	0	1	2	0	0	0	0	0	0	0	2	1	3
IN1603A.4	2	1	0	0	2	0	0	0	0	0	0	0	2	1	1
IN1603A.5	2	2	0	0	1	0	0	0	0	0	0	0	2	1	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1603A.1	3	1	0	0	0	0	0	0	0	0	0	2	1	3
IN1603A.2	3	3	3	1	2	0	0	0	0	0	0	2	1	3
IN1603A.3	3	1	0	1	2	0	0	0	0	0	0	2	1	3
IN1603A.4	2	1	0	0	2	0	0	0	0	0	0	2	1	1
IN1602A.5	2	2	0	0	1	0	0	0	0	0	0	2	1	1

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

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Course Code	IN1603(B)							Course category			PE
Course Name	ANALYTICAL INSTRUMENTATION										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	01	04	15	15	10	60	2 hrs 30 min	00	00	100	04

Course Objectives:

Aim of the course is to**:**

I. Acquire knowledge about the widely used analytical Instruments
II. Select Instrument for a particular analysis with come idea of its merits, demerits and limitations
III. Work as a service and maintenance engineering for these Instruments
IV. Learn specific technique employed for monitoring different pollutants in air and water.
V. Know the instruments used in hospital for routine clinical analysis, drug and pharmaceutical laboratories, oil refineries and above all for environmental pollution monitoring

Course Contents:

Introduction to Analytical Instrumentation: Fundamentals of analytical instruments: Elements of an analytical instrument –Classification of instrumental techniques.

Electromagnetic radiation- Electromagnetic spectrum- Laws relating to absorption of radiation. Absorption spectroscopy in ultravoilet, visible, and infrared range of electromagnetic spectrum: Absorption instruments, Radiation sources, filters, Detectors in different band of elctromagnetic spectrum. Colorimeters/ photometers: Single beam and double beam filter photometer.

Flame Photometry: Principle and constructional details of flame photometer- Emission system – Optical system – Detectors . Atomic absorption spectrophotometers: Theoretical concepts, Instrumentation: Radiation sources - Burners and flames - Plasma excitation sources - Optical and electronic system . Fluorescence spectroscopy: Principle of fluorescence – Measurement of fluorescence– Single beam and double beam filter fluorimeter- Ratio fluorimeter. Spectro-fluorimeters. Raman spectrometer- Basic theory-Photo acoustic spectroscopy- Photo thermal spectroscopy .

Spectrometericmethods : Principle of operation- Magnetic deflection mass spectrometers- Components of a mass spectrometer – Inductively coupled plasma mass spectrometer. Nuclear Magnetic Resonance spectroscopy: Basic principle – Constructional details of NMR spectrometer

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– Nuclear radiation detectors. Electron Spin Resonance spectrometer: Basic ESR spectrometer – Electron spectroscopy: Instrumentation for electron spectroscopy.

Industrial Analyzers- pH meters, Conductivity meters, Dissolved oxygen meters, Sodium analyser. Thermal Sensors: Radiation Sensors, Mechanical Sensors and Bio-Chemical Sensors, turbidity meter, turbidity analyzers
Gas analysers: Paramagnetic oxygen analyser, CO analysers, Flue gas analysers.
Thin film technology for gas sensors: Basic concepts. Measurement techniques and application of gas sensors.

Chromatography: Process, Classification and Terms in chromatography.
Gas chromatography: Block diagram, Principle, Constructional details, column details, GC detectors.
Liquid Chromatography: Principle, Types, Constructional detail of liquid chromatography, High pressure Liquid Chromatography (HPLC).

Text Books:

1. Willard, Merritt, Dean, Settle,"Instrumental Methods of Analysis", CBS Publishers & Distributors, New Delhi, Seventh edition.

2. R. S. Khandpur, "Handbook of Analytical Instruments", Tata McGraw–Hill Publications, 3rd Edition.

Reference Books:

1. Douglas A. Skoog, F. James Holler, Timothy A. Nieman, "Principles of Instrumental Analysis", Thomson Asia Pvt Ltd publications, 5th edition.
2. Galen W. Ewing, "Instrumental Methods of Chemical Analysis",McGraw-Hill Book Company, Fifth edition.
3. Robert D. Braun,"Introduction to Instrumental Analysis", McGraw-Hill Book Company

Web Resources:

1. http://www.files.chem.vt.edu/chem-ed/ac-meths.html
2. http://www.chemistry.adelaide.edu.au/external/soc-rel/content/ac-meths.htm
3. http://www.analyticalinstruments.in/home/index.html
4. http://en.wikipedia.org/wiki/Chromatography
5. http://teaching.shu.ac.uk/hwb/chemistry/tutorials/chrom/gaschrm.htm
6. http://en.wikipedia.org/wiki/Spectrophotometer
7. http://www.ruf.rice.edu/~bioslabs/methods/protein/spectrophotometer.html
8. http://www.cis.rit.edu/htbooks/nmr

Course Outcomes:
On Completion of this course, students will able to

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IN1603(B).1 Illustrate the fundamental concepts of the widely used analytical Instruments
IN1603(B).2 Understand the Instrument for a particular analysis with idea of its merits, demerits and limitations
IN1603(B).3 Design the work as a service and maintenance engineering for these Instruments
IN1603(B).4 Analyze the concept for monitoring different pollutants in air and water.
IN1603(B).5 Know the instruments used in hospital for routine clinical analysis, drug and pharmaceutical laboratories, oil refineries and above all for environmental pollution monitoring

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1603(B).1	2	0	1	1	0	0	0	0	0	0	0	0	1	1	0
IN1603(B).2	2	2	1	2	0	0	1	0	0	0	0	0	1	0	0
IN1603(B).3	2	2	3	2	1	0	1	1	0	0	0	0	0	0	2
IN1603(B).4	2	2	1	2	1	2	0	0	0	0	0	0	0	0	0
IN1603(B).5	2	1	2	2	2	2	1	0	0	0	0	0	1	0	0

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1603B.1	2	0	1	1	0	0	0	0	0	0	0	1	1	0
IN1603B.2	2	2	1	2	0	0	0	0	0	0	0	1	0	0
IN1603B.3	2	2	3	2	1	0	1	0	0	0	0	0	0	2
IN1603B.4	2	2	1	2	1	2	0	0	0	0	0	0	0	0
IN1602B.5	2	1	2	2	2	2	0	0	0	0	0	1	0	0
Average														

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

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Course Code	IN1603 C							Course category	PE
Course Name	PROCESS MODELLING AND OPTIMIZATION								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory				Total	
				CT-I	CT-II	TA	ESE	ESE Duration	
03	01	00	04	15	15	10	60	2 hrs 30 min	100	04

Course Objectives:
Aim of the course is to**:**
I. Understand the Mathematical Modeling chemical process
II. Analyze the Mechanical and Chemical systems
III. Understand the different processes using simulation
IV. Define constraints of Optimization.
V. Develop the optimization techniques for different processes

Course Contents:

Mathematical Modeling: Introduction, Uses of Mathematical Models, Scope of Coverage, Principles of Formulation Fundamental laws: Continuity equations, Energy Equations, Equations of motion, transport Equations, Equations of state, Equilibrium and Chemical Kinetics.

Modeling and Simulation of Mechanical, Chemical systems: Examples of Mathematical Models of Chemical Engineering Systems: Series of Isothermal, Constant-Holdup CSTRs , CSTRs With Variable Holdups, Two Heated Tanks Gas-Phase, Pressurized CSTR Multi-component Flash Drum Batch Reactor , Reactor With Mass Transfer.

Simulation Examples: Gravity flow tank, Three CSTRs in Series, Non-isothermal CSTR Plug flow reactor model, modeling of flash drum, Binary Distillation Column, Multi-component Distillation Column

Solution of algebraic equations: Interval halving method, Newton Raphson method. Solution of differential equations: Euler method, Modified Euler method, Runge-Kutta methods (2nd and 4th order), AdomBashforth method. Curve fitting: Lagrange interpolation method, Least squares method.

Basic concepts of optimization and unconstrained optimization: Basic concept of optimization: Continuity of functions, Concave and convex functions, Unimodal and Multimodal functions, Necessary and sufficiency condition for an extremum of an unconstrained function. Unconstrained single-variable optimization: scanning and bracketing procedures. Constrained optimization: Linear and nonlinear programming. Linear programming: Degeneracies, Graphical method, Simplex method, Karmarkar algorithm. Nonlinear programming: Lagrange multiplier method, Quadratic programming.

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Text Books:

1. W. L. Luyben, "Process, Modeling, Simulation and Control for Chemical Engineers", McGraw Hill Publications.
2. T. F. Edgar, D. M. Himmelblau, "Optimization of Chemical Processes", McGraw Hill Publications.
3. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publications.

Reference Books:

1. B. Wayne Bequette, "Process Dynamics: Modelling, Analysis and Simulation", Prentice Hall International Inc.
2. B. V. Babu, "Process Plant Simulation", Gulf Publication
3. Gorden S. G., Beveridge and Rober S. Schechter, "Optimazation: Theory and Practices", McGraw Hill Book

Course Outcome:

After successfully completing the course students will be able to,

1. Understand what mathematical modelling is and how it is related to physical problems.
2. Recognize the need for modelling, estimate necessary model complexity.
3. Simulate and understand different processes.
4. Understand Numerical methods and their applications.
5. Develop ability to do Linear and nonlinear programming

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1603C.1	2	1	1	1	1	0	0	0	0	1	0	0	1	2	1
IN1603C.2	1	2	1	1	1	0	0	0	0	1	0	0	1	2	1
IN1603C.3	2	1	2	1	2	0	0	0	1	2	0	0	1	3	1
IN1603C.4	2	2	1	1	1	0	0	0	0	1	0	0	1	2	1
IN1602C.5	2	2	1	1	1	0	0	0	1	1	0	1	1	2	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1603C.1	2	1	1	1	1	0	0	0	1	0	0	1	2	1
IN1603C.2	1	2	1	1	1	0	0	0	1	0	0	1	2	1
IN1603C.3	2	1	2	1	2	0	0	1	2	0	0	1	3	1
IN1603C.4	2	2	1	1	1	0	0	0	1	0	0	1	2	1
IN1602C.5	2	2	1	1	1	0	0	1	1	0	1	1	2	1

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

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Course Code	IN1603 D						Course category		PE
Course Name	POWER ELECTRONICS								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory					
				CT-I	CT-II	TA	ESE	ESE Duration	Total
3	1	0	4	15	15	10	60	2.30 hrs	100	4

Course Objectives: -

I. Familiarize with principles of thyristors and thyristor Commutation Techniques.
II. Acquiring an understanding of Phase Controlled Rectifiers.
III. Understand the working principles of DC Chopper and Inverters.
IV. Analyze the characteristics of Speed control of DC motors.
V. Study some Application of Power Electronics

Introduction: Introduction to basic thyristors, Design of gate triggering circuits using thyristor, thyristor protection circuits, thyristor Commutation Techniques: Principles of Natural commutation, Design of Forced commutation circuits: Self commutation, Impulse commutation, Resonant pulse commutation, Complementary commutation, External pulse commutation.

Phase Controlled Rectifiers: Single phase rectifiers: Half wave, Center tapped, Bridge (half controlled and fully controlled) with R and RL load, Introduction to Three phase rectifiers, dual converters, Power factor improvement methods.

DC Chopper: Basic chopper, continuous and discontinuous current conduction, TRC, CLC methods, Classification of choppers, step-up chopper.

Inverters: Single phase inverters: series, parallel and bridge configurations with R load, PWM inverters. Three phase inverters with 1200 and 1800 conduction with R and RL load, voltage control.

Application of Power Electronics: Battery charging, High Voltage DC transmission, Electronic Lamp ballast, Emergency Light System,
Speed control of DC motors: Basic machine equation, Schemes for DC motor Speed Control, DC chopper drives, control using multiphase choppers, microprocessor control of DC drives.

Text Books:

1. M. Ramamurty, 'An Introduction to Thyristor and Their Application', 2nd Edition, East-West Press Private Limited, New Delhi-110 020(India), 1991.
2. M. H. Rashid,'Electronics: Circuits, Devices, and Applications', 2nd Edition, Prentice Hall of India Private Limited, New Delhi-110 001(India),1994.

Reference Books:

1. Singh M. D., Khanchandani K. BPower Electronics, 2nd Edition, McGraw- Hill Publishing Company Limited, New Delhi (India), 1998.

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2. P. S. Bimbhra, 'Power Electronics', 2nd Edition, Khanna Publishers, Delhi- 110 006 (India), 1998
3. P. K. Sen and N. K. De,'Electric Drives', 5th Edition, Prentice Hall of India Private Limited, New Delhi-110001(India), 1999.
4. De G, 'Principles of Thyristorised Converters', Oxford and IBH Publications, 1982.

Course Outcomes:

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

IN1604D.1 Familiarize with thyristors and thyristor Commutation Techniques.
IN1604D.2 Understanding of Phase Controlled Rectifiers.
IN1604D.3 Understand the working principles of DC Chopper and Inverters.
IN1604D.4 Analyze the characteristics of Speed control of DC motors.
IN1604D.5 Design and implement industrial applications of power electronic circuits.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN11604D.1	2	2	1	0	0	0	1	0	0	0	0	0	1	0	0
IN1604D.2	2	3	2	1	0	0	0	0	0	0	2	0	2	2	1
IN1604D.3	2	0	3	0	0	2	0	0	0	1	0	0	1	3	0
IN1604D.4	1	2	3	2	2	0	1	0	1	0	2	2	0	1	2
IN1604D.5	2	2	1	1	0	0	0	0	0	2	0	1	1	0	0

0 - Not correlated 1 - Weakly Correlated2- Moderately Correlated 3- Strongly Correlated

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN11604D.1	2	2	1	0	0	0	0	0	0	0	0	1	0	0
IN1604D.2	2	3	2	1	0	0	0	0	0	2	0	2	2	1
IN1604D.3	2	0	3	0	0	2	0	0	1	0	0	1	3	0
IN1604D.4	1	2	3	2	2	0	0	1	0	2	2	0	1	2
IN1604D.5	2	2	1	1	0	0	0	0	2	0	1	1	0	0

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Course Code	IN 1604(A)	Course category	PE
Course Name	BIO MEDICAL IMAGE PROCESSING		

Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	15	15	10	60	2hr30 min	00	00	100	04

Course Objectives:

Aim of the course is to**:**

I. Overview of image processing systems, Image formation and perception,digital image representation
II. Study of Image smoothing and image sharpening by spatial and frequency domain filtering and its applications
III. Study of concepts of segmentation, compression with different techniques to various biomedical applications
IV. Study of the concept of image processing in biomedical applications like X-ray CT ,MRI, Ultrasound
V. Understand the images obtained in endoscopy,colonoscopy,mammograph,PET scan

Course Contents:

Fundamentals and Image Enhancement Techniques: Fundamentals steps and component of an Image Processing system ,basic relationship between pixels ,basic Gray level transformation, basics of spatial filtering, smoothing spatial filters, Sharpening spatial filters. Smoothing frequency domain filters. Sharpening frequency domain filters. Homomorphism filtering. Application of spatial and frequency domain filtering in biomedical imaging

Image Segmentation, compression : Detection of discontinuities, edge linking and boundary detection, thresholding, distance measures, region growing and clustering based segmentation, compression models, image compression standards .

X ray and Computed tomography: Basic imaging principle ,X-ray detectors, conventional X-ray radiography, digital radiography, angiography, conventional tomography, evolution of CT machines ,introduction to reconstruction algorithms, application of CT in biomedical

Ultrasonography: Basic imaging principle Acoustic propagation, absorption and scattering, ultrasonic transducers, A mode, B mode, M mode scanners, Biomedical application of Ultrasonography, Introduction to endoscopy, colonoscopy, gastroscopy, mammography.

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Magnetic resonance imaging : Basic imaging principle , magnetization, larmor frequency, free induction decay, relaxation time pulse sequences, Biomedical application of MRI ,Introduction to PET Scan.

Text Books:

1. Gonzalez R.C. and Woods R.E, "Digital Image Processing", 2nd edition, Pearson education,2002
2. Jerry L Prince & Jonathan M links," Medical imaging signals and systems ",Pearson publication

Reference Books:

1. A K Jain, "Digital Image Processing", 3rd edition, John Wiley Eastern publication 1998
2. Ray H Hashemi and William G bradely Jr, Lippinocott Williams and Wilkins," Basics of MRI"
3 Frederick W kremaku," Diagnostic ultrasound and Principles and Instruments", 5th edition

Course Outcomes :

Upon successful completion of this course, students will be able to
INU1604A.1Apply the fundamental concept of digital image processing
INU1604A.2 Implement the Image enhancement techniques in the spatial domain and frequency domain
INU1604A.3 Analyse the image segmentation and compression techniques
IN1604A.4Describe the various imaging techniques used for biomedical applications
IN1604A.5Categorize the imaging techniques as per the biomedical application.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1604A.1	3	0	0	0	0	1	0	0	0	0	0	0	1	1	1
IN1604A.2	2	2	2	0	3	1	0	0	0	0	0	0	1	2	1
IN1604A.3	1	3	2	0	3	1	0	0	0	0	0	0	1	3	1
IN1604A.4	3	1	0	0	2	1	0	0	0	0	0	0	1	2	1
IN1604A.5	2	1	0	0	0	1	0	0	0	0	0	0	1	2	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1604A.1	3	0	0	0	0	1	0	0	0	0	0	1	1	1
IN1604A.2	2	2	2	0	3	1	0	0	0	0	0	1	2	1
IN1604A.3	1	3	2	0	3	1	0	0	0	0	0	1	3	1
IN1604A.4	3	1	0	0	2	1	0	0	0	0	0	1	2	1
IN1604A.5	2	1	0	0	0	1	0	0	0	0	0	1	2	1

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

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Course Code	IN1604B						Course category		PE
Course Name	BUILDING AUTOMATION								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory					Total	
				CT1	CT2	TA	ESE	ESE Duration		
03	01	00	04	15	15	10	60	2 hrs 30 min	100	04

Course Objectives:
Aim of the course is to**:**

I. Articulate the purpose and operation of HVAC system components, the operation of HVAC systems.
II. Apply knowledge of thermal comfort conditions and its impact on human comfort, productivity, and health.
III. investigate HVAC air systems and water system operations and control Philosophies
IV. Evaluate importance of fire safety systems
V. Demonstrate the security & access control system.

Course Contents:

Introduction Building Automation Systems, Architecture and Protocols:
Intelligent building, intelligent architecture and structure, facilities management vs. intelligent buildings, Lifecycle of building, Evolution of intelligent buildings. Different types of subsystems in BAS which includes HVAC, access control, security, fire, lighting systems. Importance of each system in BAS. BAS system hierarchy – field level components, direct digital control (DDC), supervisory controller, server, operator workstation (OWS). Different communication protocol and addressing concepts, in open Protocols like BACnet, LON.

Comfort parameters and measurement in BAS system:
Comfort parameters for human being - Temperature, Heat, humidity, clean air, flow pressure, Heat transfer - conduction, convection, radiation. Working principle, characteristics of different types of temperature sensors, working principle of Psychometry, working principle of different types of relative humidity sensors, different types of pressure sensors, working of principal and construction of different air flow sensors, working principal and construction of different water flow sensors, measurement of CO_2 level in air, air filtration techniques, UV treatment, working principal of BTU meter.

HVAC Basic Concepts- Air handling unit(AHU) & Terminal Unit(VAV):
Concept of Air handling unit. Design, working of different components in AHU- damper, filter, cooling coil, heating coil, fan, heat recovery wheel, humidifier. Design and working of different types of AHU. Operation of different modes like cooling, heating, humidification, dehumidification, static pressure control, volume matching, economizer mode. Concept of Variable Air Volume (VAV) system- Design, working, use of different types of VAV-CAV,

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cooling only, with reheat, series fan powered, parallel fan powered, pressure dependent, supply-exhaust VAV for critical areas like hospitals and laboratories.

HVAC Water Systems:
Chilled Water Systems: Concept of refrigeration cycle. Working, mechanical configuration of different types of components used in refrigeration cycle- evaporator, condenser, compressor, expansion valve. Difference between air cooled chiller and water cooled chiller. Working, mechanical configuration of different types of cooling towers. Concept and working of Absorption chiller. Concept and working of heat pump.
Design, working of different types of chilled water system- single chiller system, series chiller system, parallel chiller system. Working of different components of chilled water system- de-coupler line, bypass line, primary circuit, secondary circuit, and condenser pumps.

Hot water systems: Working and design of different types of boilers- fire tube, water tube, packaged boiler. Working and design of different types of heat exchanger.Working, design of different types of hot water system- with boilers, heat exchanger with steam input, heat exchanger with hot water input, concept of geothermal system.

Access Control & Surveillance System:
Basic Concept of Access Control System it's benefits & architecture. Concept of automation in access control system for safety. Physical security system with components, RFID enabled access control with components. Computer system access control for Data Security, Data Integrity and Data Freshness. Introduction to CCTV system, Different types of cameras, Video management, Intrusion & guard tour system.

Text Books:
1. Roger W. Haines,"HVAC Systems Design Handbook", McGraw Hill Publication, Fifth Edition
2. James E. Brumbaugh,"HVAC Fundamentals", John Wiley & Sons Inc, volume 1 to 3

References Books:
1. All About AHU's by ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0005 for online shopping)
2. Chillers Basics by ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0009 for online shopping)
3. Basics of Air Conditioning by ISHRAE. Indian Society of Heating, Refrigerating &
4. Air Conditioning Engineers (product code: B0004 for online shopping)
5. Fire Alarm and Detection System: Quick Book by A. Bhatia

Course Outcome:
The students will be able to
1604B.1. Articulate the purpose and operation of HVAC system components, the operation of HVAC systems.
1604B.2. Apply knowledge of thermal comfort conditions and its impact on human comfort,

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productivity, and health.

1604B.3. Investigate HVAC air systems and water system operations and control philosophies

1604B.4. Evaluate importance of fire safety systems

1604B.5. Demonstrate the security & access control system.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1604B.1	2	1	1	1	0	0	1	0	1	1	0	0	1	2	2
IN1604B.2	2	2	2	1	0	0	1	0	2	1	0	0	1	2	2
IN1604B.3	2	1	1	1	0	0	2	0	1	1	0	0	1	2	1
IN1604B.4	2	1	1	1	0	0	1	0	3	2	0	0	1	3	2
IN1604B.5	2	1	1	1	0	0	0	0	2	2	0	0	1	2	2

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1604B.1	2	1	1	1	0	0	0	1	1	0	0	1	2	2
IN1604B.2	2	2	2	1	0	0	0	2	1	0	0	1	2	2
IN1604B.3	2	2	2	1	0	0	0	1	1	0	0	1	2	1
IN1604B.4	2	1	1	1	0	0	0	3	2	0	0	1	3	2
IN1604B.5	2	1	1	1	0	0	0	2	2	0	0	1	2	2
Average														

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

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Course Code	PE-III IN1604C							Course category	PE
Course Name	NEURAL AND FUZZY CONTROL								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory				Total	
				CT-I	CT-II	TA	ESE	ESE Duration	
03	01	00	04	15	15	10	60	2 hrs 30 min	100	04

Course Objectives:

Aim of the course is to**:**

I. Introduce the fuzzy logic and set theory.
II. Understand the concept of fuzzification and defuzzification.
III. Explain comprehensive knowledge of fuzzy logic control
IV. Provide adequate knowledge about feedback neural networks
V. Apply adequate knowledge of application of Neuro-fuzzy based control to real time systems

Course Contents:

Introduction Fuzzy Logic: Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Fuzzy Membershipand Rules: Membership functions, interference in fuzzy logic, fuzzy if- then rules, Fuzzy implications and Fuzzy algorithms, Fuzzification&Defuzzification, Fuzzy Controller, Industrial applications.

Fuzzy Logic Based Control: Fuzzy Controllers: Preliminaries Fuzzy sets in commercial products basic construction of fuzzy controller Analysis of static properties of fuzzy controller Analysis of dynamic properties of fuzzy controller simulation studies case studies fuzzy control for smart cars.

Introduction Neural Networks: Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro- associative memory.

Neuro –Fuzzy based system &controller: Neuro Fuzzy and Fuzzy Neural Controllers Neuro fuzzy systems: A unified approximate reasoning approach Construction of rule bases by self-learning: System structure and learning algorithm A hybrid neural network based Fuzzy controller with self- learning teacher. Fuzzified CMAC and RBF network based self- learning controllers.

Text Books:

1. S. Rajsekaran& G.A. VijayalakshmiPai,"Fuzzy Logic and Genetic Algorithm: Synthesis and Applications Neural Networks", Prentice Hall of India.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India.

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Reference Books:

1. SimanHaykin, "Neural Networks", Prentice Hall of India
2. Klir G.J and Folger T.A, "Fuzzy sets, Uncertainty and Information", Prentice Hall of India, New
Delhi 1994.
3. Kumar Satish, "Neural Networks", Tata McGraw Hill
4. Bose and Liang, "Artificial Neural Networks", Tata McGraw Hill, 1996.
5. KoscoB," Neural Networks and Fuzzy Systems: A Dynamic Approach to Machine Intelligence", Prentice Hall of India, New Delhi, 1992.

Course outcomes:

On Completion of this course, students will able

IN1604C.1. To introduce the fuzzy logic and set theory.
IN1604C.2. To understand the concept of fuzzification and defuzzification.
IN1604C.3. To explain comprehensive knowledge of fuzzy logic control
IN1604C.4. To provide adequate knowledge about feedback neural networks
IN1604C.5. To apply adequate knowledge of application of Neuro-fuzzy based control to real time systems

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1604C.1	2	1	2	1	0	0	0	0	0	0	0	0	1	2	0
IN1604C.2	2	1	2	1	1	0	0	0	0	0	0	0	1	2	0
IN1604C.3	2	2	1	1	1	0	0	0	1	1	0	0	1	2	0
IN1604C.4	2	1	2	1	1	0	0	0	0	0	0	0	1	2	0
IN1604C.5	2	3	1	2	1	1	0	0	1	1	0	1	1	2	0

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CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1604C.1	2	1	2	1	0	0	0	0	0	0	0	1	2	0
IN1604C.2	2	1	2	1	1	0	0	0	0	0	0	1	2	0
IN1604C.3	2	2	1	1	1	0	0	1	1	0	0	1	2	0
IN1604C.4	2	1	2	1	1	0	0	0	0	0	0	1	2	0
IN1604C.5	2	3	1	2	1	1	0	1	1	0	1	1	2	0

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Course Code	PE-II IN1604D							Course category		PE
Course Name	POWER PLANT INSTRUMENTATION									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	01	00	04	30	10	60	2 hrs 30 min	00	00	100	04

Course Objective:

Aim of the course is to**:**

I. To describe the power generation scenario.
II. To analyze the steam turbines and condensers along with their working principles and types.
III. To recognize the layout, component details of hydroelectric power plant and nuclear power plant.
IV. To emphasize the fundaments of solar and wind power plants.
V. To realize different method of energy conversion and importance of Instrumentation in power plants.

Course Content :

Energy scenario and basic concepts of Thermal Power Plant: Law of thermodynamics, renewable and nonrenewable energy sources

Thermal Power Plant: fossil fuel steam generator, steam and water cycle, boiler used in thermal power plant, coal handling system, pulverization of coal, burning of fuel, different methods of feed water treatment, Steam turbines-Impulse and Reaction type: Working principle, compounding and governing system, turbine run up system, Steam condenser: working principles and its types,

Hydroelectric power Plant: Site selection, hydrology, elements of hydroelectric power plant, Hydro Turbines: radial flow impulse turbine, Fransis turbine and Kaplan Turbine

Nuclear Power Plant: Chemical and nuclear reactions, nuclear fission, chain reaction, advantages and limitations of NPP, Nuclear reactor and its classification, essential components of NPP, Combined operations: advantages of combined operations, coordination between different plants

Solar and Wind power plant: Solar radiations, solar constants, solar angles, collectors and their classifications, types of solar plants according to temperature, Wind Energy: Classification of wind machines, performance calculation, Wave and geothermal energy: devices for wave energy conversion, tidal energy, Photovoltaic conversion: Description and principle of working

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Instrumentation in power plants: Different methods of energy conversion, pressure, temperature and flow measurements in power plants, Environmental aspects of power generation: pollution from TPS, gaseous emission and control, pollution from NPP, effects of hydro and solar plants

Text Books:

1. G.F. Gilman, "Boiler Control Systems Engineering.," 2nd edition, ISA Publication, 2005.
2. P. K. Nag, "Power plant engineering." 3rd edition, McGraw Hill, 2010.

Reference Books:

1. Domkundwar, "Power Plant Engg", 2nd edition, Dhanpat Rai and Sons. New Delhi. 96
2. B. H. Khan, "Non-conventional energy resources", 2nd edition, McGraw Hill, New Delhi, 2006
3. Chetan Singh Solanki, "Renewable energy Technology", 2nd edition, Prentice Hall Publication,
4. S. P. Sukhatme, "Solar Energy.," 3rd edition, Tata McGraw Hill, New Delhi, 2008
5. http://www.nptel.iitm.ac.in

Course outcomes: Upon Completion of this course, students will able to

IN1604D.1 To describe the power generation scenario.
IN1604D.2 To analyze the steam turbines and condensers along with their working principles and types.
IN1604D.3 To recognize the layout, component details of hydroelectric power plant and nuclear power plant.
IN1604D.4 To emphasize the fundaments of solar and wind power plants.
IN1604D.5 To realize different method of energy conversion and importance of Instrumentation in power plants

CO – PO – PSO Mapping

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1604D.1	1	0	1	1	0	0	0	0	0	0	0	0	1	1	1
IN1604D.2	1	2	0	1	1	1	0	0	0	0	0	0	1	0	0
IN1604D.3	2	1	2	1	1	0	0	0	0	0	0	0	0	1	1
IN1604D.4	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0
IN1604D.5	2	1	2	2	1	0	0	0	0	0	0	0	1	0	0

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

CO – PO – PSO Mapping

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1604D.1	1	0	1	1	0	0	0	0	0	0	0	1	1	1
IN1604D.2	1	2	0	1	1	1	0	0	0	0	0	1	0	0
IN1604D.3	2	1	2	1	1	0	0	0	0	0	0	0	1	1
IN1604D.4	2	2	1	1	1	0	0	0	0	0	0	0	0	0
IN1604D.5	2	1	2	2	1	0	0	0	0	0	0	1	0	0

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

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Course Code	IN1605							Course category			PC
Course Name	PROCESS CONTROL 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:-

Aim of the course is to**:**

I. Design of an ON-OFF and PID controller for different processes.
II. Understand the basic construction of valve and plot the Control Valve characteristics.
III. Analyzeand Design of Advanced Control systems.

Minimum Eight Experiments should be conducted from the sample list given below.

1. To understand the effect of interacting and non interacting systems as single or multi-capacity process.
2. To understand difference between self regulating and non self regulating process.
3. Design of an electronic ON-OFF controller and plot the characteristics of natural zone of controller
4. Design an PID controller
5. Simulation of pneumatic and hydraulic controllers for single and double acting cylinder.
6. To obtain and plot the pressure profile across orifice and venturimeter.
7. To obtain and plot the Control Valve characteristics
8. To control the pressure in closed tank by using closed loop control system and plot its characteristics.
9. To interface Pressure control loop to soft PID and plot its characteristics
10. Design of Cascade Control using Cascade control system trainer.
11. Design ratio control system for flow control application.
12. To determine the mathematical model of the given process.
13. Analysis of first order and second order system.

Note:

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

ESE- The End Semester Exam shall be based on performance in one of the Experiments and may be followed by sample questions.

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Course Outcomes:

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

IN1605.1: Understand the Design concept of an ON-OFF and PID controller for different processes.

IN1605.2: Draw and Explain the basic characteristics Control valve.

IN1605.3: Analyze and Design of Advanced Control systems.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1605.1	2	2	2	1	1	0	1	0	0	0	2	1	1	0	0
IN1605.2	2	3	1	0	0	0	0	0	1	0	1	0	2	2	1
IN1605.3	3	1	1	1	0	2	0	0	0	0	1	1	1	1	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1605.1	2	2	2	1	1	0	0	0	0	2	1	1	0	0
IN1605.2	2	3	1	0	0	0	0	1	0	1	0	2	2	1
IN1605.3	3	1	1	1	0	2	0	0	0	1	1	1	1	1

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

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Course Code	IN1606							Course category			VSE
Course Name	DIGITAL SIGNAL PROCESSING 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	-	50	--	50	01

Course objectives:

Aim of the course is to**:**

I. Knowledge of MATLAB or any other resources/tool to explain the classification of signals and basic operations on the signals
II. Explore the MATLAB for various filter design and implementation
III. Explore the architecture and features of DSP process

Students are supposed to write the programs (at least eight) on general-purpose computer using any development environment (MATLAB/ C/C++) or on any DSP processor and development environment

List of the Experiments

1 Write a Matlab Program to generate the ramp, exponential, sine, cosine sequence (Digital signal generation)
2 To compute the convolution of two sequences and correlation of two sequences
3 Determine the DFT and IDFT of the given sequence
4 To compute the circular convolution using FFT
5 To compute the linear convolution using FFT
6 To compute correlation using FFT
7 Design a low pass and High pass FIR filter using hamming window
8 Design a low pass FIR filter using frequency sampling method
9 Design a low pass Butterworth IIR filter using bilinear transformation method
10 DesignLowpass, Highpass IIR Chebyshev filter

Note:

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

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

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Course Outcome:

Upon completion of the course students will be able to

INU1606.1 Use the Matlab programming efficiently for any DSP signal generation and operations

INU1606.2 Design the filters as per the applications

INU1606.3 Analyse the signals by using various DSP filtering techniques

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

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
1606.1	2	2	1	0	2	0	0	0	0	0	0	0	2	1	0
1606.2	1	1	2	0	2	0	0	0	0	0	0	0	2	1	0
1606.3	1	3	0	0	2	0	0	0	0	0	0	0	2	1	0

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1606.1	2	2	1	0	2	0	0	0	0	0	0	2	1	0
IN1606.2	1	1	2	0	2	0	0	0	0	0	0	2	1	0
IN1606.3	1	3	0	0	2	0	0	0	0	0	0	2	1	0

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

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Course Code	IN1607							Course category			FP
Course Name	MINOR PROJECTS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
00	00	04	04	00	00	00	-	50	00	50	02

Course Objectives:

Aim of the course is to**:**

I. Students can be able to apply the Instrumentation engineering subjects knowledge for practical applications
II. Learn the recent technologies and used for implementation of minor projects
III. Able to carry out the budget and time scheduling of the project

The Minor Project consist of Design and fabrication of Instrumentation oriented projects based on following areas

1. Process Instrumentation and Industrial Automation
2. Biomedical Instrumentation
3. Electronic Instrumentation
4. Microprocessor and Microcontroller based Instrumentation.
5. Virtual Instrumentation
6. IoT& some relevant advance techniques/Advanced Instrumentation area/Interdisciplinary topics

The minor project work should be carried out in Laboratory only. The topic may be given to the individual student or group of not more than three students. The evaluation will be based on the quality of work, report, presentation and demonstration by the students in front of the Expert committee from the department.

Note:

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The evaluation shall be based on demonstration by the students in front of the Expert committee from the department.

Course Outcomes :

After completion of the course students will be able to

1607.1. The Instrumentation techniques/engineering principles for specific application

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1607.2. Design and develop Small Instrumentation project based on hardware and software for engineering systems.

1607.3. Carry out budget ,time planning ,presentation of the project to evaluators.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1607.1	2	2	2	1	1	0	1	0	0	0	2	1	1	0	0
IN1607.2	2	3	1	0	0	0	0	0	1	0	1	0	2	2	1
IN1607.3	3	1	1	1	0	2	0	0	0	0	1	1	1	1	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1607.1	2	2	2	1	1	0	0	0	0	2	1	1	0	0
IN1607.2	2	3	1	0	0	0	0	1	0	1	0	2	2	1
IN1607.3	3	1	1	1	0	2	0	0	0	1	1	1	1	1
Average														

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

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Course Code	IN1608						Course category		MNC
Course Name	PCB DESIGN AND CIRCUIT SIMULATOR								
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	00	50	00

Course Objectives:

Aim of the course is to**:**

I. To acquire the basic level knowledge required to understand PCB.
II. To Study the PCB layout design.
III. To understand the basic concept of PCB Manufacturing techniques.
IV. To understand assembly techniques for leaded and SMD.
V. To developbasic circuits using multisim simulator.

Course Contents:

Printed circuit Board Design:

History of Printed Circuit Boards. Various types of Printed Circuit Boards0Single Sided Boards, Double Sided Plated through Hole Boards, multilayer Boards. Process of PCB design and product development flow.

PCB Layout Design:

Study of technical terms in layout design. :0Board outline Design, components placement, Details of layers, Routing methods, Copper Pour, Adding reference texts, Build library parts (footprints, schematic symbols) Generation of various Manufacturing Documents/Output files generation (Gerber file generation) IPC standards for printed circuit board design

PCB Manufacturing Techniques:

Various material used in Manufacturing of Printed Circuit Boards and properties of material. Cleaning Method Manual and Mechanical Cleaning Methods ,Printed Circuit Board Manufacturing Methods , Method of Screen Printing for pattern transfer, Method of Wet film and Dry film for single and Double Sided Board Manufacturing. Method of Solder0mask and Legend Printings. Plating and Etching Techniques, Mechanical methods required in manufacturing of PCBs like punching, drilling, milling and routing.Study of0Fault Finding methods of PCBs, Repairing Techniques.Materials used in Soldering Process. Types of soldering techniques.Desoldering techniques.

PCB Assembly Techniques :

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Components Preparation Method, Lead identification of components ,Component mounting techniques , Lead Forming methods, Leaded through hole assembly and Surface Mount Assembly. Mixed Assembly Techniques of through hole and SMDs. Manual Assembly method, Semiautomatic and automatic Assembly method. Tools used in assembly process.

NI Multisim: Devloping basic circuits using multisim simulator.

Text Books:

1. Simon Mon,“ Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards (Electronics)”
2. James Drewniak and Bruce R Archambeault, “PCB Design for Real0World EMI Control (The Springer International Series in Engineering and Computer Science)”.

Reference Books :-

1. Michael Dsouza and Dsouza Michael ,“PCB Design: Printed Circuit Board”
2. Chris Schroeder, “PCB Design Using AutoCAD (EDN Series for Design Engineers)”
3. Save Yogesh, “OSCAD: An Open Source EDA Tool for Circuit Design, Simulation, Analysis and PCB Design”
4. Kraig Mitzner, “Complete PCB Design Using OrCAD Capture and PCB Editor”
5. Andy Artes, “PCB Design in EAGLE – Part 1: Learn about EAGLE’s user interface, adding parts, Schematics ,and more”.

Web Resources: -

1. https://hillmancurtis.com/nptel0pcb0design/#:~:text=The%20NPTEL%20PCB%20Design%20course%20is%20a%2012%2Dweek%20course,lectures%2C%20quizzes%2C%20and%20assignments.

Course Outcomes:

IN1608.1 On completion of the course, students will be able to:
IN1608.2 Acquire the basic level knowledge required to understand PCB.
IN1608.3 Understand the PCB layout design.
IN1608.4 Understand the basic concept of PCB Manufacturing techniques.
IN1608.5 Understand assembly techniques for leaded and SMD.
IN1608.6 Develop basic circuits using multisim simulator.

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

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1608.1	1	2	0	0	0	0	0	0	0	0	0	0	2	1	1
IN1608.2	1	2	1	0	0	0	0	0	0	0	0	0	1	1	0
IN1608.3	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1
IN1608.4	1	2	1	0	0	0	0	0	0	0	0	0	1	1	2
IN1608.5	3	2	0	0	0	0	0	0	0	0	0	0	2	1	2

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

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CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1608.1	1	2	0	0	0	0	0	0	0	0	0	2	1	1
IN1608.2	1	2	1	0	0	0	0	0	0	0	0	1	1	0
IN1608.3	1	1	1	0	0	0	0	0	0	0	0	1	1	1
IN1608.4	1	2	1	0	0	0	0	0	0	0	0	1	1	2
IN1608.5	3	2	0	0	0	0	0	0	0	0	0	2	1	2
Average														

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Course Code	IN1611	Course category	EX
Course Name	SKILL BASED COURSES ON INDUSTRIAL AUTOMATION IN ANY ONE PROCESS INDUSTRY		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
00	00	08	08	00	00	00	-	50	-	50	04

Study of Real time applications and submission of its reportfor Industrial Automation through PLC,SCADA and DCS in any one of the following Industry during the first month

1 Thermal Power Plant
2 Textile Industry
3 Cement Industry
4 Paper Industry
5 Fertilizer Industry
6 Pharmaceutical Industry
7 Any process industry having above scope

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Course Code	IN1612						Course category		EX
Course Name	INSTRUMENTATION SYSTEM DESIGN LAB								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
00	00	04	04	00	00	00	-	50	-	50	04

Course Objectives:-

Aim of the course is to**:**

I. Understand the use of I to P and P to I Converters for different processes.
II. Design of filter for typical noise problem
III. Understand the basic construction of control valve for given specifications and Detailing it with engineering drawings..

Minimum Eight Experiments should be conducted from the sample list given below.

1. Case study: One LAB instrument/field instrument and its detailed engineering drawings, circuit diagrams on a drawing sheet.
2. Design of any mini project like design of instrument/electronic device/ transducer/ Instrumentation component/ system, its procedure starting from preparation of specifications, designing, testing, and erection. [Drawings dimensional sketches, circuit diagram, details of different component on drawing sheet, testing its specifications, determining practical static and dynamic characteristics]
3. I to P and P to I Converters for different processes.
4. Designing and preparing a PCB layout for electronic circuit and drawing it on drawing sheet.
5. Design of a filter for typical noise problem
6. Design of any electronic intrinsically safe circuit.
7. Designing a control valve for given specifications and detailing it with engineering drawings.
8. Designing any transmitter and drawing its details.
9. Design of any sensor/transducer for particular process variables like flow/temp/Pressure and drawing its dimensional details on a sheet.
10. To control the pressure in closed tank by using closed loop control system and plot its characteristics.

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11. To interface Pressure control loop to soft PID and plot its characteristics

12. Design of Cascade Control using Cascade control system trainer.

Note:

ICA- The Internal Continuous Assessment shall be based on the practical record and Knowledge/skill acquired. The performance shall be assessed experiment wise by using continuous assessment formats A and B.

ESE- The End Semester Exam 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:

IN1612.1 Understand the use of I to P and P to I Converters for differentProcesses.

IN1612.2Understand the filter for typical noise problem

IN1612.3 Draw and Explain the basic the basic construction of control valve for given

specifications and detailing it with engineering drawings.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1605.1	2	2	2	1	1	0	1	0	0	0	2	1	1	0	0
IN1605.2	2	3	1	0	0	0	0	0	1	0	1	0	2	2	1
IN1605.3	3	1	1	1	0	2	0	0	0	0	1	1	1	1	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1605.1	2	2	2	1	1	0	0	0	0	2	1	1	0	0
IN1605.2	2	3	1	0	0	0	0	1	0	1	0	2	2	1
IN1605.3	3	1	1	1	0	2	0	0	0	1	1	1	1	1

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

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Course Code	IN1613							Course category		EX	
Course Name	INTERNSHIP / TECHNICAL PROJECT										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT1	CT2	TA	ESE	ICA	ESE		
00	00	08	08	-	-	-	-	50	-	50	8

Course Objectives:

Aim of the course is to :

I. Gain practical experience in a professional setting relevant to their field of study.
II. Apply theoretical knowledge and technical skills to solve real-world problems or contribute to ongoing projects.
III. Develop professional competencies such as communication, teamwork, problem-solving, and project management.

Course Contents:

1. The student should complete the internship of 01 month in industry as per the internship policy of the institute.

2. The student should complete the technical project within 02 month on any area of Instrumentation and Control Engineering / Industrial Automation under the supervision of the guide assigned by the department.

3. Students must complete Internship for duration of minimum eight weeks, after completion of Sixth sem. 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.

Course Outcomes:

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

IN1613.01Apply theoretical knowledge gained in their coursework to real-world situations

IN1613.02Exhibit professionalism, punctuality,ethics and reliability in their work .

IN1613.03 Effectively communicate their ideas, findings, and project outcomes to supervisors, colleagues, and other stakeholders.

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Course Code	IN 1621								Course category		PEH	
Course Name	**SPEECH AND AUDIO 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	2.30 Hr			100	03

Course Objectives:

Aim of the course is to**:**

I. To understand basic concepts and methodologies for the analysis and modeling of speech signal.
II. To characterize the speech signal as generated by a speech production model
III. To understand the mechanism of speech and audio perception
IV. To perform the analysis of speech signal using LPC
V. To provide a foundation for developing applications in this field.

Course Contents:

Fundamentals of speech production: Anatomy and physiology of speech production, Human speech production mechanism, LTI model for speech production, Nature of speech signal, linear time varying model, articulatory phonetics, acoustic phonetics, Voiced and Unvoiced speech.

Human auditory system , Human auditory system, simplified model of cochlea. Sound pressure level and loudness. Sound intensity and Decibel sound levels. Concept of critical band and introduction to auditory system as a filter bank, Uniform, non uniform filter bank, mel scale and bark scale. Speech perception: vowel perception.

Time and frequency domain methods for audio processing : Time-dependent speech processing. Short-time energy, short time average magnitude, Shorttime average zero crossing rate. Speech Vs. silence discrimination using energy and zero crossing rate. Short-time autocorrelation function, short-time average magnitude difference function. Pitch period estimation using autocorrelation method. Audio feature extraction, Spectral centroid, spectral spread, spectral entropy, spectral flux, spectral roll-off. Spectrogram: narrow band and wide band spectrogram.

Linear prediction analysis: Basic principles of linear predictive analysis. Autocorrelation method, covariance method. Solution of LPC equations: Cholesky decomposition, Durbin's

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recursive solution, lattice formulations and solutions. Frequency domain interpretation of LP analysis. Applications of LPC parameters as pitch detection and formant analysis. Introduction to Cepstral analysis

Speech and Audio processing applications Speech recognition: complete system for an isolated word recognition with vector quantization. Speaker recognition: Complete system for speaker identification, verification .Real time application of Speech and Audio signal processing.

Text Books :

1. Deller J. R. Proakis J. G. and Hanson J. H., "Discrete Time Processing of Speech Signals", Wiley Interscience
2. Ben Gold and Nelson Morgan, "Speech and audio signal processing" Wiley

Reference Books :

1. L. R. Rabiner and S.W. Schafer, "Digital processing of speech signals" Pearson Education.
2. Thomas F. Quateri , "Discrete-Time Speech Signal Processing: Principles and Practice" Pearson
3. Dr.ShailaApte, "Speech and audio processing", Wiley India Publication
4. L. R. Rabiner and B. H. Juang, "Fundamentals of speech recognition"
5. Theodoros Giannakopoulos and Aggelospikrakis, "Introduction to audio analysis : A MATLAB Approach : Eleseiver Publication.

Course Outcomes:

After successfully completing the course students will be able to

IN1621.1 Implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.
IN1621.2 Analyze speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).
IN1621.3 Understand the of mechanism of speech and audio perception
IN1621.4 Write a program for extracting LPC Parameters using Levinson Durbin algorithm Formulate
IN1621.5 Analuyse the techniques for Speech enhancement applications

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1621.1	3	1	0	0	3	0	0	0	0	0	0	0	3	2	1
IN1621.2	2	3	1	1	3	0	0	0	0	0	0	0	1	3	1
IN1621.3	3	0	0	0	1	0	0	0	0	0	0	0	1	1	0
IN1621.4	1	3	3	0	2	0	0	0	0	0	0	0	2	3	1
IN1621.5	2	3	1	0	3	0	0	0	0	0	0	0	2	2	2

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CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1621.1	3	1	0	0	3	0	0	0	0	0	0	3	2	1
IN1621.2	2	3	1	1	3	0	0	0	0	0	0	1	3	1
IN1621.3	3	0	0	0	1	0	0	0	0	0	0	1	1	0
IN1621.4	1	3	3	0	2	0	0	0	0	0	0	2	3	1
IN1621.5	2	3	1	0	3	0	0	0	0	0	0	2	2	2

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Course Code	IN1622	Course category	PEH
Course Name	WAVELETS TRANSFORM AND ITS APPLICATIONS		

Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	0	0	**03**	15	15	10	60	2hr30 min	00	100	100	**03**

Course Objectives:

Aim of the course is to**:**

I. **Understand and Explore the Fundamentals of Wavelets**
II. **Distinguish Different Wavelet**
III. Develop proficiency in implementing wavelet-based algorithms using programming tools such as MATLAB
IV. **Apply The Wavelets Technique for Image Denoising**
V. Critically analyze the advantages and limitations of wavelet-based methods

Course Contents:

The Age of Wavelets: The Origins of Wavelets-Are They Fundamentally New?, Wavelets and Other Reality Transforms, Managing Heisenberg's Uncertainty Ghost, History of Wavelet from Morlet to Daubechies via Mallat, Wavelets in the Future,Fourier Series and Geometry.

Continuous Wavelet and Short Time Fourier Transform: Wavelet Transform-A First Level Introduction, Mathematical Preliminaries-Fourier Transform, Properties of Wavelets Used in Continuous Wavelet Transform, Continuous versus Discrete Wavelet Transform.

Discrete Wavelet Transform: Haar Scaling Functions and Function Spaces, Nested Spaces, Haar Wavelet Function, Orthogonality of o (t) and (t) 62, Normalization of Haar Bases at Different Scales, Standardizing the Notations, Refinement Relation with Respect to Normalized Bases, Support of a Wavelet System , Daubechies Wavelets, Seeing the Hidden-Plotting the Daubechies Wavelets.

Application of wavelet Transformation for Image Compression: Overview of Image Compression Techniques, Wavelet Transform of an Image, Quantization, Entropy Encoding, EZW Coding (Embedded Zero-tree Wavelet Coding), SPIHT (Set Partitioning in Hierarchical Tree), EBCOT (Embedded Block Coding with Optimized Truncation).

Application of wavelet Transformation forDenoising: A Simple Explanation and a 1-D Example, Denoising Using Wavelet Shrinkage-Statistical Modelling and Estimation, Noise

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Estimation, Shrinkage Functions, Shrinkage Rules, Denoising Images with Matlab, Matlab Programs for Denoising, Simulation for Finding Effectiveness of Thresholding Method.

Text Books:

1 K.D. Soman, K.I. Ramchandran, "InsightInto Wavelets From Theory to Practice", Second Edition,

Reference Books:

1. "Gonzalez R.C. and Woods R.E" ,Digital Image Processing, 2nd edition, Pearson education,2002

Course Outcomes:

After The Completion Of Course Student will be

1N1622.1. **Demonstrate a Strong Understanding of Wavelet Theory** .
1N1622.2. **Apply Wavelet Transforms to Real-World Problems**
1N1622.3. **Develop and Implement Wavelet-Based Algorithms**
1N1622.4. **Apply The Wavelets Technique For Image applications**
1N1622.5. Analyze the advantages and limitations of wavelet-based methods

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1622.1	3	0	1	0	1	0	0	0	0	0	0	0	2	3	0
IN1622.2	1	3	2	1	3	0	0	0	0	0	0	0	3	2	0
IN1622.3	1	3	3	3	3	0	0	0	0	0	0	0	2	3	1
IN1622.4	1	2	2	2	2	0	0	0	0	0	0	0	3	2	1
IN1622.5	1	3	2	1	3	0	0	0	0	0	0	0	1	3	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO3
IN1622.1	3	0	1	0	1	0	0	0	0	0	0	2	3	0
IN1622.2	1	3	2	1	3	0	0	0	0	0	0	3	2	0
IN1622.3	1	3	3	3	3	0	0	0	0	0	0	2	3	1
IN1622.4	1	2	2	2	2	0	0	0	0	0	0	3	2	1
IN1622.5	1	3	2	1	3	0	0	0	0	0	0	1	3	1

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

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Course Code	IN1641						Course category		MN
Course Name	INDUSTRIAL DRIVES								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory				Total	
				CT-I	CT-II	TA	ESE	ESE Duration		
03	00	00	03	15	15	10	60	2 hrs 30 min	100	03

Course Objectives:

Aim of the course is to**:**

I. Study the different types of industrial drives.
II. Study the different characteristics and breaking methods ofD.C motors.
III. Understand the starting methods of electrical machines.
IV. Understand different methods of speed control of DC machines.
V. To understand different methods of speed control of DC machines.

Course Contents:

Introduction to Industrial Drives: Definition of electric drive, type of drives. Speed torque characteristic of driven unit/loads, motors. Concept of Multi-quadrant operation, Classification and components of load torque;

Drive Motor Characteristics: Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

Starting Methods: Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

Conventional and Solid state speed control of DC Drives: Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

Conventional and Solid state speed control of ACDrives: Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

Text Books:

1. G. K. Dubey, “Fundamentals of Electrical Drives”, Narosa, 2001.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, PHI-India, 2005.

Reference Books:

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1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall international, New Jersey, 1989.
2. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia, 2003.
3. N. K. De and P. K. Sen, "Electric Drives", Prentice Hall of India Private Limited, 2006.
4. S. K. Pillai, "A First Course on Electrical Drives", New Age International.
5. S. B. Dewan, G. R. Slemon and A. Straughen, "Power Semiconductor Drives", John Wiley and Sons, New York 1984.

Course Outcomes:

After completion of this course student will be able

IN1641.1 To study the different types of industrial drives.
IN1641.2 To study the different characteristics and breaking methods ofD.C motors.
IN1641.3 To understand the starting methods of electrical machines.
IN1641.4 To understand different methods of speed control of DC machines.
IN1641.5 To understand different methods of speed control of DC machines.

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1641.1	2	1	1	1	0	0	0	0	0	0	0	0	1	1	1
IN1641.2	2	1	1	1	0	0	0	0	1	0	0	0	1	1	1
IN1641.3	2	1	1	1	0	0	0	0	0	0	0	0	1	1	1
IN1641.4	2	2	2	1	0	0	0	0	1	1	0	0	1	1	1
IN1641.5	2	2	2	1	0	0	0	0	1	1	0	0	1	1	1

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

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1641.1	2	1	1	1	0	0	0	0	0	0	0	1	1	1
IN1641.2	2	1	1	1	0	0	0	1	0	0	0	1	1	1
IN1641.3	2	1	1	1	0	0	0	0	0	0	0	1	1	1
IN1641.4	2	2	2	1	0	0	0	1	1	0	0	1	1	1
IN1641.5	2	2	2	1	0	0	0	1	1	0	0	1	1	1

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

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Course Code	IN 1642	Course category	MN
Course Name	ADVANCE PROGRAMMING IN PLC,DCS,SCADA		

Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	00	00	03	15	15	10	60	2hr30 min	00	00	100	03

Course Objectives:

Aim of the course is to:

I. To give knowledge of fundamentals concepts in PLC,DCS,SCADA
II. To give the programming languages knowledge of PLC,DCS,SCADA
III. To understand the integration and communication of PLC, DCS,SCADA
IV. To Explore and understand the applications of PLC ,DCS and Scada in plants
V. To study the case studies of plant automation by using the PLC,DCS,SCADA

Course Contents

PLC Programming Languages:

PLC architecture, ladder diagrams, ladder programming [LAD]and its features,a text based programming language Statement List [STL], graphicallangugae based Function Block Diagram [FBD], sequential Function Chart [SFC], Programming Examples

PLC Interfacing:

PLC Interfacing to AC and DC Drives/HMI/Hydraulic/Pneumatic/Motion control, Interfacing of VFD TO PLC, Interfacing to Pneumatic circuits, interfacing to hydraulic system Introduction of Motion control, different elements in motion control

DCS Configurations:

Distributed control system architecture, supervisory computer displays, set point stations , DCS programming and configuration , DCS control techniques, , DCS algorithm, DCS applications .Introduction to Object Linking and Embedding (OLE) for Process Control, application software, and Knowledge-based software

SCADA Configuration:

SCADAarchitecture,Development of SCADA, tag definition, alarms and trends, GUI Industrial Standards, Interfacing with MES.

Instrumentation Standard Protocols for Communication :

An introduction to network, Introduction to open system interconnection (OSI)model, overall fieldbus trends, Instrumentation Network Design, Fieldbus advantages and disadvantages, HART Network, Foundation Fieldbus Network, Modbus TCP/IP , Ethernet and TCP/IP based system

Text Books:

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1. Gary Dunning , "Introduction to Programmable Logic Controller", Cengage Learning India Pvt. Ltd., Third Edition, 2006 •
2. John W. Webb, "Programmable Logic Controllers", Prentice Hall, Fourth Edition, 1999
3. Dobrivoje Popovic, "Distributed Computer Control for Industrial Automation", Marcel Dekker, 1990

Reference Books:

1. B. G. Liptak , "Process Control, Instrument Engineering Hand book", Chilton Book Company, Third Edition, 1995

2. B. G. Liptak, "Process Software and Digital Networks", CRC Press. Third Edition 2000

3. Ronald L. Krutz," Securing SCADA System" 1st edition, Wiley Publishing, 2007.

4. Batten G. L., "Programmable Controllers", 2nd Edition, McGraw Hill Inc., 2004.

Course Outcomes

Upon successful completion of this course, students will be able to

IN1642.1 Explain the fundamentals concepts in PLC, DCS, SCADA
IN1642.2 Write the programs inprogramming languages of PLC, DCS, SCADA
IN1642.3 Interface PLC with pneumatic, hydraulic processes
IN1642.4 Configure PLC with DCS and / SCADA
IN1642.5 Configure, program the Automation with given process loops

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

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IN1642.1	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0
IN1642.2	2	3	2	1	3	0	0	0	0	0	0	0	2	3	1
IN1642.3	2	0	2	1	2	0	0	0	0	0	0	0	2	2	1
IN1642.4	2	3	2	1	2	0	0	0	0	0	0	0	2	2	1
IN1642.5	2	0	3	2	3	0	0	0	0	0	0	0	2	2	1

0:Not correlated 1:Weakly Correlated 2 :Moderately Correlated 3:Strongly Correlate

CO-PO-PSO mapping as per NBA Jul 2024 Format [w.e.f. from 01 Jan 2025]:

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
IN1642.1	3	0	0	0	0	0	0	0	0	0	0	0	3	0
IN1642.2	2	3	2	1	3	0	0	0	0	0	0	2	3	1
IN1642.3	2	0	2	1	2	0	0	0	0	0	0	2	2	1
IN1642.4	2	3	2	1	2	0	0	0	0	0	0	2	2	1
IN1642.5	2	0	3	2	3	0	0	0	0	0	0	2	2	1

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

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Course Code	IN 1631	Course category	PER
Course Name	RESEARCH PROJECT STAGE 2		

Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
00	00	08	08						100	00	100	04

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

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