तार : विश्वविद्यालय
Gram : UNIVERSITY

टेलीफोन : कार्या0 : 2320496
कुलसचिव : निवास : 2321214
फैक्स : 0510 : 2321667

बुन्देलखण्ड विश्वविद्यालय, झाँसी
BUNDELKHAND UNIVERSITY, JHANSI

झाँसी (उ.प्र.) 284128

संदर्भ BU/ACAD/2017/3115-3120 दिनाँक 14.08.2017

The Minutes of Meeting of BOS

In reference to the BOS of department of Electronics and Instrumentation and Institute of Engineering and Technology held on 14.08.2017 regarding the revision of syllabus in tune with CBCS/NEP-2020 and subsequent approval from Academic Council. This is to certify that the syllabus is 100% revised.

Registrar
Bundelkhand University
JHANSI

HOD/Coordinator
(Pradeep Verma
EIE, IET)

MINUTES CONSTITUTED MEETING OF BOARD OF STUDIES (BOS)

B.TECH. (ELECTRONICS & INSTRUMENTATION ENGINEERING)

Following a committee constituted with the approval of the Hon'ble Vice Chancellor meet on 15th December 2020, in the Electronics & Instrumentation Engineering department to discuss issues pertaining to Evaluation scheme and examiners panel of B.Tech. (Electronics & Instrumentation Engineering) department .

Committee members present:

1. Prof.Shiv Kumar Katiyar,Dean/Director , Institute of Engineering & Technology ,Bundelkhand University, Jhansi.
2. Er.Brijendra Shukla,Academic Coordinator, Institute of Engineering & Technology ,Bundelkhand University, Jhansi.
3. Er.Neha Jain, Coordinator, Department of Electronics & Instrumentation Engineering, Institute of Engineering & Technology, Bundelkhand University, Jhansi.
4. Er.Ikroop Kaur Verma , Internal member, Department of Electronics & Instrumentation Engineering , Institute of Engineering & Technology, Bundelkhand University , Jhansi

Agenda:

- To finalize examiners panel of B.Tech.(2nd ,3rd and 4th year) of Electronics & Instrumentation Engineering for the session 2020-21.
- To finalize the Evaluation scheme(Choice Based Credit System) of 3rd,4th,5th,6th,7th and 8th semester from batch 2019-20 of Electronics & Instrumentation Engineering.
- To modify the Evaluation scheme (Choice Based Credit System) of 5th ,6th ,7th and 8th semester of batch 2018-19 for department of Electronics & Instrumentation Engineering .

Minutes of meeting:

- Examiners panel of B.Tech. (2nd ,3rd and 4th year) of Electronics & Instrumentation Engineering for the session 2020-21 was put before the members of Board of Studies. Examiners panel for theory and practical of all the subjects in the curriculum were finalized for the session 2020-21.
- The Evaluation scheme(Choice Based Credit System) of 3rd, 4th, 5th, 6th,7th & 8th semester from batch 2019-20 of department of Electronics &Instrumentation Engineering were finalized(total marks per semester is 1000 without General Proficiency).
- The Evaluation scheme(Choice Based Credit System) of 5th ,6th ,7th and 8th semester of batch 2018-19 of department of Electronics & Instrumentation Engineering were modified (Sum of total marks of all semesters without General Proficiency is 8000)

15/12/2020

15-12-20

Dean/Director (IET)	Academic Coordinator (IET)	Coordinator (E&I)	Internal Member (E&I)
Prof.Shiv Kumar Katiyar	Er.Brijendra Shukla	Er.Neha Jain	Er.Ikroop Kaur Verma

Copy to:

1. P.S to Hon'ble Vice Chancellor for information please
2. Registrar

INSTITUTE OF ENGINEERING AND TECHNOLOGY

BUNDELKHAND UNIVERSITY, Jhansi

DEPARTMENT
OF
ELECTRONICS & INSTRUMENTATION
ENGINEERING.

SYLLABUS

2022-23

Vision & Mission of the Institute (IET)

Vision of Institute:

To emerge as an institution of excellence in engineering education and research that emphasizes on the human values, competence and professionalism integrated with the course curriculum as per global standards to serve the nation as well as the society with innovating mindset to take up any challenge they come across in industrial, scientific or academic fields within or outside the country.

Mission of Institute:

M1	To equip with the latest tools and equipment matching the state-of-art technologies to facilitate the academic and research activities at par with the best institutions.
M2	To inculcate a proper mix of creativity, innovation, competence, entrepreneurial leadership, and professionalism in the minds of the students so as to yield the internationally accepted best products.
M3	To provide proper ambiance for the teaching-learning system that preserves Universal human values, ethics, and morals to meet the aspirations of all the stake holders for sustainable development of the institute.
M4	To develop a potential pool of intellectuals and professionals that can serve any where efficiently in decision making and policy adoption according to the local, National and global needs.

Vision & Mission of the Department (E&IE)

Vision of E&IE Department

To supply industry-ready Electronics and Instrumentation engineers and entrepreneurs with right skills & knowledge for the contribution in the society.

Mission of E&IE Department

M1	To impart the students with the right theoretical and practical knowledge of Electronics Engineering as well as Instrumentation Engineering.
M2	To provide the students with the right skill set so that they can be accepted as global assets.
M3	To provide proper ambiance for effective interactions of students, faculty and management with the Electronics and Instrumentation Engineering industry personnel, alumni, academicians of premier Institutions and other stake holders for sustainable development of the department and its stake holders.
M4	To inculcate entrepreneurship and human values & ethics in the students for sustainable development of the society and the Engineering community.

PROGRAM OUTCOMES (PO) for IET

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review and analyze complex engineering problems from the research papers and literature, and there after reach substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate cultural, societal, and environmental considerations for public health and safety.
PO4: Conduct investigations of complex problems: Use research-based knowledge and methods including design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply to reason informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams and individual and in multidisciplinary settings relevant to the professional engineering practice.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12:Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM OUTCOMES (PO) for E&IE Dept.

On completion of the B. Tech degree the Electronics and Instrumentation Engineering, the graduates will be able to:

PO1: Engineering knowledge: - Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex Electronics and Instrumentation Engineering problems.

PO2: Problem analysis: - Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: - Design solutions for complex Electronics and Instrumentation Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: - Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: - Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: - Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: - Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: - Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: - Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: - Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: - Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12:Life-long learning: - Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological changes in the field of Electronics and Instrumentation.

PROGRAM SPECIFIC OUTCOMES (PSO) for E&IE Dept.

On completion of the B. Tech degree the Electronics and Instrumentation Engineering, the graduates will be able to attain the following program specific attributes in addition to 12 PO's mentioned:

PSO-1: Graduates of the program will be able to analyze real world engineering problems and able to design its solutions in the field of Electronics and Instrumentation engineering.

PSO-2: Graduates of the program will be able to design and develop systems/processes based on core concepts of Electronics and Instrumentation engineering to provide solution to multidisciplinary engineering problems.

PROGRAM EDUCATIONAL OBJECTIVES (PEO) for E&IE Dept.

PEO-1: Engineering Graduates must be experts in Electronics & Instrumentation fields both in the industry and academics by analyzing the requirement of society and applying their knowledge in a professional manner.

PEO-2: Engineering graduates must be able to effectively solve engineering problems and develop products through advanced research in Electronics & Instrumentation.

PEO-3: Engineering graduates must be capable of applying their knowledge both individually and as a part of a team and they must be able to effectively present the same through the required media.

PEO-4: Engineering Graduates must be capable of realizing the unwanted and hazardous impacts of their contributions and keep ethical and societal values and responsibilities before individual achievements.

PEO-5: Engineering Graduates must keep pace with the ongoing improvements and advancements in the field of Electronics & Instrumentation and not only incorporate but carry forward the same for entrepreneurship development.

Institute of Engineering and Technology

List of value added courses-

SEM -I	SEM-II
Photography	Cyber security & ethical hacking
Google Ads	Digital marketing
Goal Setting	Bio-CNG (Green Fuel)
SEM-III	**SEM-IV**
IELTS | IID	E- waste recycling business
Mushroom Cultivation Business	Advance Excel
Introduction to MATLAB	Mobile App Development
SEM-V	**SEM-VI**
Internet of things (IOT)	Marketing Content Writer
Bakery Technology	Milk Processing Business
Drone technology	Organic Waste Management

Note-

- ✓ The Students have to choose any one value added course in each semester from the list.
- ✓ The course will be of non - evaluative and non – credit in nature
- ✓ Each value-added course shall be of 30 hrs.

INSTITUTE OF ENGINEERING & TECHNOLOGY

BUNDELKHAND UNIVERSITY, JHANSI

STUDY AND EVALUATION SCHEME
YEAR I, SEMESTER-I
Common for all branches of B. Tech.

SN	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	MA-1841/ MA*-1842/ BT*-1852	Maths-I/ Elementary Mathematics-I /Remedial Biology-I/	3	1	0	30	20	50	100	150	4
2	ME-1850/CE-1851	Manufacturing Process/ Environment And Ecology	2	1	0	15	10	25	50	75	3
3	PH-1843	Engineering Physics-I	2	1	0	15	10	25	50	75	3
4	CY-1844/ ME-1845	Engineering Chemistry/ Engineering Mechanics	3	1	0	30	20	50	100	150	4
5	EC-1846/ CS-1847	Electrical Engineering/ Computer concepts and programming in C	3	1	0	30	20	50	100	150	4
6	EC -1848/ HU-1849	Electronic Engineering/ Professional Communication	3	1	0	30	20	50	100	150	4
PRACTICAL/TRAINING/PROJECT											
7	PH-10859/ HU-10860	Physics Lab/ Professional Communication Lab	0	0	2	10	10	20	30	50	1
8	CY-10853/ ME-10854	Engineering Chemistry/ Engineering Mechanics Lab.	0	0	2	10	10	20	30	50	1
9	WS-10857/ ME-10858	Workshop Practice/ Computer Aided Engg. Graphics Lab..	0	0	3	10	10	20	30	50	1
10	EE-10855/ CS-10856	Electrical Engineering Lab/ Computer Programming Lab.	0	0	2	10	10	20	30	50	1
11	10861/GP-101	General Proficiency	-	-	-	-	-	50	-	50	-
		Total	16	6	9	-	-	-	-	1000	26

Note:- *Elementary Mathematics is for the students who passed 10+2 examination with Biology and Remedial Biology is for the students who passed 10+2 with Mathematics (Only for the students of Biotechnology stream)

INSTITUTE OF ENGINEERING & TECHNOLOGY

BUNDELKHAND UNIVERSITY, JHANSI

STUDY AND EVALUATION SCHEME
YEAR I, SEMESTER-II
Common for all branches of B. Tech.

SN	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	*MA-1855/ 1856 BT-1866	Maths-II/Elementary Mathematics-II /Remedial Biology-II	3	1	0	30	20	50	100	150	4
2	ME-1859/HU-1858	Engg. Mechanics / Engineering Chemistry	3	1	0	30	20	50	100	150	4
3	PH-1857	Engineering Physics-II	2	1	0	15	10	25	50	75	3
4	EE-18/ HU-1863	Electronics Eng./Professional Communication	3	1	0	30	20	50	100	150	4
5	CS-1861/EE-1860	Computer Concepts and Programming in C/Electrical Engg.	3	1	0	30	20	50	100	150	4
6	CE-1865/ME-1864	Environment and Ecology/Manufacturing process	2	1	0	15	10	25	50	75	3
PRACTICAL/TRAINING/PROCT											
7	PH-10873/HU - 10874	Physics Lab/Professional Communication Lab	0	0	2	30	20	50	-	50	1
8	CS-10870/EE-10869	Computer Programming Lab/Electrical Engg. Lab	0	0	2	10	10	20	30	50	1
9	CE-10872/WS-10871	Computer Aided Engineering Graphics/Workshop Practice	0	0	3	10	10	20	30	50	1
10	ME-10868/CY - 10867	Engineering Mechanics Lab/Engg. Chemistry Lab	0	0	2	10	10	20	30	50	1
11	10875/GP - 201	General Proficiency	-	-	-	-	-	50	-	50	-
		Total	**16**	**6**	**9**	**-**	**-**	**-**	**-**	**1000**	**26**

NOTE : *Elementary Mathematics is for the students who passed 10+2 examination with Biology and Remedial Biology is for the students who passed 10+2 with Mathematics (Only for the students of Biotechnology stream

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI

STUDY AND EVALUATION SCHEME

B.Tech. (EIE) YEAR II, SEMESTER-III
[Effective from the session 2022-23]

SN	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	MA-301/2271	Mathematics-III	3	0	0	30	20	50	100	150	3
2	IC-301/2272	Fundamentals of Electronics Devices	3	0	0	30	20	50	100	150	3
3	IC-302/2273	Digital Electronics	3	0	0	30	20	50	100	150	3
4	IC-303/2274	Electromagnetic Field Theory	3	0	0	30	20	50	100	150	3
5	IC-304/2275	Fundamentals of Network Analysis & Synthesis	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
1	IC-351/20271	Electronics Engineering Lab-I	0	0	2	-	25	25	50	75	1
2	IC-352/20272	Digital Electronics Lab		0	2	-	25	25	50	75	1
3	IC-353/20273	Electronics Workshop & PCB Lab	0	0	2	-	40	40	60	100	1
4	GP-301/20274	General Proficiency (Non Credit)	-	-	-	-	-	50	-	50	0
		Total	15	0	6	-	-	-	-	1000	18

CT: Class Test, TA: Teacher Assessment, L: Lecture, T: Tutorial, P: Practical

Value Added Course:

1. **IELTS/IID** **2.Mushroom Cultivation Business** **3.Introduction to MATLAB**

- ✓ The Students have to choose any one value added course from the list.
- ✓ The course will be of non - evaluative and non – credit in nature.
- ✓ Each value-added course shall be of 30 hrs.

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI

STUDY AND EVALUATION SCHEME

B.Tech. (EIE) YEAR II, SEMESTER-IV
[Effective from the session 2022-23]

SN	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	OE-040-043 /2276-2279	**Open Elective-I** 1. Introduction to soft Computing(Neural Network, Fuzzy Logic & Genetic algorithm) 2. Numerical Methods 3. Data Structure using 'C' 4. Material Science	3	0	0	30	20	50	100	150	3
2	IC-401/2284	Electronic Circuits	3	0	0	30	20	50	100	150	3
3	IC-402/2289	Electrical Measurement & Measuring Instruments	3	0	0	30	20	50	100	150	3
4	IC-403/2286	Signal & Systems	3	0	0	30	20	50	100	150	3
5	IC-404/2288	Transducers & Signal Conditioning	3	1	0	30	20	50	100	150	4
PRACTICAL/TRAINING/PROJECT											
1	IC-451/20288	Electronics Engineering Lab-II	0	0	2	-	25	25	50	75	1
2	IC-452/20289	Transducers Lab	0	0	3	-	40	40	60	100	2
3	IC-453/20290	Measurement Lab	0	0	2	-	25	25	50	75	1
4	GP-401/20291	General Proficiency (Non Credit)	-	-	-	-	-	50	-	50	0
		Total	15	1	7	-	-	-	-	1000	20

CT: Class Test, TA: Teacher Assessment, L: Lecture, T: Tutorial, P: Practical

Value Added Course:

1. **E-Waste recycling business** **2.Advance Excel** **3.Mobile App development**

- ✓ The Students have to choose any one value added course from the list.
- ✓ The course will be of non - evaluative and non – credit in nature.
- ✓ Each value-added course shall be of 30 hrs.

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI

STUDY AND EVALUATION SCHEME

B.Tech. (EIE) YEAR III, SEMESTER-V
[Effective from the session 2022-23]

SN	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	IC-501/3271	Power Electronics	3	0	0	30	20	50	100	150	3
2	IC-502/3272	Integrated Circuits	3	0	0	30	20	50	100	150	3
3	IC-503/3273	Control Systems-I	3	0	0	30	20	50	100	150	3
4	IC-504/3274	Industrial Instrumentation & Measurement	3	1	0	30	20	50	100	150	4
5	IC-505/3275	Microprocessors	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
1	IC-551/30276	Integrated Circuits Lab	0	0	2	-	20	20	30	50	1
2	IC-552/30277	Control systems-I Lab	0	0	2	-	25	25	50	75	1
3	IC-553/30278	Instrumentation Lab	0	0	2	-	25	25	50	75	1
4	IC-554/30279	Microprocessor Lab	0	0	2	-	20	20	30	50	1
5	GP-501/30280	General Proficiency (Non Credit)	-	-	-	-	-	50	-	50	0
		Total	15	1	8	-	-	-	-	1000	20

CT: Class Test, TA: Teacher Assessment, L: Lecture, T: Tutorial, P: Practical

Value Added Course:

1. Internet of things (IOT) 2. Bakery Technology 3. Drone technology

- ✓ The Students have to choose any one value added course from the list.
- ✓ The course will be of non - evaluative and non – credit in nature.
- ✓ Each value-added course shall be of 30 hrs.

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI

STUDY AND EVALUATION SCHEME

B.Tech. (EIE) YEAR III, SEMESTER-VI
[Effective from the session 2022-23]

SN	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	IC-060-063 /3276-3279	**Departmental Elective-I** 1. Optoelectronics 2. Process Dynamics & Control 3. Digital Control System 4. Microwave Engineering	3	1	0	30	20	50	100	150	4
2	IC-601/3280	Electrical Machines	3	0	0	30	20	50	100	150	3
3	IC-602/3281	Microcontroller	3	0	0	30	20	50	100	150	3
4	IC-603/3282	Communication Engineering	3	0	0	30	20	50	100	150	3
5	IC-604/3283	Digital Signal Processing	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
1	IC-651/30284	Seminar	0	0	2	-	50	50	-	50	1
2	IC-652/30285	Communication Lab	0	0	2	-	20	20	30	50	1
3	IC-653/30286	Microcontroller Lab	0	0	2	-	25	25	50	75	1
4	IC-654/30287	DSP Lab	0	0	2	-	25	25	50	75	1
5	GP-601/30288	General Proficiency (Non Credit)	-	-	-	-	-	50	-	50	0
		Total	15	1	8	-	-	-	-	1000	20

CT: Class Test, TA: Teacher Assessment, L: Lecture, T: Tutorial, P: Practical

Value Added Course:

1. **Marketing Content Writer**
2. **Milk Processing Business**
3. **Organic Waste Management**

- ✓ The Students have to choose any one value added course from the list.
- ✓ The course will be of non - evaluative and non – credit in nature.
- ✓ Each value-added course shall be of 30 hrs.

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI

STUDY AND EVALUATION SCHEME

B.Tech. (EIE) YEAR IV, SEMESTER-VII
[Effective from the session 2022-23]

SN	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	OE-070-073 /4271-74	**Open Elective-II** 1. Operation Research 2. Advanced Sensors 3. Computer Organization & Architecture 4. Transducer	3	0	0	30	20	50	100	150	3
2	IC-070-073 /4275-4278	**Departmental Elective-II** 1. Optical Instrumentation 2. Power Plant Instrumentation 3. Artificial Neural Network 4. Fluid Mechanics	3	1	0	30	20	50	100	150	4
3	IC-701/4279	Control Systems-II	3	0	0	30	20	50	100	150	3
4	IC-702/4280	Data Acquisition &Transmission	3	0	0	30	20	50	100	150	3
5	IC-703/4281	Digital Measurement Techniques	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
1	IC-751/40282	Control System-II Lab	0	0	2	-	25	25	50	75	1
2	IC-752/40283	Data Acquisition & Transmission Lab	0	0	2	-	25	25	50	75	1
3	IC-753/40284	Industrial Training	0	0	4	-	20	20	30	50	2
4	IC-754/40285	Project (Minor)	0	0	4	-	50	50	-	50	2
5	GP-701/40286	General Proficiency (Non Credit)	-	-	-	-	-	50	-	50	0
		Total	15	1	12	-	-	-	-	1000	22

CT: Class Test, TA: Teacher Assessment, L: Lecture, T: Tutorial, P: Practical

Note-4 to 6 week Industrial training/Certified Course after VI semester exams to be evaluated in VII semester.

INSTITUTE OF ENGINEERING & TECHNOLOGY
BUNDELKHAND UNIVERSITY, JHANSI

STUDY AND EVALUATION SCHEME

B.Tech. (EIE) YEAR IV, SEMESTER-VIII
[Effective from the session 2022-23]

SN	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL	Credit
						SESSIONAL EXAM			ESE		
			L	T	P	CT	TA	TOTAL			
1	OE-080-083 /4286-4289	**Open Elective-III** 1. Non Conventional Energy Resources 2. Nano science 3. Embedded System 4. Computer Network	3	0	0	30	20	50	100	150	3
2	IC-080-083 /4290-4293	**Departmental Elective-III** 1. Computerized Process Control 2. Biomedical signal Processing 3. Analytical Instrumentation 4. Filter Design	3	1	0	30	20	50	100	150	4
3	IC-801/4295	Optimal Control Systems	3	0	0	30	20	50	100	150	3
4	IC-802/4296	Biomedical Instrumentation	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
1	IC-851/40298	Biomedical Instrumentation Lab	0	0	2	-	40	40	60	100	1
2	IC-852/40297	Project**	0	0	16	-	100	120	180	300	8
3	GP-801/40299	General Proficiency (Non Credit)	-	-	-	-	-	50	-	50	0
		Total	12	1	18	-	-	-	-	1000	22

CT: Class Test, TA: Teacher Assessment, L: Lecture, T: Tutorial, P: Practical

****Out of 16 periods, 06 periods per week should be allotted for interaction of group with project guide and 10 periods per week should be allotted for self studies and project work**

THEORY SEMESTER-3

Course Title	**MATHEMATICS-III**				
Course code	**MA-301/2271**				
Scheme and Credits	L	T	P	C	Semester III
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of Basic Engineering Mathematics				
Course Objectives	• To develop logical understanding of the subject. • To develop mathematical skill so that students are able to apply. Mathematical methods & principals in solving problem from engineering fields. • To make aware students about the importance and symbiosis between Mathematics and Engineering.				

Course Outcomes

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

CO1	Apply the fundamental concepts of Ordinary Differential Equations and Partial Differential Equations and the basic numerical methods for their resolution	Applying
CO2	Solve the problems choosing the most suitable method	Evaluating
CO3	Understand the difficulty of solving problems analytically and the need to use numerical approximations for their resolution	Understanding
CO4	Use computational tools to solve problems and applications of Ordinary Differential Equations and Partial Differential Equations	Applying
CO5	Formulate and solve differential equation problems in the field of Industrial Organization Engineering	Applying

Detailed Contents Mathematics-III MA-301/2271			
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	Analytic function, C-R equations, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic function, Taylor's and Laurent's series, singularities, Residue theorem, Evaluation of real integrals of the type $\int_0^{2\pi} f(Cos\,\theta, Sin\,\theta)\,d\theta$ and $\int_{-\infty}^{+\infty} f(x)\,dx$.	9	-
II	**Statistical Techniques - I** Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves etc., Correlation, Linear, non –linear and multiple regression analysis, Probability theory.	9	-
III	**Statistical Techniques - II** Binomial, Poisson and Normal distributions, Sampling theory (small and large), Tests of significations: Chi-square test, t-test, Analysis of variance (one way) , Application to engineering, medicine, agriculture etc. Time series and forecasting (moving and semi-averages), Statistical quality control methods, Control charts, $\bar{X}$, R, p, np, and c charts	9	-
IV	**Numerical Techniques – I** Zeroes of transcendental and polynomial equation using Bisection method, Regula-falsi method and Newton-Raphson method, Rate of convergence of above methods. Interpolation: Finite differences, difference tables, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals.	9	-
V	**Numerical Techniques –II** Solution of system of linear equations, Gauss- Seidal method, Crout method. Numerical differentiation, Numerical integration , Trapezoidal , Simpson's one third and three-eight rules, Solution of ordinary differential (first order, second order and simultaneous) equations by Euler's, Picard's and forth-order Runge-Kutta methods	12	-
	Total	**48**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	AUTHOR	TITLE
1	H K Das	Higher Engineering Mathematics
2	H K Das	A Textbook on Engineering Mathematics Vol-III
3	B.S. Grewal	Higher Engineering Mathematics, Khanna Publishers, 2005

Electronics materials, Web Site, etc: www.nptel.ac.in

Course Title	FUNDAMENTALS OF ELECTRONIC DEVICES				
Course code	IC-301/ 2272				
Scheme and Credits	L	T	P	C	Semester III
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of Semiconductor Physics				
Course Objectives	The objective of this course is to impart • To expose the students to Fundamentals Semiconductor Physics • To understand the Energy bands in PN Junction, BJT, FET and Electrical Characteristics. • To learn the Opto Electronic Devices, Quantum Mechanics, Tunneling, • To learn Types of Microwave Devices, Transit Time, Transferred Electron Devices • To Understand operation Power Electronic Devices				

Course Outcomes

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

CO1	Understanding Crystal Properties, Energy band Formations, Semiconductor Physics and Calculations of parameters associated with Semiconductors.	Introducing, Evaluating
CO2	Understanding Concept of Excess Charge, Diffusion, Carrier Lifetime Continuity Equation and Develop Diode Equation	Understanding
CO3	Understanding Formation of PN Junctions its properties and variations in Energy Bands with Biasing.	Understanding
CO4	Apply the Concepts to Understand Types of Transistors BJT, MISFET, and MESFET.	Applying
CO5	Understanding the Concept of Opto-Electronic Devices and Power Electronic Devices.	Understanding
CO6	Types Microwave Devices Tunnel Diode, Schottky Junction, Transit Time Devices, Transferred Electron Devices	Understanding

Detailed Contents Fundamentals of Electronic Devices IC-301/ 2272			
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Crystal Properties and charge Carriers in Semiconductors:** Elemental and compound carriers in semiconductors, carrier concentrations, drift of carriers in electric and magnetic fields.	9	-
II	**Excess Carriers in Semiconductors**: Optical absorption, luminescence, carrier life time and photo conductivity, diffusion of carriers.	6	-
III	**Junction Properties:** Equilibrium conditions, biased junctions, steady state conditions, reverse bias break down, transient and AC conditions .Metal semiconductor junctions.	9	-
IV	**Transistors:** Metal semi conductor-field-effect-transistors (MESFET), Metal-insulator-semiconductor-field-effect-transistors (MISFET), Metal oxide semiconductor field effect transistor (MOSFET): Construction, Operation and characteristics of above devices. Bipolar junction transistors: Fundamentals of BJT operation, amplification with BJTs,	9	-
V	**Some special devices**: Photodiodes, photo detectors, solar cell, light emitting diodes, semiconductor lasers, and light emitting materials. Tunnel Diode: degenerate semiconductors.IMPATT diode; the transferred electron mechanism: The GUNN diode. P-NP-N diode, semiconductor controlled rectifier (SCR), bilateral devices: DIAC, TRIAC, IGBT	12	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	AUTHOR	TITLE
1	B. G. Streetman and S. Banerjee	"Solid state electronics devices", 5th Edition, PHI.
2	S. M. SZE, KWOK K NG	"Physics of Semiconductor" Devices, 3rd Edition WILEY Publications
3	MillMan, Halkias	"Integrated Electronics", McGraw Hill Electrical and Electronic Engineering Series
4	Donald A Neamen	"Semiconductor Phuysics and Devices",4th Edition, Mc Graw Hill (Indian Edition)

Electronics materials, Web Site, etc: www.nptel.ac.in

Course Title	**DIGITAL ELECTRONICS**				
Course code	**IC- 302/2273**				
Scheme and Credits	L	T	P	C	Semester III
	3	0	0	3	
Pre-requisites (if any)	None. Desirable– Knowledge of Logic gates				
Course Objectives	The objective of this course is to impart • To Introduce with Binary Algebra Boolean Functions and Logic Gates • To understand the problem and solve it using Truth table and Boolean functions. • To learn the Designing Combinational and Sequential Circuits • To introduce Logic Families.				

Course Outcomes

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

CO1	Introducing Binary Number system and Arithmetic, Boolean algebra. Minimization schemes, Designing an Example and implement Using Basic logic Gates also Converting it Using Universal Gates.	Understanding
CO2	Designing SSI(Gate Level) circuits by Applying the concepts of Truth Table, K Map and logic Gates	Applying
CO3	Understand the Logic of Combinational Circuits and Design MSI circuits and PLDs	Applying
CO4	Understand the Logic of Sequential Circuits and Design them Using flip-flops by Applying Concept of Characteristics and Excitation Tables	Applying
CO5	Understand Various Logic Families on the Basis of Device Technologies. Also Compare their Electrical switching Characteristics.	Understanding
CO6	Understand the impairments associated with Digital Circuits Like Hazards, Glitches and Races and their Remedies.	Understanding

Detailed Content	**Digital Electronics IC- 302/2273**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	Digital system and binary numbers: Signed binary numbers, binary codes, cyclic codes, error detecting and correcting codes, hamming codes. Floating point representation Gate-level minimization: The map method up to five variable, don't care conditions, POS simplification, NAND and NOR implementation, Quine Mc-Clusky method (Tabular method).	10	-
II	**Combinational Logic**: Combinational circuits, analysis procedure, design procedure, binary adder-sub tractor, decimal adder, binary multiplier, magnitude comparator, decoders, encoders, multiplexers	8	-
III	**Synchronous Sequential logic:** Sequential circuits, storage elements: latches, flip flops, analysis of clocked sequential circuits, state reduction and assignments, design procedure. Registers and counters: Shift registers, ripple counter, synchronous counter, and other counters.	10	-
IV	**Memory and programmable logic:** RAM ROM, PLA, and PAL. Design at the register transfer level: ASMs, design example, design with multiplexers.	8	-
V	**Asynchronous sequential logic:** Analysis procedure, circuit with latches, design procedure, reduction of state and flow table, race free state assignment, hazards.	9	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	M. Morris Mano and M. D. Ciletti	"Digital Design", 6th Edition, Pearson Education
2	S. Salivahanan	"Digital Circuits and Design" , 5th Edition,Oxford University Press
3	A K Maini	"Digital Electronics",2019 Wiley
4	A. K. Singh	"Foundation of Digital Electronics & Logic Design," New Age Int. Publishers.
5	Hill & Peterson	"Switching Circuit & Logic Design", Wiley
6	A. Anand Kumar	" Fundamentals of Digital Circuits" 4th Edition,PHI
7	W.H. Gothmann	"Digital Electronics- An Introduction to Theory and Practice," PHI, 2nd edition, 2006.

Electronics materials, Web Site, etc: www.nptel.ac.in

Course Title	**ELECTROMAGNETIC FIELD THEORY**				
Course code	**IC-303/2274**				
Scheme and Credits	L	T	P	C	Semester III
	3	0	0	3	
Pre-requisites (if any)	None. Desirable– Knowledge of basic physics				
Course Objectives	The objective of this course is to impart • Electromagnetic theory is an essential basis for understanding the devices, methods, and systems used for electrical energy. • To impart knowledge about basic ideas of vector calculus, electrostatics, magneto statics and wave applications.				

Course Outcomes

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

CO1	Description of various coordinate systems and their applications in vector calculus.	Analysis
CO2	Explain the concept of electrostatics, current and energy stored in an electric field.	Understanding
CO3	Explain the concept of magneto statics and energy stored in a magnetic field.	Analysis
CO4	Explain the basic concepts of ground, space, sky wave propagation mechanism.	Analysis
CO5	Explain the transmission line theory.	Understanding

Detailed Contents	**Electromagnetic Field Theory IC-303/2274**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	Coordinate systems and transformation: Cartesian coordinates, circular cylindrical coordinates, spherical coordinates Vector calculus: Differential length, area and volume, line surface and volume integrals, del operator, gradient of a scalar, divergence of a vector and divergence theorem, curl of a vector and Stokes's theorem, Laplacian of a scalar.	10	-
II	Electrostatics: Electrostatic fields, Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses' Law – Maxwell's equation, Electric dipole and flux lines, energy density in electrostatic fields. Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, dielectric constants, continuity equation and relaxation time, boundary condition. Electrostatic boundary value problems: Poisson's and Laplace's equations, general procedures for soling Poisson's or Laplace's equations, resistance and capacitance, method of images.	10	-
III	Magneto statics: Magneto-static fields, Biot-Savart's Law, Ampere's circuit law, Maxwell's equation, application of ampere's law, magnetic flux density-Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential. Magnetic forces, materials and devices: Forces due to magnetic field, magnetic torque and moment, a magnetic dipole, magnetization in materials, magnetic boundary conditions, inductors and inductances, magnetic energy.	10	-
IV	Waves and applications: Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, displacement current, Maxwell's equation in final form. Electromagnetic wave propagation: Wave propagation in lossy dielectrics, plane waves in lossless dielectrics, plane wave in free space, plain waves in good conductors, power and the pointing vector, reflection of a plain wave in a normal incidence.	7	-
V	Transmission lines: Transmission line parameters, Transmission line equations, input impedance, standing wave ratio and power, The Smith chart, Some applications of transmission lines.	8	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	M. N. O. Sadiku	1. "Elements of Electromagnetic", 4th Ed, Oxford University
2	W. H. Hayt and J. A. Buck	2. "Electromagnetic field theory", 7th Ed., TMH.

Course Title	**FUNDAMENTALS OF NETWORK ANALYSIS AND SYNTHESIS**				
Course code	**IC-304/ 2275**				
Scheme and Credits	L	T	P	C	Semester III
	3	0	0	3	
Pre-requisites (if any)	None. Desirable– Knowledge of basic electrical theorems				
Course Objectives	The objective of this course is to impart • To develop an understanding of the fundamental laws and elements of electrical circuits. • To learn the energy properties of electric elements and the techniques to measure voltage and current.				

Course Outcomes

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

CO1	Understand the basic electrical circuits with nodal and mesh analysis. Study of steady state and transient analysis.	Understanding
CO2	Description of various network theorems. Apply Laplace transform for circuit analysis.	Analysis
CO3	Description of two port network and its parameters.	Understanding
CO4	Description of different network functions.	Analysis
CO5	Description and synthesis of various networks.	Evaluating

Detailed Contents	**Fundamentals of Network Analysis and Synthesis IC-304/ 2275**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	Signal analysis, complex frequency, network analysis, network synthesis General characteristics and descriptions of signals, step function and associated wave forms, The unit impulse Introduction to network analysis, network elements, initial and final conditions, step and impulse response, solution of network equations.	10	-
II	Review of Laplace transforms poles and zeroes, initial and final value theorems, the transform circuit, Thevenin's and Norton's theorems, the system function, step and impulse responses, the convolution integral. Amplitude and phase responses. Network functions, relation between port parameters, transfer functions using two port parameters, interconnection of two ports.	10	-
III	Hurwitz polynomials, positive real functions. Properties of real immittance functions, synthesis of LC driving point immittances, properties of RC driving point impedances, synthesis of RC impedances or RL admittances, properties of RL impedances and RC admittances.	10	-
IV	Properties of transfer functions, zeroes of transmission, synthesis of Y21 and Z21 with 1 termination.	7	-
V	Introduction to active network synthesis	8	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	M. E. Van Valkenberg	"Network Analysis", 2nd Edition, Prentice Hall of India Ltd
2	Charles Alexander and Sadiku Mathew	Fundamental of Electric circuit
3	D. Roy Chowdhary	Network and Systems

LABORATORY SEMESTER-3

Course Title	**ELECTRONICS ENGINEERING LAB-I**				
Course code	**IC-351/ 20271**				
Scheme and Credits	L	T	P	C	Semester- III
	0	0	2	1	
Pre-requisites (if any)	None. Desirable– Knowledge of Electronic Devices				
Course Objective	To attain expertise in lab equipment handling and understanding the basic devices, their properties, characteristics in detail. Along with their practical usage in the circuit.				

Course Outcomes

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

CO1	Demonstrate the operations of Millimeters, Electronic Component Testing On Bread Board.	Applying
CO2	Plotting VI Characteristics of PN Junction Diode, and Zener Diode. Using Voltmeters and Ammeters integrated on LAB kit.	Applying
CO3	Understanding Operation of CRO and Obtain/Trace Input and Output Waveforms of Rectifiers on it.	Understanding
CO4	Understand behavior of BJT and FET by plotting its Input and output characteristics	Understanding
CO5	Calculating h-Parameters of BJT using LAB kit and apply it for calculating gains and Impedances of amplifiers.	Evaluating
CO6	Understand the Behavior of Power Electronic Devices by plotting its VI Characteristics.	Understanding

Detailed Contents	**Electronics Engineering Lab – I IC-351/ 20271**
S.No.	**Practical**
1	Study of lab equipment's and components: CRO, Multi meter, Function Generator, Power supply, Active, Passive Components & Bread Board
2	P-N Junction Diode: Characteristics of PN Junction Diode-Static and dynamic resistance measurement from graph.
3	Applications of PN junction diode: Half & Full wave rectifier- Measurement of Vrms, Vdc, and Ripple factor-use of filter- ripple reduction (RC Filter)-Clipper & Clamper.
4	Properties of junctions Zener diode characteristics. Heavy doping alters the reverse characteristics. Graphical measurement of forward and reverse resistance.
5	Application of Zener diode: Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.
6	Characteristic of BJT: BJT in CB and CE configuration- Graphical measurement of h parameters from input and output characteristics. Measurement of Av, AI, Ro and Ri of CE amplifier with potential divider biasing.
7	Characteristic of FET: FET in common source configuration. Graphical measurement of its parameters gm, rd & gm from input and output characteristics.
8	Characteristic of silicon-controlled rectifier.
9	To plot V-I Characteristics of DIAC.
10	To draw V-I characteristics of TRIAC for different values of Gate Currents.

Course Title	**DIGITAL ELECTRONICS LAB**				
Course code	**IC- 352/ 20272**				
Scheme and Credits	L	T	P	C	Semester-III
	0	0	2	1	
Pre-requisites(if any)	None. Desirable– Knowledge of Digital Electronics				
Course Objectives	To understand the digital logic and create various systems by using these logics.				

Course Outcomes

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

CO1	Verify the Behavior (truth table) of Logic Gates and Satisfying Theorems.	Applying
CO2	Design Digital Circuits for Arithmetic Operations using Logic gates and verifying on Practical Kits in LAB containing Switches, LEDs and Supply voltages.	Applying
CO3	Designing Combinational (MSI) Circuits using SSI ICs. So that student Understand their Constructions.	Applying
CO4	Understanding Operations of MSI ICs like MUX, DECODER, Implementing ROM and other applications.	Understanding
CO5	Design and Verifying Flip flops using gates	Evaluating
CO6	Applying Flip flops for Designing Counters, Registers and State Machines	Applying

Detailed Contents	**Digital Electronics Lab IC- 352 / 20272**
S.No.	**Practical**
1	Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet, concept of Vcc and ground, verification of the truth tables of logic gates using TTL ICs.
2	Implementation of the given Boolean function using logic gates in both SOP and POS forms
3	Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.
4	Implementation and verification of Decoder/De-multiplexer and Encoder using logic gates.
5	Implementation of different types of multiplexer and demultiplexer using 16 to 1 line multiplexer and 1 to 16 line multiplexer4x1 multiplexer using logic gates
6	To verify the truth table of 4 -bit full adder and subtractor.
7	Design, and verify the truth table of 2 input half adder and half subtractor.
8	To verify the truth table of 4- bit synchronous and asynchronous counter.
9	Mini Project

Course Title	ELECTRONICS WORKSHOP & PCB LAB				
Course code	IC-353/20273				
Scheme and Credits	L	T	P	C	Semester III
	0	0	2	1	
Pre-requisites(if any)	None. Desirable– Knowledge of basic Electronics				
Course Objectives	• This course aims to provide Basic Electrical and Electronics Engineering concepts. • The main objective is to make the students able to understand, design and prepare electrical and electronics circuits using basic concepts.				

Course Outcomes

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

CO1	Design an electronic circuit starting with a given specification.	Creating
CO2	Conceive the optimum design out of many available options.	Applying
CO3	Determine values and specifications of the components required for a design.	Evaluating
CO4	Integrate a circuit on PCB to get a final product.	Applying
CO5	Examine the designed circuit to check its performance.	Analyzing

Detailed Contents	**Electronics Workshop & PCB Lab IC -353/20273**
S.No.	**Practical**
1	**Winding shop:** Step down transformer winding of less than 5VA.
2	**Soldering shop:** Fabrication of DC regulated power supply
3	**PCB Lab:** a) Artwork & printing of a simple PCB b) Etching & drilling of PCB.
4	**Wiring & fitting shop:** Fitting of power supply along with a meter in cabinet
5	Testing of regulated power supply fabricated.
6	Fabricate and test the audio amplifier circuit by using above power supply

THEORY SEMESTER-4

Course Title	**ELECTRONIC CIRCUITS**				
Course code	**IC-401/ 2284**				
Scheme and Credits	L	T	P	C	Semester IV
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of Basic Electronics				
Course Objectives	The objective of this course is to impart • To Introduce the Properties and Characteristics of Electronic Devices • To understand the Operations of BJT, FET, in various circuit configurations. • To Design Various Circuits using Op Amp IC 741. • To Apply the Circuit Configurations in Industrial and Communication Circuits				

Course Outcomes

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

CO1	Recognize the Electronic Circuit, functions of Devices the contained and uses.	Understanding
CO2	Classify Various Amplifiers based on their application and understand their characteristics and Design Parameters	Understanding
CO3	Understand the functioning of OP-AMP and design OP-AMP based circuits	Applying
CO4	Understand the frequency response of Various Amplifiers and their design by manipulating capacitances	Understanding
CO5	Understand the concept of negative feedback, their advantages and Applications.	Understanding
CO6	Design sinusoidal and non-sinusoidal oscillators.	Evaluating

Detailed Contents	**Electronic Circuits IC-401/ 2284**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Operational Amplifier:** Inverting and non-inverting configurations, difference amplifier, Effect of finite open loop gain and bandwidth on circuit performance, large signal operation of op-amp	8	-
II	**MOSFET:** Review of device structure operation and V-I characteristics. Circuits at DC, MOSFET as Amplifier and switch, Biasing in MOS amplifier circuits, small-signal operation and models, single stage MOS amplifier, MOSFET internal capacitances and high frequency model, frequency response of CS amplifier	9	-
III	**BJT**: Review of device structure operation and V-I characteristics, BJT circuits at DC, BJT as amplifier and switch, biasing in BJT amplifier circuit, small-signal operation and models, single stage BJT amplifier, BJT internal capacitances and high frequency model, frequency response of CE amplifier.	9	-
IV	**Differential Amplifier:** MOS differential pair, small signal operation of the MOS differential pair, BJT differential pair, other non-ideal characteristic of the Differential amplifier (DA), DA with active load.	9	-
V	**Feedback**: The general feedback structure, properties of negative feedback, the four basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, the shunt-shunt and shunt series feedback amplifier. **Oscillators:** Basic principles of sinusoidal oscillators, op-amp RC oscillator circuits, LC oscillator.	10	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	A. S. Sedra and K. C. Smith	"Microelectronic Circuits", Oxford University Press, 5th Ed
2	Jacob Millman, C, Halkias	Integrated Electronics, Second Edition TMH
3	Robert L Boylestad, L Nashelkky	"Electronic Devices and Circuit Theory", 10th Edition, Pearson Publication.

Electronics materials, Web Site, etc: www.nptel.ac.in

Course Title	ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS				
Course code	IC-402/ 2289				
Scheme and Credits	L	T	P	C	Semester IV
	3	0	0	3	
Pre-requisites(if any)	Basic Electrical Engineering				
Course Objectives	The objective of this course is • To know the necessity of different measuring instruments and their design principle. • To understand the working principle of different measuring instruments. • To learn the architecture and working principle of advanced measuring instrument and their applications.				

Course Outcomes

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

CO1	Understand the principle and working of various analog Electromechanical instruments and to design the instruments for extension in instruments range.	Understanding & Analyzing
CO2	Manifest the working of instruments like electronic voltmeter and ammeter, series ohmmeter, multi-meter, frequency meter.	Understanding
CO3	Analyze the bridges for the measurement of resistance, capacitance and inductance.	Analyzing
CO4	Understand the principle and working of various waveform generators, analyzers and display devices and analyze the phase and frequency by Lissajous pattern.	Analyzing
CO5	Demonstrate the working of instrument transformers.	Understanding

Detailed Contents	**Electrical Measurement and Measuring Instruments IC-402/2289**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Analog Measuring Instruments:** Classification of analog instruments, operating forces in indicating instruments, T/W ratio, pointers and scales. Working principle, theory, construction and salient features of electromechanical indicating / registering instrument viz. PMMC, Electrodynamometer, Moving iron, Rectifier type, Induction type for the measurement of dc and ac voltage, current, power, energy (1 -phase induction type wattmeter), power factor (single phase Electrodynamometer).	8	-
II	**Ammeter, Voltmeter and Ohmmeter**: galvanometer, DC ammeter, DC voltmeter, series ohm meter, AC electronic voltmeter, current measurement with electronic instruments, multi meter probes, digital multi meters.	8	-
III	**Measurement of Resistances:** Classification of resistances, measurement of medium resistance, Measurement of low resistance (Kelvin double bridge, Ammeter - Voltmeter) and Measurement of high resistance including loss of charge method and Mega ohm bridge method. **AC Bridges:** General theory of ac bridge, Measurement of self inductance, Measurement of capacitance, Measurement of mutual inductance, Measurement of frequency, Sources of error in ac bridges and their minimization.	8	-
IV	**Instrument Transformers:** Theory and construction of current and potential transformers, transformation ratio and phase angle errors and their minimization, effects of pf, secondary burden and frequency.	8	-
V	**Cathode Ray Oscilloscope:** Principle and working of CRO, Block diagram presentation of CRO and brief description of various elements of CRO – CRT, horizontal Deflecting system, Vertical deflecting system, CRO screen, Measurement of voltage, frequency and phase angle using CRO, CRO probes, DSO ,DSO Probe,Wave analyzer.	8	-
	Total	**40**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	A K Sawhney	Electrical and Electronics Measurements and Instrumentation,19th Edition,(2016)
2	H S Kalsi	Electronics Instrumentation and Measurements, 4th edition(March 2019)
3	Devid A Bell	Electronic Instrumentation and Measurements", Prentice Hall, Inc, New Delhi (2013)
4	W D Cooper	Electronic Instrumentation and Measurement Techniques", Prentice Hall, New Delhi ,2nd Edition

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

Course Title	SIGNALS AND SYSTEMS				
Course code	IC-403/2286				
Scheme and Credits	L	T	P	C	Semester IV
	3	0	0	3	
Pre-requisites (if any)	None. Desirable– Knowledge of basic elementary signals.				
Course Objectives	The objective of this course is to impart • To identify whether a given system exhibits these properties and its implication for practical systems. • To able to perform the process of convolution between signals and understand its implication for analysis of linear time-invariant systems.				

Course Outcomes

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

CO1	Analysis of different types of signals.	Analysis
CO2	Analysis and determination of Laplace and Z- transform of continuous and discrete time signals respectively.	Evaluating
CO3	Analysis and determination of Fourier transform of continuous and discrete time signals.	Analysis
CO4	Analysis of different types of systems. Determine the linearity, causality, time-invariance and stability properties of continuous and discrete time systems.	Analysis
CO5	Analysis of continuous and discrete systems in time and frequency domain.	Evaluating

Detailed Contents	**Signal and Systems IC-403/2286**		
Module	**Contents**	**L (Hours)**	**T (Hours)**
I	Signals: Definition, types of signals and their representations: continuous-time/discrete-time, periodic/non-periodic, even/odd, energy/power, deterministic/ random, one dimensional/multidimensional; commonly used signals (in continuous-time as well as in discrete-time): unit impulse, unit step, unit ramp (and their interrelationships), exponential, rectangular pulse, sinusoidal; operations on continuous-time and discrete-time signals (including transformations of independent variables).	11	-
II	Laplace-Transform (LT) and Z-transform (ZT): (i) One-sided LT of some common signals, important theorems and properties of LT, inverse LT, solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC) (ii) One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s-to z-plane mapping.	11	-
III	Fourier Transforms (FT):(i) Definition, conditions of existence of FT, properties, magnitude and phase spectra, Some important FT theorems, Parseval's theorem, Inverse FT, relation between LT and FT (ii) Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT.	10	-
IV	Systems: Classification, linearity, time-invariance and causality, impulse response, characterization of linear time-invariant (LTI) systems, unit sample response, convolution summation, step response of discrete time systems, stability. convolution integral, co-relations, signal energy and energy spectral density, signal power and power spectral density, properties of power spectral density,	7	-
V	Time and frequency domain analysis of systems: Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, system functions of CT systems, poles and zeros, block diagram representations; discrete-time system functions, block diagram representation, illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter.	7	-
	Total	**46**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	P. Ramakrishna Rao	`Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi
2	Chi-Tsong Chen	`Signals and Systems', 3rd Edition, Oxford University Press, 2004
3	V. Oppenheim	A.S. Willsky and S. Hamid Nawab, 'signals & System',PEARSON Education, Second Edition, 2003

Course Title	**TRANSDUCER & SIGNAL CONDITIONING**				
Course code	**IC-404/ 2288**				
Scheme and Credits	L	T	P	C	Semester IV
	3	1	0	4	
Pre-requisites(if any)	None. Desirable– Knowledge of basic physics				
Course Objectives	The objective of this course is to impart • To expose the students to various sensors & transducers for measuring mechanical quantities. • To understand the specifications of sensors and transducers. • To learn the basic conditioning circuits for various sensors & transducers. • To introduce advances in sensor technology.				

Course Outcomes

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

CO1	Recognize the transducer and sensors and their importance. Classify various transducers. List the specifications of the measuring instruments in terms of its performance Parameters.	Understanding
CO2	Distinguish among transducers, sensors and converters.	Analysing
CO3	List the criteria in the selection of instrumentation system for the desired measurement application.	Remembering
CO4	Identify the active and passive transducers with applications. Explain elastic transducers.	Understanding
CO5	Understand and become familiar with the sensors commonly used in industrial applications.	Evaluating
CO6	Understand the requirement of signal conditioning and methods.	Understanding

Detailed Contents	**Transducer & Signal Conditioning IC-404/ 2288**		
Module	**Contents**	**L(Hours)**	**T (Hours)**
I	Measurement systems, Basic electronic measuring system, Transduction principles, Classification of transducers, General transducers characteristics, Criteria for transducer selection.	9	-
II	**Resistive Transducers**: Principles of operation, construction, theory, advantages and disadvantages, applications of Potentiometers, strain gauges, (metallic and semi-conductor type), Resistance Thermometer, Thermistors. **Inductive Transducers**: Types of Inductive transducer, Principles of operation, construction, Advantages & disadvantages and applications. Various variable Inductive Transducers, LVDT (Linear variable differential transformer). **Capacitive Transducers**: Types of capacitive transducer, Principles of operation, construction, theory, advantages and disadvantages and applications, of capacitive transducers based upon familiar equation of capacitance. **Elastic Transducers**: Spring bellows, diaphragm, bourdon tube – their special features and application	12	-
III	**Active Transducers**: Principle of operation, construction, theory, advantages and disadvantages and applications of following transducers: Thermocouple, Piezo-electric transducer, Magneto-strictive transducer, Hall effect transducer, Photo-voltaic transducer and electrochemical transducer.	9	-
IV	**Other Transducers:** Optical transducers: photo-emissive, photo-conductive and Photo- voltaic cells, Digital Transducers: Optical encoder, Shaft encoder. Feedback fundamentals, introduction to Inverse transducer.	9	-
V	**Signal Conditioning**: Concept of signal conditioning, Introduction to AC/DC Bridges. Op - amp circuits used in instrumentation, Instrumentation amplifiers, analogue-digital sampling, introduction to A/D and D/A conversion, signal filtering, averaging, correlation, Interference, grounding , and shielding.	9	-
	Total	**48**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Ernest O Doebelin	Measurement Systems: Application and Design, 7th Edition.
2	D Patranabis	Sensors and Transducers, 2nd Edition.
3	DVS Murty	Transducers & Instrumentation, 2nd Edition ,2009
4	A K Sawhney	Electrical and Electronics Measurements and Instrumentation,19th Edition, (2016)

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

Course Title	**ELECTRONICS ENGINEERING LAB-II**				
Course code	**IC-451 /20288**				
Scheme and Credits	L	T	P	C	Semester IV
	0	0	2	1	
Pre-requisites(if any)	None. Desirable– Knowledge of Electronic Circuits.				
Course Objective	To design and implement the circuits to gain knowledge on performance of the circuit and its application's.				

Course Outcomes

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

CO1	Verify the operation of Operational Amplifier IC-741 , Its Calibration and Calculation of Parameters of Practical Op-Amps like CMRR and Slew Rate.	Evaluating
CO2	Designing and Verifying Applications Circuits of Op Amp.	Applying
CO3	Demonstrate the Operation and applications Small Signal Voltage Amplifiers Using BJT and FET	Understanding
CO4	Implementing Standard circuits using BJT and FET, like Differential Amplifier, Current Mirror, Level shifter, Darlington Pair, Push-pull.	Applying
CO5	Demonstrate the operations and Applications of various Power Amplifiers.	Evaluating
CO6	Implement and Understand various Sinusoidal and Relaxation Oscillators and Obtaining Their Output waveforms on CRO	Evaluating

Detailed Contents	**Electronics Engineering Lab-II IC-451/ 20288**
S.No.	**Practical**
1	Measurement of Operational Amplifier Parameters-Common Mode Gain, Differential Mode Gain, CMRR, Slew Rate.
2	Applications of Op-amp- Op-amp as summing amplifier, Difference amplifier, Integrator and differentiator
3	Field Effect Transistors- Single stage Common source FET amplifier –plot of gain in dB Vs Frequency, measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier
4	Bipolar Transistors- Design of single stage RC coupled amplifier –design of DC biasing circuit using potential divider arrangement –Plot of frequency Vs gain in dB. Measurement of bandwidth of an Amplifier, input impedance and Maximum Signal Handling Capacity of an amplifier.
5	Two stage Amplifier. Plot of frequency Vs gain. Estimation of Q factor, bandwidth of an amplifier
6	Common Collector Configuration-Emitter Follower (using Darlington pair)-Gain and input impedance measurement of the circuit.
7	Power Amplifiers-Push pull amplifier in class B mode of operation –measurement of gain.
8	Differential Amplifier –Implementation of transistor differential amplifier. Non ideal characteristics of differential amplifier
9	Oscillators -Sinusoidal Oscillators- (a) Wein-bridge oscillator (b) phase shift oscillator
10	Simulation of Amplifier circuits studied in the lab using any available simulation software and Measurement of bandwidth and other parameters with the help of simulation software.

Course Title	**TRANSDUCERS LAB**				
Course code	**IC-452/20289**				
Scheme and Credits	L	T	P	C	Semester IV
	0	0	3	2	
Pre-requisites(if any)	Desirable– Knowledge of basic Transducer and Sensor				
Course Objectives	• Introduce students to the principle of various Transducers, their construction, applications and principles of operation, standards and units of measurements. • Provide students with opportunities to develop basic skills in the design of electronic equipment.				

Course Outcomes

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

CO1	Examine the characteristics of potentiometric transducer, strain gauge and load cell	Analyzing
CO2	Examine the characteristics of LVDT, Hall effect transducer, LDR and Photoelectric tachometer.	Analyzing
CO3	Analyze the characteristics and step response of temperature transducer	Analyzing
CO4	Experiment with balancing of DC bridges	Evaluating
CO5	Experiment with balancing of AC bridges	Evaluating
CO6	Examine the errors through calibration of various meters.	Analyzing

Detailed Contents	**Transducers Lab IC-452/20289**
S.No.	**Practical**
1	To measure displacement using an LVDT (linear variable differential transformer)
2	To measure the temperature using thermocouple and to plot variation of temperature with the voltage
3	To measure the force using a full bridge strain gauge-based transducer
4	To measure the strain of a deflecting beam with the help of a strain gauge
5	To measure speed-using a proximity type sensor
6	To measure temperature using a thermistor and to plot variation of resistance with temperature
7	To study the recording of different signals from sensors on a magnetic tape recorders.
8	To study the acquisition data from strain gauge transducer using a data acquisition system
9	To study the acquisition of data from inductive transducer using a data acquisition system
10	To measure the vibrations of system using a piezoelectric crystal
11	To study the performance of an LCD, LED, BCD to 7-segment display
12	To measure a load using a load cell

Course Title	**MEASUREMENT LAB**				
Course code	**IC-453/20290**				
Scheme and Credits	L	T	P	C	Semester IV
	0	0	2	1	
Pre-requisites(if any)	None. Desirable– Knowledge of Electronic measurement technique				
Course Objective	• To know the procedures for measuring Resistance, Inductance and Capacitance of different ranges. • To perform experiments to measure three phase power, frequency, core losses. • To design experiments for calibration of energy meter. • To know the industrial practices of Measuring earth resistance, dielectric strength of transformer oil & Testing of underground cables.				

Course Outcomes

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

CO1	Understand the concepts of measurement, error and uncertainty.	Understanding
CO2	Understand the static and dynamic characteristics of measuring instruments.	Understanding
CO3	Gain knowledge about the principle of operation and Characteristics of different types of resistance, capacitance and inductance transducers.	Understanding
CO4	Acquire knowledge of analyzing different stages of signal conditioning units.	Applying
CO5	Ability to work as a member of a team while carrying out Experiments.	Applying

Detailed Contents	**Measurement Lab IC-453/20290**
S.No.	**Practical**
1	To measure amplitude and frequency of the signal using CRO (Y-t mode).
2	To measure frequency of an unknown signal and phase angle between two signals obtaining Lissajous pattern using a CRO.
3	Measurement of medium resistance with the help of a Wheatstone bridge.
4	Measurement of low resistance with the help of a Kelvin Double Bridge.
5	Measurement of high resistance using a Meggar .
6	Measurement of capacitance and inductance by Maxwell's Bridge.
7	Measurement of capacitance by Schering Bridge.
8	Measurement of frequency by Wein's Bridge.
9	To plot calibration curve for PMMC, Moving Iron and Electrodynamometer type of voltmeters.
10	To find Q-factor of the coil using series resonance method and verify it using LCR-Q meter.

OPEN ELECTIVE-I

Course Title	**INTRODUCTION TO SOFT COMPUTING(NEURAL NETWORKS, FUZZY LOGIC & GENETIC ALGORITHM)**				
Course code	**OE-040/2276**				
Scheme and Credits	L	T	P	C	Semester IV
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of basic computer				
Course Objectives	The main objective of the course is to expose the students to soft computing, various types of soft computing techniques, and applications of soft computing, upon completion of this course, the student should be able to get an idea on • Artificial Intelligence, Various types of production systems, characteristics of production systems. • Neural Networks, architecture, functions and various algorithms involved. • Fuzzy Logic, Various fuzzy systems and their functions. • Genetic algorithms, its applications and advances				
Course Outcomes On the successful completion of the course, students will be able to:					
CO1	Recall the functionality of human brain neurons and design the basic artificial model for neuron.				Understanding
CO2	Understand the various learning process for artificial neural model				Understanding
CO3	Construct the artificial neural model for pattern mapping, pattern recognition and pattern classification				Applying
CO4	Explain feed forward and feedback network for artificial neural network				Evaluating
CO5	Summarize the concept of artificial neural network and practical application of ANN.				Evaluating
CO6	Understand the concept genetic algorithm.				Understanding

Detailed Contents	**Introduction to Soft Computing OE-040/2276**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	Neural Networks-1(Introduction & Architecture) 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.	9	-
II	**Neural Networks-II (Back propagation networks) Architecture:** perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, applications.	10	-
III	**Fuzzy Logic-I (Introduction)** 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.	10	-
IV	**Fuzzy Logic –II (Fuzzy Membership, Rules)** Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzifications & Defuzzification's, Fuzzy Controller.	10	-
V	**Genetic Algorithm (GA)** Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.	9	-
	Total	**48**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Siman Haykin	Neural Networks, Prentice Hall of India
2	Kumar Satish	Neural Networks, Tata Mc Graw Hill
3	Timothy J. Ross	Fuzzy Logic with Engineering Applications, Wiley India

Electronics materials, Web Site, etc: www.nptel.ac.in,www.gateacademy.com

Course Title	**NUMERICAL METHODS**				
Course code	**OE -041/2277**				
Scheme and Credits	L	T	P	C	Semester IV
	3	0	0	3	
Pre-requisites (if any)	None. Desirable– Knowledge of basic Engineering mathematics				
Course Objectives	To provide the numerical methods of solving the non-linear equations, interpolation, differentiation, and integration.				
Course Outcomes On the successful completion of the course, students will be able to					
CO1	Compare the rate of accuracy between various methods and Approximating the root of the equation and distinguish among the criteria of section and procedures of various numerical integration rules.				Evaluating
CO2	Estimate the best fit polynomial for the given tabulated data using the methods of Newton's interpolation formulae and Lagrange's Interpolation.				Applying
CO3	Apply various numerical methods in solving the initial value problem involving the ordinary differential equations.				Applying
CO4	Estimate the unknown dependent variable using curve fitting methods				Applying
CO5	Generate the single valued functions in the form of Fourier series and obtained the Fourier Transforms				Evaluating

Detailed Contents	**Numerical Methods OE-041/2277**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	Roots of algebraic and transcendental equations, Bisection Method, Regula – Falsi method, Newton –Raphson method, Bairstow's method and Greeff's root squaring method. Solution of simultaneous algebraic equations, matrix inversion and Eigen-value problems, triangularization method, Jacobi's and Gauss-Seidel iteration method, partition method for matrix inversion, power method for largest Eigen-values and Jacobi's method for finding all Eigen-values.	9	-
II	Finite differences, interpolation and numerical differentiation, forward, backward and central differences, Newton's forward, backward and divided difference interpolation formulas, Lagrange's interpolation formula, Sterling's and Bessel's central difference interpolation formulas, numerical differentiations using Newton's forward and backward difference formulas and Numerical differentiations using Stirling's and Bessel's central difference interpolation formulas.	12	-
III	Numerical integration, Trapezoidal rule, Simpson's one-third rule and numerical double integration using Trapezoidal rule and Simpson's one-third rule.	9	-
IV	Taylor's series method, Euler's and modified Euler's methods, Runge -Kutta fourth order methods for ordinary differential equations, simultaneous first order differential equations and second order differential equations.	9	-
V	Boundary value problems, finite difference methods for boundary value problems. Partial differential equations, finite difference methods for elliptic, Parabolic and hyperbolic equations.	9	-
		48	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	S S Sastry	Introductionary Methods of Numerical Analysis, 3rd Edition
2	Grewal, B S	Numerical Methods", Khanna Publishers, Delhi
3	S C Chapra and R P Canale	Numerical Methods for Engineers, 2nd Edition, McGraw Hill Book Company, Singapore 1990.

Electronics materials, Web Site, etc: www.nptel.ac.in

Course Title	**DATA STRUCTURE USING 'C'**				
Course code	**OE- 042/2278**				
Scheme and Credits	L	T	P	C	Semester IV
	3	0	0	3	
Pre-requisites(if any)	Code Block Turbo C Compiler.				
Course Objectives	• To provide the basic knowledge of Data Structures and their implementations. • To understand importance of Data Structures in context of writing efficient program.				

Course Outcomes

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

CO1	Understand the concept of Dynamic memory management, data types, algorithms, analysis of algorithms by Asymptotic notations.	Understanding
CO2	Understand basic data structures such as arrays, linked lists, stacks and queues.	Understanding
CO3	Describe the hash function and concepts of collision and its resolution methods.	Understanding
CO4	Solve problem involving graphs, trees and heaps.	Applying
CO5	Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data in various data structures like linked list, stack, queue, graphs and tree.	Applying

Detailed Contents	**Data Structure Using 'C' OE- 042/2278**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Introduction to data structure and Algorithms:** Performance : Analysis of Algorithm, Time Complexity, Big-oh notation, Elementary data organization, data structure operations, Recurrences, Arrays, operations on arrays, representation of arrays in memory, single dimensional multidimensional arrays, Sparse matrices character storing in C, string operation.	12	-
II	**Statistics, Queues and Linked lists:** Stack operation, PUSH and POP, Array representation of stacks, operation associated with Slacks Application of stack, Recursion, Polish Notations, Representation of queues' operation on queues', Priority queues D-queues, Singly and circular linked in C, string operations. Lists implements.	9	-
III	**Tree:** Basic terminology, Binary trees representation, Algebraic expressions. Complete: Binary trees, extended binary trees, represent of binary trees in memory. Linked representation of binary trees, traversal of binary tree, Searching binary tree, searching algorithm, Heaps, threaded binary tree.	9	-
IV	**Graphs**: Terminology & representations of Graphs, types of graphs, Sequential Representation of graphs, adjacency metrics, transversal, connected component "Spanning trees, Minimum Cost Spanning Prisms and Kruskal Algorithm, BSF, DFS, Shortest path and transitive closure, Activity networks. Topological Sort and critical paths.	9	-
V	**Searching and Sorting**: Linear search ',' Binary Search, Internal and External Sorting, Bubble Sort, Insertion Sort, Quick Sort, Two ways merge Sort, Heap Sort, sorting on different' keys, practical J/consideration for internal soaring. External Sorting, Storage', Devices: Magnetic tapes Disk Storage, File organization and storage management.	9	-
		48	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Horowitz and Sahani	Fundamentals of data Structures
2	R. Kruse etal	Data Structures and Program Design in C
3	Adam Drozdek	Data Structures and Algorithms in C++", Thomson Asia Pvt. Ltd.(Singapore)

Electronics materials, Web Site, etc: www.nptel.ac.in

Course Title	**MATERIAL SCIENCE**				
Course code	**OE- 043/2279**				
Scheme and Credits	L	T	P	C	Semester IV
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of basic physics				
Course Objectives	To learn the principles of material testing and characterization and to apply them for various engineering applications.				
Course Outcomes On the successful completion of the course, students will be able to:					
CO1	Understand the basic concepts of bonds in metals and alloys, and To know the basic requirements for the formation of Solid solutions and other compounds.				Understanding
CO2	Identify the regions of stability of the phases that can occur in an alloy system.				Evaluating
CO3	Identify the differences between cast irons and steels, their Properties and practical applications.				Applying
CO4	Apply the concept of heat treatment of steels & strengthening mechanisms.				Applying
CO5	Identify the properties and applications of widely used non-ferrous metals and their alloys.				Evaluating

Detailed Contents Material Science OE -043/2279			
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Crystal Structure:** Fundamental concepts, Crystal systems, Closed packed structures, Crystallographic planes and directions, Miller indices, Crystal defects.	9	-
II	**Electrical Properties:** Classical free electron theory of metals, Quantum theory – Particle in a box, Wave function and energy states, Finite potential barrier, Tunneling, Fermi-Dirac distribution law, Density of energy states, Classification of solids into conductors, Semiconductors and insulators, Hall effect and its applications.	9	-
III	**Semiconductor Materials:** Intrinsic and extrinsic materials, Electron and hole concentrations at equilibrium, Temperature dependence of carrier concentrations, Conductivity and mobility.	9	-
IV	**Magnetic Properties:** Basic concepts, Soft and hard magnetic materials, Ferrites, Selection techniques for applications, Magnetic recording, Magnetic memories. **Superconductivity:** Properties of superconductors, London equations, Quantum explanation of superconductivity, Applications of superconductors.	9	-
V	**Dielectric & Optical Properties:** Dielectric materials, Polarization mechanisms, Dipole moment, Dielectric strength, Methods for producing polarization, Application of dielectric materials, Index of refraction, Damping constant, Characteristic penetration depth and absorbance, Reflectivity and transmissivity, Optical storage devices. **Nanomaterials:** Introduction to nanotechnology, Nanowire and nanotube, Carbon nanotubes, Single wall carbon nanotubes, Multiwall carbon nanotubes, Fabrications, Properties and applications.	12	-
		48	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Dekker A J	Solid State Physics, MacMillan, India Limited, Madras (2000)
2	Pillai S O	Solid State Physics, New Age International Publishers, New Delhi (1999)
3	Hummel R E	Electronic Properties of Materials, Narosa Publishing House, New Delhi (1997)

Electronics materials, Web Site, etc: www.nptel.ac.in

THEORY SEMESTER-5

Course Title	**POWER ELECTRONICS**				
Course code	**IC-501/ 3271**				
Scheme and Credits	L	T	P	C	Semester V
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of fundamental of electronics				
Course Objectives	• To impart knowledge about basic ideas, challenges, techniques, and applications of process control for controlling various processes. • To teach the fundamental aspects of process dynamics and control, which includes developing dynamic models of processes, control strategies for linear time-invariant systems and instrumentation aspects				

Course Outcomes

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

CO1	Recall the fundamental concepts of basic power electronics components like Diode, Transistor or BJT, UJT etc.	Understanding
CO2	Understanding of basic concepts of circuits used in power electronics.	Understanding
CO3	Demonstrate construction and working of different power electronics devices	Understanding
CO4	Differentiate between different power electronics devices such as different rectifiers, choppers, inverters, dual converters, cyclo-converters etc	Understanding

Detailed Contents	**Power Electronics IC-501/3271**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Introduction:** concept of power electronics, applications of power electronics, advantages and disadvantages of power electronics. **Diode Circuits and Rectifiers:** diode circuits with DC source, freewheeling diodes, single phase diode rectifiers.	10	-
II	**Thyristors:** thermal characteristics of thyristors, thyristor turn-on methods, switching characteristics of thyristors, thyristor gate characteristics, two transistor model of a thyristor, thyristor ratings, thyristor protection, series and parallel operation of thyristors. Thyristor Commutation Techniques: class A commutation: load commutation, class B commutation: resonant pulse commutation, class C commutation: complementary commutation, class D commutation: impulse commutation, class E commutation: external pulse commutation, class F commutation: line commutation	10	-
III	**Phase Controlled Rectifiers:** principle of phase control, full-wave controlled converters, single phase full-wave converters, three-phase converter systems using diodes, three-phase thyristor converter circuits, effect of source impedance on the performance of converters.	8	-
IV	**Choppers:** principle of chopper operation, control strategies, step-up choppers, types of chopper circuits, thyristor chopper circuits: voltage-commutated chopper, current-commutated chopper, load-commutated chopper.	8	-
V	**Inverters:** operating principle of single-phase voltage source inverters, force - commutated thyristor inverters, three-phase bridge inverters, voltage control in single phase inverters, PWM inverters, operating principle of current source inverters	8	-
	Total	**44**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Muhammad H. Rashid	Power Electronics | Devices, Circuits and Applications | Fourth Edition | Pearson Paperback – Picture Book, 28 November 2017
2	Ned Mohan, T.M.Undeland and W.P.Robbins,	Ned Mohan, T.M.Undeland and W.P.Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Ltd, 2008.
3	Robert W. Erickson	Fundamentals of Power Electronics Hardcover – Illustrated, 31 January 2001

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

Course Title	**INTEGRATED CIRCUITS**				
Course code	**IC-502 / 3272**				
Scheme and Credits	L	T	P	C	Semester V
	3	0	0	3	
Pre-requisites(if any)	Knowledge of Electronic Circuits and Digital Electronics				
Course Objectives	The objective of this course is to • Familiar in the operational amplifier principle- analysis- design and application. • Gain knowledge on the linear and nonlinear applications of operational amplifiers. • Understand the theory and applications of Active filters. • Develop skill to implement and analyze simple digital circuits using CMOS digital IC technology. • Familiar in the ADC- DAC and its classifications. • Understand the working and applications of special function ICs-555Timer IC and PLL.				

Course Outcomes

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

CO1	Explain complete analysis of Op-Amp 741 IC	Understanding
CO2	Illustrate linear and non- linear applications of Op-Amp	Understanding
CO3	Construct different types of filters	Analyzing
CO4	Implement digital circuits, logic gates and memory circuits using CMOS digital IC technology	Understanding
CO5	Gain knowledge about the working of data convertors along with the applications of special ICs such as 555 Timer and PLL	Understanding
CO6	Build multivibrators using 555 Timer IC	Analyzing

Detailed Contents	**Integrated Circuits IC-502/3272**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**IC Design Philosophy**: IC Biasing-Current Sources, Current Mirrors and Current Steering Circuits, The Cascode Amplifier, Current Mirror Circuits with Improved Performance, The 741 Op-Amp Circuit, DC Analysis of the 741, Small Signal Analysis of the 741 ,Gain, Frequency Response and Slew Rate of the 741: Small Signal Gain, Frequency Response, A Simplified Model, Slew Rate, Relationship Between f and SR.	8	-
II	**Linear Applications of IC op-amps:** An Overview of Op-Amp (ideal and non ideal) based Circuits V-I and I-V converters, generalized Impedance converter simulation of inductors. Filters: First and second order LP, HP, BP BS and All pass active filters, KHN, Tow-Thomas and State Variable Biquad filters; Sinusoidal oscillators .	8	-
III	**Digital Integrated Circuit Design-An Overview:** CMOS Logic Gate Circuits: Basic Structure CMOS realization of Inverters, AND, OR, NAND and NOR Gate Latches and Flip flops: The Latch, The SR Flip-flop, CMOS Implementation of SR Flip-flops, A Simpler CMOS Implementation of the Clocked SR Flip-flop, D flip-flop circuits.	8	-
IV	**Non-Linear applications of IC Op-amps:** Log–Anti Log Amplifiers, Precision Rectifiers, Peak Detectors, Simple and Hold Circuits, Analog Multipliers and their applications. Op-amp as a comparator, Zero crossing detector, Schmitt Trigger, Astable multivibrator, Monostable multivibrator, Generation of Triangular Waveforms	8	-
V	**A/D and D/A convertors.** **Integrated Circuit Timer:** The 555 Circuit, Implementing a Monostable Multivibrator Using the 555 IC, Astable Multivibrator Using the 555 IC. **Phase locked loops (PLL):** Ex-OR Gates and multipliers as phase detectors,block diagram of IC PLL and applications of PLL.	8	-
	Total	**40**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Sedra & Smith	Micro-Electronic Circuits , 7th Edition, Oxford University(2018)
2	Ramakanth A. Gayakwad	Op-Amps & Linear ICs ,Pearson(2015)
3	D. Roy Choudhury and Shail B. Jain	Linear Integrated Circuits - D. Roy Choudhury and Shail B. Jain,Forth edition(2018)
4	Jacob Milliman and Arvin Grabel	Microelectronics ,2nd Edition,TMH(2017)

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

Course Title	**CONTROL SYSTEMS-I**				
Course code	**IC-503 / 3273**				
Scheme and Credits	L	T	P	C	Semester V
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of Basic network system and engineering mathematics				
Course Objectives	• To introduce different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical system to construct equivalent electrical models for analysis. • To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system • Formulate different types of analysis in frequency domain to explain the nature of stability of the system.				

Course Outcomes

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

CO1	Describe the basics of control systems along with different types of feedback and its effect. Additionally, they will also be able to explain the techniques such as block diagrams reduction, signal flow graph.	Understanding
CO2	Explain the concept of state variables for the representation of LTI system.	Understanding
CO3	Interpret the time domain response analysis for various types of inputs along with the time domain specifications.	Evaluate
CO4	Distinguish the concepts of absolute and relative stability for continuous data systems along with different methods.	Understanding
CO5	Interpret the concept of frequency domain response analysis and their specifications.	Applying

Detailed Contents	**Control System-I IC-503/3273**		
Module	**Contents**	**L(Hours)**	**T (Hours)**
I	**Introduction:** Basic Components of a control system, Feedback and its effect, types of feedback control systems. Block diagrams and signal flow graphs, Modeling of Physical systems.	9	-
II	**State-Variable Analysis:** Introduction, Vector matrix representation of State equation, State Transition Matrix, State-Transition Equation, Relationship between State Equations and High-order Differential Equations, Relationship between State Equations and Transfer Functions.	9	-
III	**Time domain Analysis of Control Systems:** Time response of continuous data systems, typical test signals for the time response of control systems, the unit step response and time domain specifications, Steady-State error, Time response of a First order system, Transient response of a Prototype second order system.	9	-
IV	**Stability of Linear Control Systems:** Introduction, Bounded-Input Bounded-output Stability Continuous Data Systems, Zero-input and asymptotic stability of continuous data systems, Methods of determining stability, RH criterion	9	-
V	**Frequency Domain Analysis:** Introduction: Mrσr and Bandwidth of the Prototype Second Order System, Effects of Adding a zero to the Forward path, Effects of Adding a pole to the Forward Path, Nyquist Stability criterion, Relative Stability: Gain Margin and Phase Margin, Stability Analysis with the Bode Plot.	12	-
	Total	**48**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	B.C. Kuo	Automatic Control Systems, 9th Edition wiley Publications.
2	I.J. Nagrath& M .Gopal	Control System Engineering,6th Edn. , New Age Publishers,India

Electronics materials, Web Site, etc:www.nptel.ac.in

Course Title	**INDUSTRIAL INSTRUMENTATION AND MEASUREMENT**				
Course code	**IC-504 /3274**				
Scheme and Credits	L	T	P	C	Semester V
	3	1	0	4	
Pre-requisites(if any)	Knowledge of Electronic Circuits and Digital Electronics				
Course Objectives	• To expose the students to various sensors & transducers for measuring mechanical quantities. • To understand the specifications of sensors and transducers. • To learn the basic conditioning circuits for various sensors & transducers. • To introduce advances in sensor technology.				

Course Outcomes

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

CO1	Demonstrate measurement techniques for force, torque and speed.	Applying
CO2	Illustrate measurement techniques for acceleration & vibration.	Applying
CO3	Select a suitable instrument for measuring pressure and vacuum.	Remembering
CO4	Summarize various temperature measurement techniques.	Understanding
CO5	Identify special techniques for high temperature measurements.	Understanding
CO6	Analyze a suitable instrumentation system for various industries.	Analyzing

Detailed Contents	**Industrial Instrumentation and Measurement IC-504/3274**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Metrology:** Line and length standards, gauge, gauge block, mechanical, optical, pneumatic and electrical comparators, interferometer and flats, sine bar, review of displacement, velocity, acceleration and seismic pickups.	12	-
II	**Pressure Measurement:** Standards and calibration, Deadweight piston gauges and manometers, elastic transducers, bourdon tube, bellows and diaphragm, high pressure measurement, vacuum measurement-McLeod gauge, Knudsen gauge, thermal conductivity gauges, Pirani and lionization gauge.	8	-
III	**Temperature Measurement:** Measurement, Standards and calibrations, thermal expansion methods, bimetallic thermometers, filled in systems, their errors, thermoelectric sensors electric resistance sensors, junction semiconductor sensors, radiation pyrometer.	10	-
IV	**Flow Measurement:** Head type, area type, positive displacement type, mass flow meters vortex type, electrical type, Turbo magnetic, Electromagnetic, ultrasonic hot wire anemometer, flow marker, open channel flow metering, their working principle and applications.	8	-
V	**Other Variable measurements:** Mass, weight, force, torque and shaft power measurement, level measurement, Humidity and moisture measurement.	8	-
	Total	**46**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Ernest O Doebelin	Measurement Systems: Application and Design, 7th Edition.
2	D Patranabis	Sensors and Transducers, 2nd Edition.
3	DVS Murty	Transducers & Instrumentation, 2nd Edition ,2009
4	A K Sawhney	Electrical and Electronics Measurements and Instrumentation,19th Edition, (2016)

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

Course Title	**MICROPROCESSORS**				
Course code	**IC-505 / 3275**				
Scheme and Credits	L	T	P	C	Semester V
	3	0	0	3	
Pre-requisites (if any)	None. Desirable– Knowledge of Digital Electronics				
Course Objectives	The objective of this course is to impart • To expose the students to Stored Programme Control Concept • To Understand the Basic Architecture of a Microprocessor • To learn the basic and Advanced Programming in Assembly language for 8085 • To introduce interfacing Devices and advances Microprocessors.				

Course Outcomes

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

CO1	To Analyze the Functional Block Diagram of Intel's 8085 Microprocessors. And Learn its Pin Diagram with functions.	Analyzing
CO2	Understand Basic Fetch and Read/write operations with Timing diagram functions and Identifying Addressing modes in simple Instructions	Understanding
CO3	Learn to write Basic Program for 8085 in Assembly Language using Arithmetic Operations.	Learning
CO4	Evaluate Time Delay , Apply Call Return Concepts in Real Time Applications	Evaluating
CO5	Applying the Stack Subroutine and Call Return Concepts and Apply them in Modular program.	Applying
CO6	Understand Peripheral Devices and their Interfacing with 8085	Understanding

Detailed Contents	**Microprocessors IC-505/3275**		
Module	**Contents**	**L (Hours)**	**T (Hours)**
I	**Introduction to Microprocessor**, Microprocessor architecture and its operations, Memory, Input & output devices, Logic devices for interfacing, The 8085 MPU, Example of an 8085 based computer, Memory interfacing.	8	-
II	**Basic interfacing concepts**, Interfacing output displays, Interfacing input devices, Memory mapped I/O, Flow chart symbols, Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, Writing assembly language programs. Programming techniques: looping, counting and indexing.	9	-
III	**Additional data transfer and 16 bit arithmetic instruction,** Arithmetic operations related to memory. Logic operation: rotate, compare, counter and time delays. Illustrative program: Hexadecimal counter, zero-to-nine, (module ten) counter, generating pulse waveforms, debugging counter and time delay, Stack ,Subroutine, Restart, Conditional call and return instructions, Advance subroutine concepts, The 8085 Interrupts, 8085 vector interrupts.	10	-
IV	**Program:** BCD-to-Binary conversion, Binary-to-BCD conversion, BCD-to-Seven segment code converter, Binary-to-ASCII and ASCII-to-Binary code conversion, BCD Addition, BCD Subtraction, Introduction to Advance instructions and Application, Multiplication, Subtraction with carry.	9	-
V	8255 Programmable peripheral interface, interfacing keyboard and seven segment display, 8254 (8253) programmable interval timer, 8259A programmable interrupt controller, Direct Memory Access and 8237 DMA controller. Introduction to 8086 microprocessor: Architecture of 8086 (Pin diagram, Functional block diagram, Register organization)	9	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Ramesh Gaonkar	Microprocessor Architecture, Programming, and Applications with the 8085", 4th Edition, Penram International Publication (India) Pvt. Ltd
2	Douglas V. Hall	"Microprocessors and Interfacing", 2nd Edition, TMH, 2006
3	Barry B. Brey	"Intel Microprocessors ", Pearson Publication, 8th Edition
4	K Bhurchandi And A K Ray	"Advanced Microprocessors and Interfacing",3rd Edition , TMH

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

LABORATORY SEMESTER- 5

Course Title	**INTEGRATED CIRCUITS LAB**				
Course code	**IC-551 / 30276**				
Scheme and Credits	L	T	P	C	Semester V
	0	0	2	1	
Pre-requisites (if any)	Electronic Circuits and Digital Electronics				
Course Objectives	To design and implement the circuits to gain knowledge on performance of the circuit and its application. These circuits should also be simulated on P spice.				

Course Outcomes

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

CO1	Design and analyze the various linear applications of Op-Amp.	Analyzing
CO2	Design and analyze the various non-linear applications of Op-Amp.	Analyzing
CO3	Design and analyze Filter circuits using op-amp.	Analyzing
CO4	Design and analyze the various applications of 555 timers.	Analyzing
CO5	Explain the working of A/D and D/A converters.	Understanding

Detailed Contents	**Integrated Circuits Lab IC-551 / 30276**
S.No.	**Practical**
1	Measurement of op-amp parameters (open loop gain, input offset voltage, CMRR, Slew rate)
2	Applications of Op-amp- Op-amp as summing amplifier, Difference amplifier, Integrator and differentiator
3	Voltage comparator and zero crossing detectors
4	Operational amplifier as a Schmitt trigger
5	Operational amplifier as a Logarithmic amplifier
6	Second order filters using operational amplifier for–
a	Low pass filter of cutoff frequency 1 KHz
b	High pass filter of frequency 12 KHz.
c	Band pass filter with unit gain of pass band from 1 KHz to 12 KHz
7	To study Phase Lock Loop
8	A/D and D/A convertor
9	Voltage to current and current to voltage convertors
10	Astable and mono stable multi vibrator using IC 555

Course Title	**Control System-I Lab**				
Course code	**IC-552/ 30277**				
Scheme and Credits	L	T	P	C	Semester V
	0	0	2	1	
Pre-requisites(if any)	None. Desirable– Knowledge of basic control system				
Course Objectives	Classify and evaluate the performance parameters of a system and then with simulation prepare an advance tool to modify the values of the parameter of the system in order to meet the desired need.				

Course Outcomes

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

CO1	Classify different tools in MATLAB along with the basic matrix operations used in MATLAB	Understanding
CO2	Evaluate the poles and zeros on s-plane along with transfer function of a given system.	Evaluating
CO3	Construct state space model of a linear continuous system.	Applying
CO4	Evaluate the various specifications of time domain response of a given system.	Evaluating
CO5	Evaluate the various specifications of frequency domain response of a given system.	Evaluating

Detailed Contents	**Control System-I Lab IC-552/30277**
S.No.	**Practical**
1	To study open loop response of the process.
2	Study of on-off controller.
3	Study of P control action using the software.
4	Study of PI control action using the software.
5	Study of PID control action using the software.
6	Study of the Industrial PID controller as on/off controller.
7	Study of the Industrial PID controller as P controller.
8	Study of the Industrial PID controller as PI controller.
9	Study of the Industrial PID controller as PID controller.
10	**Introduction to MATLAB (Control System Toolbox), Implement at least any two experiment in MATLAB.**
a	Different Toolboxes in MATLAB, Introduction to Control Systems Toolbox.
b	Determine transpose, inverse values of given matrix
c	Plot the pole-zero configuration in s-plane for the given transfer function.
d	Determine the transfer function for given closed loop system in block diagram representation.
e	Plot unit step response of given transfer function and find peak overshoot, peak time.
f	Plot unit step response and to find rise time and delay time.
g	Plot locus of given transfer function, locate closed loop poles for different values of k.
h	Plot root locus of given transfer function and to find out S, Wd, Wn at given root & to discuss stability.
i	Plot bode plot of given transfer function.
j	Plot bode plot of given transfer function and find gain and phase margins
k	Plot the Nyquist plot for given transfer function and to compare their relative stability
l	Plot the Nyquist plot for given transfer function and to discuss closed loop stability, gain and Phase margin.

Course Title	**INSTRUMENTATION LAB**				
Course code	**IC-553 / 30278**				
Scheme and Credits	L	T	P	C	Semester V
	0	0	2	1	
Pre-requisites(if any)	None. Desirable– Knowledge of transducer.				
Course Objectives	• Understand the measurement techniques for physical variables. • Able to analyze the suitable instrumentation system for various industries.				

Course Outcomes

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

CO1	Analyze instrumentation amplifier, active filters, regulated power supply/I and I/V converters	Analyzing
CO2	Examine the signal conditioning circuit for thermocouple, strain gauge and RTD	Analyzing
CO3	Analyze control valve, orifice plate and rotameter	Analyzing
CO4	Inspect P & ID controller	Analyzing
CO5	Summarize P & ID for industrial processes	Understanding

Detailed Contents	**Instrumentation Lab IC-505/30278**
S.No.	**Practical**
1	Instrumentation Amplifier: Design for specific gain and verification of CMRR.
2	Study the RTD calibration.
3	Study of Storage Oscilloscope & Transient response of RLC.
4	To study & observe the characteristics of Photoconductive Cell.
5	Study of Characteristics of a Strain Gauge.
6	Construction of chopper amplifier.
7	Study of low noise and low frequency amplifier for biomedical application
8	To study & implement Light intensity control using PWM.
9	Study of Capacitive and Inductive Pressure pickups.
10	Study of Piezoelectric transducer.

Course Title	**MICROPROCESSORS LAB**				
Course code	**IC-554 /30279**				
Scheme and Credits	L	T	P	C	Semester V
	0	0	2	1	
Pre-requisites(if any)	None. Desirable– Knowledge of Assembly Language Programming for 8085				
Course Objective	• To make students familiar with Operations of 8085 Microprocessor unit. • Understand assembly language program of and convert its OPCODES • LOAD, RUN and CHECK the RESULT memory Contents				

Course Outcomes

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

CO1	Introduction to MPU Kit, Procedure of LOAD EXECUTE and CHECK RESULT using an Example	
CO2	Writing ALP for Addition Subtraction operations for 8085, Obtaining its Opcodes and Execute on MPU	
CO3	Understand and implement JMP and CALL instructions for Looping and verify its Examples	
CO4	Calculate and implement DELAY subroutine and apply it in Practical Applications	
CO5	Understand and implement STACK and Subroutine in ALPs and verify its Examples	
CO6	Understand and Demonstrate the Interfacing of Peripheral Devices.	
CO7	Use of Simulators for 8085 programs on PC	

Detailed Contents	**Microprocessor Lab IC-554/30279**
S.No.	**Practical**
1	Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers.
2	Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers
3	To perform multiplication and division of two 8 bit numbers using 8085.
4	To find the largest and smallest number in an array of data using 8085 instruction set.
5	To write a program to arrange an array of data in ascending and descending order.
6	To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085 instruction set.
7	To write a program to initiate 8251 and to check the transmission and reception of character.
8	To interface 8253 programmable interval timer to 8085 and verify the operation of 8253 in six different modes.
9	To interface DAC with 8085 to demonstrate the generation of square, saw tooth and triangular wave.
10	Serial communication between two 8085 through RS-232 C port.

THEORY SEMESTER-6

Course Title	**ELECTRICAL MACHINES**				
Course code	**IC-601 /(3280)**				
Scheme and Credits	L	T	P	C	Semester VI
	3	0	0	3	
Pre-requisites (if any)	None. Desirable– Knowledge of basic physics, Faradays Law.				
Course Objectives	• The objective of this course is to impart • To introduce the concepts of ideal synchronous machines and poly-phase induction machines. • Applications which will be utilized in the electrical machines with its performance and theory of operation. • Study of special machines				

Course Outcomes

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

CO1	Explain the theory of ideal synchronous machines and, basic machine relation.	Understanding
CO2	Analyze and apply the concept of steady state analysis and electrical transients in polyphase machines	Analyzing
CO3	Examine the starting and running performance of single phase induction motor and revolving field theory.	Analyzing
CO4	Make use of various speed control system for AC motors.	Applying
CO5	Evaluate the basic operation and performance of special machines and can select special machines for different purpose	Evaluating

Detailed Contents	**Electrical Machines (IC-601/3280)**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Basic concept of rotating machines:** Elementary machines –synchronous machines, dc machine, generated emf , rotating magnetic field, torque in round rotor machines. Operations of Basic Machine types – synchronous, asynchronous, ac machines, dc machines, matching characteristics of electric machines and load.	9	-
II	**DC Machine:** Introduction, emf equation, torque equation, power balance, linear magnetization, circuit model, generating mode ,motoring mode, armature reaction, compensating winding, commutation, method of excitation, characteristics of dc shunt, series and compound motors and generators. Starting of dc motor, speed control of dc motor, breaking of dc moto	10	-
III	**Synchronous machines:** Introduction of basic synchronous machine model, circuit model of synchronous machine, determination of armature reaction ampere turn and leakage reactance of synchronous machine, synchronizing to infinite bus bar, operating characteristics ,power flow equations, parallel operation of synchronous generators ,hunting in synchronous machines.	9	-
IV	**Induction Motor:** Introduction, construction, flux and mmf phasor in induction motors, slip and frequency of rotor currents, rotor emf, power, induction motor phasor diagram, torque slip characteristics, determination of equivalent circuit parameters, circle diagram, starting of induction motor, speed control.	9	-
V	**Single Phase Motors:** Introduction, types of single phase motor, single phase induction motor, split phase motors, single phase commutator motor, single phase synchronous motor, stepper motor.	9	-
	Total	**46**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	D P Kothari & I J Nagrath	"Electric Machines", Tata McGraw Hill Education Pvt Ltd, 3rd Edition,2004
2	A. Fitzgerald, C. Kingsley and S Umans ,	"Electric Machinery", Tata McGraw Hill Education Pvt Ltd, 6th Edition, 2002.
3	P.S. Bimbhra	"Electrical Machine I" 1st Edition 2021, Khanna Publicatons

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

Course Title	**MICROCONTROLLER**				
Course code	**IC-602/ (3281)**				
Scheme and Credits	L	T	P	C	Semester VI
	3	0	0	3	
Pre-requisites (if any)	None. Desirable– Knowledge of Microprocessors				
Course Objectives	The objective of this course is to impart • To Analyze the Architecture of 8051 Microcontroller and Memory organization. • To Understand the Assembly Language Programming for 8051 • To Interface 8051 with sensors and input devices • To Interface 8051 with displays and Motors.				

Course Outcomes

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

CO1	Demonstrate the basic architecture of 8051 and pin functions	Demonstrate
CO2	Illustrate the programming model and RAM organization of microcontroller	Understanding
CO3	Illustrate Addressing modes and Basic instructions which enable writing assembly language programs.	Understanding
CO4	Demonstrating Operations and Functions of Displays like LCD, LED and Switches and keyboards	Applying
CO5	Demonstrate functions of Motors, Relays and RTCs and implement their Coding in ALP for 8051	Evaluating
CO6	Illustrate the interfacing of 8051 and implement them to design projects on real time problems	Applying

Detailed Contents	**Microcontroller (IC-602/3281)**		
ModuleS	**Contents**	**L (Hours)**	**T (Hours)**
I	Introduction, Microcontrollers and Embedded processors, Overview of the 8051, Inside the 8051, Addressing modes.	8	-
II	Introduction to 8051 assembly programming, Assembling and running an 8051 program, The program counter and ROM space in the 8051,8051 data types and directives, 8051 flag bits and the PSW register,8051 register banks and stack, 8051 I/O programming, I/O bit manipulation programming.	9	-
III	Programming the 8051 timers, Counter programming, Basics of serial communications, 8051 connection to RS-232, 8051 serial port programming assembly, 8051 interrupts, Programming timer interrupts, programming external hardware interrupts, programming the Serial communication interrupts, Interrupts priority in the 8051.	10	-
IV	Interfacing with 8051: Memory address decoding 8031/ 51 interfacing with external ROM, 8051 data memory space, LCD, Keyboard, Parallel and Serial ADC, DAC interfacing, Sensor interfacing and Signal Conditioning, Stepper motor and DC motor	12	-
V	Programming the 8255 and Interfacing, Introduction to Intel 8096 andMC68HC11 microcontroller.	9	-
	Total	**48**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Mazidi Ali Muhammad, Mazidi Gillispie Janice, and McKinlay Rolin D	The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson, 2nd Edition.
2	Ayala Kenneth	, "The 8051 Microcontroller", Cengage Learning, 3rd Edition
3	Chhabra Bhupendra Singh	"Microcontrollers & its Applications" Dhanpat Rai Publishing Company
4	Ghoshal Subrata	" 8051 Microcontroller Internals, Instructions, Programming and Interfacing"Pearson

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

Course Title	**COMMUNICATION ENGINEERING**				
Course code	**IC-603/ (3282)**				
Scheme and Credits	L	T	P	C	Semester VI
	3	1	0	4	
Pre-requisites (if any)	None. Desirable– Knowledge of Signals and Systems				
Course Objectives	The objective of this course is to impart • To expose the students to classifications of Analog Modulation Techniques • To understand the Transmitters and Receivers and Noise performances • To learn the Pulse modulation Techniques, Source & Waveform Coding • To introduce Digital Modulation Techniques and Multiplexing				

Course Outcomes

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

CO1	Classify the signals and Understand their mathematical analysis. Spectrum plot	Understanding
CO2	Analyze and compare different analog modulation schemes for their efficiency and bandwidth	Analysing
CO3	Analyze the behavior of a communication system in presence of noise	Analysing
CO4	Investigate pulsed modulation system and analyze their system performance.	Investigating
CO5	Investigate various multiplexing techniques.	Investigating
CO6	Evaluate different digital modulation schemes and compute the bit error performance.	Evaluating

Detailed Contents	**Communication Engineering (IC-603/ (3282)**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Introduction:** The Communication Process, The Layered Approach, and Example of communication. Amplitude Modulation: Introduction, Amplitude modulation, Double Sideband-Suppressed Carrier modulation, Quadrature-Carrier Multiplexing, Single-Sideband and Vestigial-Sideband Methods of modulation, VSB Transmission of Analog and Digital Television, Frequency Translation, Frequency-Division Multiplexing	10	-
II	**Phase and Frequency Modulation:** Introduction, Basic Definitions, Frequency Modulation, Phase-Locked Loop, Nonlinear Effects in FM Systems, The Super-heterodyne Receiver, Analog and Digital FM Cellular Telephone	8	-
III	**Noise in Analog Modulation:** Introduction, Receiver Model, Noise in DSB-SC Receivers, Noise in AM receivers, Noise in FM Receivers, Pre-emphasis and De-emphasis in FM Digital Representation of Analog Signals: Introduction, Digitization of Analog Sources, The Sampling Process ,Pulse-Amplitude Modulation, Time-Division Multiplexing, Pulse-Position Modulation, PPM in Impulse Radio, The Quantization Process, Pulse-Code Modulation, Delta Modulation, Digitization of Video and MPEG.	10	-
IV	**Base band Transmission of digital Signals:** Introduction, Baseband Pulses and matched Filter Detection, Probability of Error Due to Noise, Inter symbol Interference, Eye Pattern, Nyquist Criterion for Distortion less Transmission, Baseband M-array PAM Transmission, Tapped Delay Line Equalization, Transmission of 100 Mbps Over Twisted Pair	8	-
V	**Band-Pass Transmission of Digital Signals:** Introduction, band-Pass Transmission Model, Transmission Binary PSK and FSK, M-array Data Transmission Systems, Comparison of Noise Performances of various PSK and FSK Systems, Orthogonal Frequency Division Multiplexing (OFDM). Information and Forward Error Correction: Introduction, uncertainty, Information and Entropy, Source-Coding Theorem, Lossless Data Compression	10	-
	Total	**46**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Simon Haykin & Michael Moher	"Communication Systems", 5th Edition, Wiley India Publication.
2	B.P. Lathi & Zhi Ding	" Modern Digital and Analog Communication Systems" I
3	R.P. Singh & S.D. Sapre	"Communication Engineering", TMH Publications

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

Course Title	**DIGITAL SIGNAL PROCESSING**				
Course code	**IC-604 /(3283)**				
Scheme and Credits	L	T	P	C	Semester VI
	3	0	0	3	
Pre-requisites (if any)	None. Desirable– Knowledge of Basics Signals & Systems				
Course Objectives	• To make students aware about the meaning and implications of the properties of systems and signals • To make students familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors.				

Course Outcomes

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

CO1	Design and describe different types of realizations of digital systems (IIR and FIR) and their utilities.	Evaluating
CO2	Select design parameters of analog IIR digital filters (Butterworth and Chebyshev filters) and implement various methods such as impulse invariant transformation and bilinear transformation of conversion of analog to digital filters.	Applying
CO3	Design FIR filter using various types of window functions	Evaluating
CO4	Define the principle of discrete Fourier transform & its various properties and concept of circular and linear convolution. Also, students will be able to define and implement FFT i.e. a fast computation method of DFT.	Understanding
CO5	Define the concept of decimation and interpolation. Also, they will be able to implement it in various practical applicati.	Understanding

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Detailed Contents	**Digital Signal Processing IC-604 / 3283**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Realization of Digital Systems:** Introduction, direct form realization of IIR systems, cascade realization of an IIR systems, parallel form realization of an IIR systems, Ladder structures: continued fraction expansion of H(z), example of continued fraction, realization of a ladder structure, example of a ladder realization.	10	-
II	**Design of Infinite Impulse Response Digital Filters:** Introduction to Filters, Impulse Invariant Transformation, Bi-Linear Transformation, All-Pole Analog Filters: Butterworth and Chebyshev Design of Digital Butterworth and Chebyshev Filters.	9	-
III	**Finite Impulse Response Filter Design:** Windowing and the Rectangular Window, Other Commonly Used Windows, Examples of Filter Designs Using Windows, The Kaiser Window.	9	-
IV	**Discrete Fourier Transforms:** Definitions, Properties of the DFT, Circular Convolution, Linear Convolution.	9	-
V	**Fast Fourier Transform Algorithms:** Introduction, Decimation –In Time (DIT) Algorithm, Computational Efficiency, Decimation in Frequency (DIF) Algorithm.	9	-
	Total	**46**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Johnny R. Johnson,	"Digital Signal Processing", PHI Learning Pvt Ltd., (2009).
2	Proakis,J.&D.G. Manolakis.	(2007), "Digital Signal Processing : Principles, Algorithms and Applications" , 4th Edition, Pearson Education

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

DEPARTMENTAL ELECTIVE-I

Course Title	**OPTO ELECTRONICS**				
Course code	**IC- 060 (3276)**				
Scheme and Credits	L	T	P	C	Semester VI
	3	1	0	4	
Prerequisites (if any)	None				
Course Objectives	• Understand the basic optoelectronics including electromagnetism, light propagation in waveguides, light amplification and detection, lasers, modulators, and detectors. • Be familiar with recent trends in optoelectronics.				

Course Outcomes

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

CO1	Explain the basic learning of Optical waveguides, photo source and detectors.	Understanding
CO2	Demonstrate the concept of Electro Optic effects.	Applying
CO3	Analyze the working of optical fiber sensor.	Evaluating
CO4	Interpret the basics of optical detection principles	Understanding
CO5	Express the basics of optical computing	Understanding

Detailed Contents	**Opto Electronics IC- 060/3276**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Introduction to Optical waveguide, Photo sources and detectors:** Optical waveguide modes-Theory of Dielectric slab waveguides-Symmetric and Asymmetric slab wave guide, Channel waveguide Light emitting diode(LED), materials, constructions, Drive circuitry, Fundamentals of lasers and its applications	10	-
II	**Electro Optic Effects:** Birefringence phenomenon EO Retardation, EO Amplitude and Phase Modulator, Electro optic Intensity Modulators ,Beam deflection, Acousto-optics, A-O Modulators, Integrated optic spectrum analyzer, Non linear optics second harmonic generation, Parametric amplification	9	-
III	**Fourier Optics and Holography:** Phase transformation of thin lens ,Fourier transforming property of Lens, Image forming property of Lens, Inter ferrometry, Principles of Holography On axis and Off Axis Holography, Holographic inter ferrometry -Real time, Double exposure, Contour generation, Optical data storage, Holographic optical elements, Speckle Phenomenon and methods of Measurements, Laser Interferometer.	10	-
IV	**Optical Fiber Sensors:** Multimode fiber Sensors-Displacement, pressure, stress, strain. Intensity modulated sensors, Active multimode FO sensors, Micro-bend optical fiber sensor, Current sensors, Magnetic sensors, Single mode FO sensors, Phase modulated, Polarization modulated, Fiber Optic Gyroscope.	8	-
V	**Optical Computing:** Analog linear optical processing, half tone processing, non linear processing, analog arithmetic operation addition/subtraction, multiplication, division, averaging, differentiation and integration. Digital logic: modified signed digit number system, residue number system, logarithmic number system. Arithmetic operations: MSD, residue, signed logarithmic arithmetic, threshold logic, threshold devices, spatial light modulators, and theta modulation devices shadow casting and symbolic substitution	10	-
	Total	**47**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	M. A. Karim,	**"Optical Computing –An introduction", Wiley India, 2010.**
2	Emmanuel Rosencher and BorgeVinter	**"Optoelectronics", Cambridge University Press, 2012.**

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

Course Title	**PROCESS DYNAMICS AND CONTROL**				
Course code	**IC-061 / 3277**				
Scheme and Credits	L	T	P	C	Semester VI
	3	1	0	4	
Pre-requisites (if any)	None. Desirable– Knowledge of Control System -1				
Course Objectives	• To impart knowledge about basic ideas, challenges, techniques, and applications of process control for controlling various processes. • To teach the fundamental aspects of process dynamics and control, which includes developing dynamic models of processes, control strategies for linear time-invariant systems and instrumentation aspects				

Course Outcomes

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

CO1	Demonstrate fundamental understanding of process control.	Understanding
CO2	Develop transfer function (input-output) and models for linear	Evaluating
CO3	Characterize the dynamics and stability of processes based on mathematical analysis	Applying
CO4	Explain different control modes and their application in controlling various processes.	Understanding
CO5	Explain the working of different controllers and valves.	Understanding
CO6	Explain controller implementation, and Control algorithm and Also implement it in various practical applications	Understanding & Applying

Detailed Contents	**Process Dynamics and Control IC-061 / 3277**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Basic Considerations:** Introduction, Basic components, diagrammatic representation, symbol and Terminology, changes at arbitrary points in the loop, offset and its analysis.	8	-
II	**Process Characteristics:** Process variables, mathematical modeling of liquid, gas, thermal, mechanical and chemical systems. Linearzing techniques, Liquid level control in a tank. Dynamics of manometer, response of non-interacting and interacting first-order elements in series, Mixing process, Heat transfer process, Distillation column	10	-
III	**Controller Characteristics:** Control modes, characteristics and comparison of on-off, proportional, integral, derivative modes and their combinations (PI, PD and PID), Introduction to Digital controllers. Automatic Control: Single and combined modes in closed loop, static error, velocity error. Dynamic behavior of feedback control processes for different modes, IAE, ISE, IATE criteria, Tuning of controllers, process reaction curve.	11	-
IV	**Controller Hardware:** Electronic pneumatic and hydraulic controller's implementation, single and composite modes of controllers. Final Control Elements: Control valves, types, functions, Electrical, Pneumatic hydraulicactuators, Solenoid, E-P converters, stepper motors.	10	-
V	**Introduction to Computerized Process Controls:** Control algorithm, PID Control action with Dead time.	4	-
	Total	**43**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Dr.K.T.Jadhav	PROCESS DYNAMICS AND CONTROL Kindle26 oct- 2020 Edition
2	Patranabis.D	Principles of Process Control, TMH, New Delhi 3e Copyright © 2012

Electronics materials, Web Site, etc: www.nptel.ac.in**:** https://onlinecourses.nptel.ac.in

Course Title	**DIGITAL CONTROL SYSTEMS**				
Course code	**IC- 062 (3278)**				
Scheme and Credits	L	T	P	C	Semester VI
	3	1	0	4	
Prerequisites (if any)	None				
Course Objectives	• To understand the concepts of digital control systems and assemble various components associated with it. Advantages compared to the analog type. • The theory of z–transformations and application for the mathematical analysis of digital control systems. • To represent the discrete–time systems in state–space model and evaluation of state transition matrix, the design of state feedback control by "the pole placement method." design of state observers. • To examine the stability of the system using different tests. • To study the conventional method of analyzing digital control systems in the w–plane.				

Course Outcomes

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

CO1	learn the advantages of discrete time control systems and the "know how" of various associated accessories	Understanding
CO2	Understand z–transformations and their role in the mathematical analysis of different systems (like Laplace transforms in analog systems).	Understanding
CO3	Learn the stability criterion for digital systems and methods adopted for testing the same are explained.	Evaluating
CO4	Understand the conventional and state space methods of design are also introduced.	Understanding
CO5	Design of digital control systems with digital controllers	Understanding

Detailed Contents	**Digital Control Systems IC-062/3278**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Discrete Data and Digital Control Systems:** Introduction, basic elements of Discrete-data control systems, signals conversion and processing, data conversion and quantization. **Sampling and Data Reconstruction of Sampled Signals:** mathematical modeling of ideal & actual samplers, sampling theorem, Hold circuits and comparison between hold circuits based on step response and frequency domain characteristics.	10	-
II	**Transform Analysis of Digital Control System:** Introduction, Linear Difference equations, the pulse TF and pulse response, z- transform, relationship between the s-plane and the z plane, Limitation of z-transform, the delayed & modified z-transforms.	9	-
III	**The State Variable Technique for Digital Systems:** Introduction, state equations and solutions of continuous and digital systems, Development of state formulation of Discrete data system with S/hold -devices, relationship between state equation and T.F., diagonalization of system-matrix, Jordon Canonical form, state diagrams, state variable analysis of response between sampling instants.	10	-
IV	**Controllability, Observability and Stability:** Concept of controllability for LTIV-discrete data systems, observability & TF, stability of Linear digital control systems, various methods of stability test, the second method of Liapunov & its applications to LTIV – discrete data system for stability analysis.	8	-
V	**Design of Discrete-Data Control Systems:** Concept of cascade compensation, Digital controllers including PID-controller, Design of digital control systems with digital controllers, Introduction to design of robust control systems, Pole-placement design by state and output – feedback, DSP control – digital signal processors	9	-
	Total	**46**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Benjamin C. Kuo,	Digital Control Systems, 2E University of Illinois at Urbana-Champaign,, February 2012.
2	Rashmi Vashisth , Kavita Singh	Digital Control System Paperback – 1 January 2012

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

Course Title	**MICROWAVE ENGINEERING**				
Course code	**IC- 063/(3279)**				
Scheme and Credits	L	T	P	C	Semester VI
	3	1	0	4	
Prerequisites (if any)	None				
Course Objectives	• An understanding of microwave waveguides, passive & active devices, tubes and network analysis. • An ability to design microwave matching networks. • An ability to perform microwave measurements. • An understanding of RADARs and its applications.				

Course Outcomes

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

CO1	Explain different types of waveguides and their respective modes of propagation.	Understanding
CO2	Analyze typical microwave networks using impedance, admittance, transmission and scattering matrix representations & Explain working of microwave passive circuits such as isolator, circulator, Directional couplers, attenuators etc.	Applying
CO3	Describe and explain working of microwave tubes.	Understanding
CO4	Describe and explain working of solid state devices.	Understanding
CO5	Perform measurements on microwave devices and networks using power meter and VNA & VSWR.	Evaluating

Detailed Contents	**Microwave Engineering IC-063/3279**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Rectangular Wave Guide:** Field Components, TE, TM Modes, DominantTE10 mode, Field Distribution, Power, and Attenuation. Circular Waveguides: TE, TM modes. Wave Velocities, Micro strip Transmission line (TL),Coupled TL, Strip TL, Coupled Strip Line, Coplanar TL, Microwave Cavities.	10	-
II	**Scattering Matrix, Passive microwave devices:** Microwave Hybrid Circuits. ,Terminations , Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Microwave Propagation in ferrites, Faraday Rotation, Isolators, Circulators. S parameter analysis of all components.	10	-
III	**Microwave Tubes:** Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Traveling Wave Tube, Backward Wave Oscillators: Their Schematic, Principle of Operation, Performance Characteristic and their applications.	10	-
IV	**Solid state amplifiers and oscillators:** Microwave Bipolar Transistor, Microwave tunnel diode, Microwave Field-effect Transistor, Transferred electron devices, Avalanche Transit – time devices: IMPATT Diode, TRAPPAT Diode	8	-
V	**Microwave Measurements:** General set up of a microwave test bench, Slotted line carriage, VSWR Meter, microwave power measurements techniques, Crystal Detector, frequency measurement, wavelength measurements, Impedance and Refection coefficient, VSWR, Insertion And attenuation loss measurements, measurement of antenna characteristics, microwave link design.	10	-
	Total	**48**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Benjamin C. Kuo,	Digital Control Systems, 2E University of Illinois at Urbana-Champaign, February 2012.
2	Rashmi Vashisth , Kavita Singh	Digital Control System Paperback – 1 January 2012

Electronics materials, Web Site, etc: https://onlinecourses.nptel.ac.in

LABORATORY SEMESTER-6

Course Title	**COMMUNICATION LAB**				
Course code	**IC-652 (30285)**				
Scheme and Credits	L	T	P	C	Semester VI
	0	0	2	1	
Pre-requisites (if any)	None. Desirable– Knowledge of Communication Engineering				
Course Objective	To Verify the operations of Various Circuits of Transmitters and Receivers Used in Analog and Digital Communication Networks on Lab Kits and also simulate on MATLAB				

Course Outcomes

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

CO1	Demonstrate the Representations of Signals in time and frequency domain sing MATLAB.	Understanding
CO2	Understand and Implement Transmitters and Receivers for Amplitude Modulations(DSB-SC SSB-SC, AM) and obtain their Waveforms on CRO	Evaluating
CO3	Understand and Implement Transmitters and Receivers for Angle Modulations(FM and PM) and obtain their Waveforms on CRO	Evaluating
CO4	Understand and Implement Transmitters and Receivers for Pulse Modulations(PAM, PWM, PPM) and obtain their Waveforms on CRO	Analyzing
CO5	Understand and Implement Circuits for Analog signal to Digital data conversion(Waveform Coding) Techniques (PCM,DPCM,DM & ADM) and obtain their Waveforms on CRO	Evaluating
CO6	Understand and Implement Transmitters and Receivers for Digital Modulations(ASK ,FSK and PM) and obtain their Waveforms on CRO	Analyzing

Detailed Contents	**Communication Lab IC-652 /30285**
S.No.	**Practical**
1	To study DSB/ SSB amplitude modulation & determine its modulation factor & power in side bands.
2	To study amplitude demodulation by linear diode detector
3	To study frequency modulation and determine its modulation factor
4	To study sampling and reconstruction of Pulse Amplitude modulation system
5	To study Pulse Width Modulation and Pulse Position Modulation.
6	To construct a triangular wave with the help of Fundamental Frequency and its Harmonic component.
7	To construct a Square wave with the help of Fundamental Frequency and its Harmonic component.
8	Study of Pulse code modulation (PCM) and its demodulation using Bread Board.
9	Study of Amplitude shift keying modulator and demodulator.
10	Study of Frequency shift keying modulator and demodulator.
11	Study of Phase shift keying modulator and demodulator.

Course Title	**MICROCONTROLLER LAB**				
Course code	**IC-653/(30286)**				
Scheme and Credits	L	T	P	C	Semester VI
	0	0	2	1	
Pre-requisites (if any)	None. Desirable– Knowledge of Assembly Language Programming for 8051				
Course Objectives	• The objective of this lab is to enable the students for programming in assembly language, learn to interface various I/O Devices and simulate on KEIL. • It also aims to run machine code on Microcontroller kit where real input and output modules can be interfaced and emulated.				

Course Outcomes

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

CO1	Demonstrate the procedure of simulating 8051 ALP on KEIL	Understanding
CO2	Demonstrate the Procedure of transferring Hex code into Microcontroller	Analyzing
CO3	Examine and Debug the code	Evaluating
CO4	Interfacing various Output Modules like: LED, Seven Segment and LCD Displays and Motors: DC motor, Stepper motor.	Desidning
CO5	Interfacing various Input Modules like: Push button, Matrix Keyboard.	Designing
CO6	Interfacing Sensors like Temperature Sensor, IR sensor , Data convertors: A/D and D/A convertors.	Designing

Detailed Contents Microcontroller Lab IC-653 /30286	
S.No.	**Practical**
1	Write a program of Flashing LED connected to port 1 of the Micro Controller
2	Write a program to show the use of INT0 and INT1.
3	Write a program to generate 10 kHz square wave.
4	Write a program to generate 10 kHz frequency using interrupts.
5	Write a program for temperature & to display on intelligent LCD display
6	Write a program to demonstrate the polling of Interrupt of 8051/8031 micro controllers.
7	Write a program to generate a Ramp waveform using DAC with micro controller.
8	Write a program to control a stepper motor in direction, speed and number of steps.
9	Write a program to control the speed of DC motor.
10	Write a program to interface Microcontroller with 8255.
11	Write a program to set the Baud rate at 9600, 8 Bit data and 1 Stop bit, to send the text string "Microcontroller" to serial port 1.

Course Title	**DIGITAL SIGNAL PROCESSING LAB**				
Course code	**IC-652/30287**				
Scheme and Credits	L	T	P	C	Semester VI
	0	0	2	1	
Pre-requisites(if any)	None.				
Course Objectives	The objective of the laboratory is to enable the students simulate and experiment with digital signals and systems and apply the theory they have studied in DSP courses. Students can implement digital signal processing algorithms using different computational platforms and DSP tools (MATLAB)				

Course Outcomes

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

CO1	Create and visualize various discrete/digital signals using MATLAB/Scilab.	Analyzing
CO2	Perform and test the basic operations of Signal processing.	Evaluating
CO3	Examine and analyse the spectral parameters of window functions.	Analyzing
CO4	Design IIR and FIR filters for band pass, band stop, low pass and high pass filters.	Designing
CO5	Design the signal processing algorithms using MATLAB/Scilab.	Designing

Detailed Contents	**DSP LAB IC-652/ 30287**
S.No.	**Practical**
1	With the help of Fourier series, make a square wave from sine wave and cosine waves. Find out coefficient values.
2	Evaluate 4 point DFT of and IDFT of x (n) = 1, $0 \leq n \leq 3$; 0 elsewhere.
3	Implement the FIR Filters for 2 KHz cutoff frequency and 2 KHz bandwidth for band pass filter.
4	Design FIR filter using Fourier series expansion method.
5	Implement IIR low pass filter for a 4 KHz cutoff frequency and compare it the FIR filter with the same type use chirp as input signal.
6	Verify Blackman and Hamming windowing techniques for square wave as an input which window will give good results.
7	Implement the filter functions.
8	Generate an Amplitude Modulation having side low frequencies 1200 Hz and 800 Hz. Observe and verify the theoretical FFT characteristics with the observed ones.
9	Generate Frequency Modulation having carrier frequencies 1 KHz and modulating frequency Hz with the modulation index of 0.7. Observe and verify the theoretical FFT characteristics with the observed ones.
10	Generate an FSK wave form for transmitting the digital data of the given bit sequence. Predict and verify the FFT for the same one.

THEORY SEMESTER- 7

Course Title	**CONTROL SYSTEMS -II**				
Course code	**IC- 701/4279**				
Scheme and Credits	L	T	P	C	Semester VII
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of Basics Control System -I				
Course Objectives	• To design compensators using classical methods and analyze the closed-loop stability. • To impart in-depth knowledge in state space design of digital controllers and observers. • To analyze the system performance and stability aspects with controller and observer in closed-loop.				

Course Outcomes

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

CO1	Explain the concept of sampling & signal conversion and basics of Z-Transform.	Understanding
CO2	Analyze transfer function of system and PID controller.	Analyzing
CO3	Design state space analysis of sampled data systems.	Creating
CO4	Design digital controls using state space analysis.	Creating
CO5	Analyze the control algorithms using microprocessors	Analyzing

Detailed Contents	**Control System –II IC- 701/4279**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Sampling and Signal Conversion:** Sampled-Data Control Systems, Digital to Analog Conversion, Sample and Hold operations, Sample and Hold Devices, frequency–Domain Characteristic of Zero order Hold. The Z-Transform: Linear Difference equations, The Pulse Response, The Definition of the Z transform, Relationship between the Laplace transform and the Z transform, Relationship between S -plane and the Z-plane, The constant Damping Loci, The constant Frequency Loci, The constantDamping Ratio Loci, The Inverse Z-Transform, Theorems of the Ztransform, Limitations of the Z-transform, Application of the Z-transform, Stability Analysis, Systems with Dead-Time.	10	-
II	**Transfer Functions,** Block Diagrams, and Signal flow Graphs, The Pulse Transfer Function and The Z-Transfer Function, The Pulse Transfer Function of the Zero-Order Hold and the Relation Between G(s) and G(z), Closed loop systems, The Sampled Signal flow Graph, The Modified Ztransfer function, Multirate Discrete Data System. Transform Design of Digital Controls Design of position Servo Design Specifications, Design on the W- plane, Design of the W-plane, the Digital PID Controllers	10	-
III	**State Space Analysis of Sampled Data Systems** Discrete time state equations. Similarity Transformations, The Cayley-Hamilton Theorem, Realization of Pulse Transfer function, State Equations for sampled Data Systems, Concepts of Controllability and Observability, Liapunov Stability Analysis Systems with Dead time.	8	-
IV	**Design of digital controls using State Space analysis** Formulation of the optimal control Problem Optimal State Regulator, Use of State Regulator results, Eigen value Assignment by State feedback, State observers Stochastic optimal State Estimation.	8	-
V	**Mechanization of Control algorithms** Using Micro Processors General Description of Microcontrollers, Digital quantization, Microprocessor based Position Control System.	8	-
	Total	**44**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Madan Gopal	Digital Control Engineering Paperback, New Age International Private Limited; Second edition (1 January 2014)
2	B.C. Kuo	"Digital Control Systems", Second edition Oxford University Press.

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

Course Title	**DATA ACQUISITION AND TRANSMISSION**				
Course code	**IC-702/4280**				
Scheme and Credits	L	T	P	C	Semester VII
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of communication Engineering and transducer				
Course Objectives	To understand concepts of acquiring the data from transducers/input devices, their interfacing and instrumentation system design				

Course Outcomes

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

CO1	Identity a data acquisition system.	Understanding
CO2	Prescribe a sensor type to measure a specific environmental change.	Applying
CO3	Determine what type of amplifier is needed for a specific sensor output.	Understanding
CO4	Identify with different forms of signal conditioning.	Understanding
CO5	Identify with different methods of Analog-to-Digital conversion.	Applying

Detailed Contents	Data Acquisition and Transmission IC-702/4280		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Data Acquisition System:** Definition and generalized block diagram of data acquisition system (DAS),Classification of DAS, working principle block diagram, construction and salient features of the following data acquisition systems: Analog data acquisition system using time division multiplexing, Analog data acquisition system using frequency division multiplexing, Digital data acquisition system with different configurations and Data logger.	9	-
II	**Data Transmission Systems**: Definition, generalized block diagram of Telemetry system, classification ofTelemetry system the working principle, block diagram, construction, salient features and applications of the following Telemetry systems: DC voltage, current and position telemetry system (Landline Telemetry system), Radio frequency amplitude modulated and frequency modulated telemetry system – theory related to amplitude and frequency modulation techniques, Pulse telemetry system – pulse amplitude modulated (PAM) system, pulse width modulated system (PWM), pulse code modulated system (PCM) system, Coding for varying levels .Modem based telemetry system, Satellite Telemetry system and Fiber optic Telemetry system.	12	-
III	**Display Systems**: Construction, principle of operation and salient features of various kinds of display devicessuch as LED, Nixie tube, LCD, segmental gas discharge type, single and multi digit LED 7-segmental display system (study of BCD to 7 segment code converter / decoder), Nixie tube based display system for numeric display (study of BCD to decimal decoder), to design LED Dot Matrix (3 x 5) numeric display system and LCD 7-segmental numeric display system	9	-
IV	**Digital Instruments**: Digital voltmeters (DVMs): working principle, construction, operation, salient features,range selection– Ramp type, dual slope integrating type, successive approximation type salient features,range selection– Ramp type, dual slope integrating type, successive approximation type frequency ratio meter, Digital Clock: block diagram construction and working, Analog Storage Oscilloscope and Digital storage oscilloscope: working principle, construction, operation and salient features.	9	-
V	**Recorders**: The working principle, construction, operation and salient features of X-t strip chart recorder, X-Ystrip chart recorder and Magnetic tape recorder.	9	-
	Total	**48**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	AUTHOR	TITLE
1	Sawhney A K	. Electric and Electronic Measurement and Instrumentation.
2	Bell David A	Electronic Instrumentation and Measurement.
3	Jason king	A introduction to data Acquisition

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

Course Title	**DIGITAL MEASUREMENT TECHNIQUES**				
Course code	**IC-703 /4281**				
Scheme and Credits	L	T	P	C	Semester VII
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of Electronic Measurements				
Course Objectives	The objective of this course is to impart • To introduce the students to various Methods of Time& Frequency Measurement.. • To Understand Programmable Measurement Devices • To Design Programmable Gain Amplifiers and Filters • To Design Programmable DAC and ADCs.				

Course Outcomes

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

CO1	To describe the basic knowledge of Digital Measurement Technique.	Understanding
CO2	To demonstrate the concepts of DMT involved in term of frequency.	Understanding
CO3	To Design the programmable Networks, Amplifiers and Filters circuits and evaluate filter parameters	Evaluating
CO4	To Design the performance of digital to analog converters	Designing
CO5	To apply the concept of voltage measurement in DMT.	Applying

Detailed Contents	Digital Measurement Techniques IC-703 /4281		
Module	**Contents**	**L(Hours)**	**T (Hours)**
I	**Digital Time Measurement Techniques:** Philosophy of digital measurements**,** Measurement of time interval between two events, error in time interval measurement,Vernier technique for small time measurement, measurement of time interval with constraints, measurement of periodic time, phase, time interval between two events defined by voltage levels, capacitance, quality factor of ringing circuit, decibel meter, logarithmic A/D converter.	10	-
II	**Digital Frequency Measurement Techniques:** Measurement of frequency, ratio of two frequencies, product of two frequencies, high frequency, average frequency difference, deviation of power frequency, peak frequency. Fast low-frequency Measurement.	7	-
III	**Digitally Programmable Circuits**: Resistor, Potentiometer, amplifiers, Schmitt trigger, dual polarity gain amplifiers. Programmable gain amplifier with dual output, two stage programming, programmable biquads	9	-
IV	**Digital to Analog Converters:** Output input relation, DACs derived from programmable gain amplifiers, Weighted-resistor DAC, Weighted current DAC, Weighted reference voltage DAC, Ladder DAC, switches.	8	-
V	**Digital Voltage Measurement Techniques:** Sampling theorem, time-division multiplexing, quantization, indirect type A/D converters, direct type A/D converters, Input circuitry of a digital voltmeter	9	-
	Total	**43**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	AUTHOR	TITLE
1	T. S. Rathore	"Digital Measurement Technique", Narosa Publishing House, 1996.

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

OPEN ELECTIVES-II

Course Title	**TRANSDUCER**				
Course code	**OE- 073/4274**				
Scheme and Credits	L	T	P	C	Semester VII
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of Physics, Basic of Biology, Electronics & Instrumentation				
Course Objectives	To make students familiar with the constructions and working principle of different types of sensors and transducers.				

Course Outcomes

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

CO1	Describe the purpose and methods of measurement.	Understanding
CO2	Know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.	Understanding
CO3	Remember and understand the concepts, types, working and practical applications of important biosensors.	Understanding
CO4	Know some of the commonly used biomedical transducers.	Applying
CO5	Know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications	Evaluating

Detailed Contents	**Transducer OE- 073/4274**		
Module	**Contents**	**L(Hours)**	**T (Hours)**
I	**Introduction**: Measurement systems, Basic electronic measuring system, Transduction principles, Classification of transducers, General transducers characteristics, Criteria for transducer selection.	9	-
II	**Resistive Transducers**: Principles of operation, construction, theory, advantages and disadvantages, applications of Potentiometers, strain gauges, (metallic and semi-conductor type), Resistance Thermometer, Thermistors.	9	-
III	**Inductive Transducers**: Types of Inductive transducer, Principles of operation, construction, Advantages &disadvantages and applications. Various variable Inductive Transducers, LVDT (Linear variable differential transformer).	9	-
IV	**Capacitive Transducers**: Types of capacitive transducer, Principles of operation, construction, theory, advantages and disadvantages and applications, of capacitive transducers based upon familiar equation of capacitance. **Elastic Transducers**: Spring bellows, diaphragm, bourdon tube – their special features and application.	9	-
V	**Other Transducers**: Optical transducers: photo-emissive, photo-conductive and Photo-voltaic cells, Digital Transducers, Encoder. Hall effect transducer, Photo-voltaic transducer.	9	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Arun K Ghosh	Introduction to transducer
2	Sawhney A K	Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons, New Delhi (2000).
3	Patranabis D	Sensors and Transducers, PHI, New Delhi (2003)

Electronics materials, Web Site, etc:. http://nptel.ac.in,www.gateacademy.com

Course Title	**COMPUTER ORGANIZATION AND ARCHITECTURE**				
Course code	**OE-072 /4273**				
Scheme and Credits	L	T	P	C	Semester VII
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of basic computer				
Course Objectives	1. Discuss the basic concepts and structure of computers. 2. Understand concepts of register transfer logic and arithmetic operations. 3. Explain different types of addressing modes and memory organization. 4. Learn the different types of serial communication techniques				

Course Outcomes

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

CO1	Discuss about the basic concepts of system design methodology and processor level design.	Understanding
CO2	Explain the basics of processor and basic formats of data representation	Understanding
CO3	Perform fixed- and floating-point arithmetic operations	Applying
CO4	Describe the basic concepts of control design and pipeline performance	Understanding
CO5	Explain the architecture and functionality of central processing unit.	Understanding
CO6	Describe the SISD, SIMD, MIMD Processor	Understanding

Detailed Contents	**Computer Organization and Architecture OE-072 /4273**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Introduction:** Historical overview, economic trends, underlying technologies, Data Representation- Data Types, Complements, Fixed -Point Representation, Floating-Point Representation, Error detection and correction, Addition, subtraction, multiplication and division algorithms and hardware	9	-
II	**Computer Performance:** The metrics of performance, popular performance metrics, Comparing and summarizing performance- Transaction Processing Benchmarks. **Arithmetic Logic Unit:** Arithmetic, logic and shift micro operations, Constructing an arithmetic logic shift unit. **Basic Computer Architecture and Design:** Computer registers, Computer Instructions-Instruction Set Completeness, Classifying Instruction Set Architecture, Basic steps of Instruction Execution, Hardwired control, Micro programmed Control, Horizontal and Vertical Microprogramming, Interrupts.	12	-
III	**Central Processing Unit:** General Register Organization, Stack Organized CPU, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, RISC Vs CISC. **Pipelining:** Parallel and pipeline Processing, Pipeline Control, Pipeline Implementations, Conflicts Resolution, and Pipeline Hazards. Vector Processing, and Array Processors	10	-
IV	**Memory Organization:** Memory Systems: principle of locality, principles of memory hierarchy Caches, associative memory, main memory, Virtual memory, Paging and Segmentation, Memory Interleaving. **Input Output Organization:** I/O performance measures, types and characteristics of I/O devices, I/O Modes-Programmed I/O, Interrupt Initiated I/O and DMA. Buses: connecting I/O devices to processor and memory, interfacing I/O devices to memory, processor, and operating system.	10	-
V	**Parallel Computers:** Classification, SIMD, MIMD Organizations, Connection Networks, Data Flow Machines, and Multithreaded Architectures.	9	-
	Total	**50**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	M Moriss Mano	Computer System Architecture
2	J. Hayes	Computer Architecture and Organization
3	C. Hamacher, V. Zvonko, S. Zaky	Computer Organization
4	William Stallings	Computer Organization and Architecture: Designing for performance

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

Course Title	**OPERATION RESEARCH**				
Course code	**OE- 070/4271**				
Scheme and Credits	L	T	P	C	SemesterVII
	3	0	0	3	
Pre-requisites(if any)	None. Desirable–Knowledge of mathematics				
Course Objectives	The central objective of operations research is optimization, i.e., "to do things best under the given circumstances." This general concept has great many applications, for instance, in agricultural planning, biotechnology, data analysis.				

Course Outcomes

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

CO1	Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.	Applying
CO2	Determine optimal strategy for Minimization of Cost of shipping of products from source to Destination/ Maximization of profits of shipping products using various methods, Finding initial basic feasible and optimal solution of the Transportation problems.	Understanding
CO3	Optimize the allocation of resources to Demand points in the best possible way using various techniques and minimize the cost or time of completion of number of jobs by number of persons.	Evaluating
CO4	Model competitive real-world phenomena using concepts from theory. Analyze game pure and mixed strategy games.	Applying
CO5	Formulate Network models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Network problems	Evaluating

Detailed Contents	**Operation Research OE- 070/4271**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Introduction:** Definition and scope of operations research (OR), OR model, solving the OR model, art of modeling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.	9	-
II	**Transportation Problems:** Types of transportation problems, mathematical models, transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines.	9	-
III	**Network Techniques:** Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management, guidelines for network construction, CPM and PERT.	9	-
IV	**Theory of Games:** Rectangular games, Minim ax theorem, graphical solution of 2 x n or m x 2 games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized Poisson queuing model, single server models.	9	-
V	**Inventory Control:** Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipment's that deteriorate with time, equipment's that fail with time.	9	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Frederick S. Hillier	Introduction to Operations Research
2	Richard Bronson, Govindasami Naadimuthu	Schaum's Outline of Operations Research
3	R. Panneer Seevam	Operations Research, PHI Learning, 2008.

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

Course Title	**ADVANCED SENSORS**				
Course code	**OE- 071 / 4272**				
Scheme and Credits	L	T	P	C	Semester VII
	3	0	0	3	
Pre-requisites (if any)	None. Desirable–knowledge of basic electronics, Electrical engineering, Measurement Technique				
Course Objectives	To make students familiar with the constructions and working principle of different types of sensors and transducers.				

Course Outcomes

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

CO1	Use concepts in common methods for converting a physical parameter into an electrical quantity.	Understanding
CO2	Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.	Applying
CO3	Predict correctly the expected performance of various sensors.	Evaluating
CO4	Locate different type of sensors used in real life applications and paraphrase their importance.	Evaluating
CO5	Set up testing strategies to evaluate performance characteristics of different types of sensors and develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system.	Applying

Detailed Contents	**Advanced Sensors**	**OE- 071 / 4272**	
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Micro mechanical sensing and actuating structures:** SAW micro sensors, Resonant micro sensors, micro accelerometers, Pressure micro sensors, micro actuators and micro motors, semiconductor strain gauges, Piezo resistive elements.	11	-
II	**Temperature and Light Sensitive Microstructures:** Solid state temperature sensors – silicon resistive temperature sensors, Transistor based sensors, Integrated thermocouple, Photo detectors, Pneumatic detectors, Pyro electric detectors, Photo emissive, photo conductive, Schottky, CCDs, Radiation detectors, Fiber optic sensors: Pressure, Temperature and Phase modulated, Gyroscopes.	12	-
III	**Miscellaneous Miniature Sensors:** Magnetic sensors, solid-state, chemical sensors: silicon based, Metal oxide based, Catalyst.	11	-
IV	**Sensor Fusion:** Introduction to sensor fusion and sensor selection. Bayesian theory of sensor fusion and its applications.	11	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Khazan Alexander D	Transducers and their elements – Design and Applications, PTR Prentice Hall, Englewood Cliff, NJ07632 (1994)
2	Randy Frank	Understanding Smart Sensors
3	Daniel E Suarez	Smart Sensors & Sensing Technology (Electrical Engineering Developments

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

DEPARTMENTAL ELECTIVES-II

Course Title	**OPTICAL INSTRUMENTATION**				
Course code	**IC-070/ 4275**				
Scheme and Credits	L	T	P	C	Semester VII
	3	1	0	4	
Pre-requisites(if any)	None. Desirable– Knowledge of Basic Physics and optics				
Course Objectives	To make the students able to understand different aspects of optical instrumentation				

Course Outcomes

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

CO1	Explain the basic concepts of optical transmitting and receiving.	Understanding
CO2	Understand Fundamental of Fibers, Fiber Optic Communication system, Optical Time domain Reflectometer (OTDR).	Understanding
CO3	Design Photo diode, PIN, Photo-Conductors, Solar cells, Phototransistors, Materials used to fabricate LEDs and Lasers.	Applying
CO4	Describe selection of the appropriate optical fiber sensors for industrial application.	Evaluating
CO5	Aware of Principle of Holography, On-axis and Off axis Holography, Application of Holography, Optical data storage. Optical Fiber Sensor.	Applying

Detailed Contents	**Optical Instrumentation IC-070/4275**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Light Sourcing, Transmitting and Receiving:** Concept of Light, Classification of different phenomenon based on theories of light, Basic light sources and its Characterization, Polarization, Coherent and Incoherent sources, Grating theory Application of diffraction grating, Electro-optic effect,Acousto optic effect and Magneto-optic effect	9	-
II	**Opto –Electronic devices and Optical Components:** Photo diode, PIN, Photo-Conductors, Solar cells, ,Phototransistors, Materials used to fabricate LEDs and Lasers Design of LED for Optical communication, Response times of LEDs ,LED drive circuitry, Lasers Classification :Ruby lasers, Neodymium Lasers, He- Ne Lasers,CO2 Lasers, Dye Lasers, Semiconductors Lasers ,Lasers Applications.	9	-
III	**Interferometers:** Interference effect, Radio-metry, types of interference phenomenon and its Application, Michelson's Interferometer and its application Fabry-perot interferometer, Refractometer, Rayleigh's interferometers, Spectrographs and Monochromators, Spectrophotometers, Calorimeters, Medical Optical Instruments.	9	-
IV	**Holography:** Principle of Holography, On-axis and Off axis Holography, Application of Holography, Optical data storage. Optical Fiber Sensors: Active and passive optical fiber sensor, Intensity modulated, displacement type sensors, Multimode active optical fiber sensor (Micro bend sensor)Single Mode fiber sensor-Phase Modulates and polarization sensors	9	-
V	**Fiber optic fundamentals and Measurements:** Fundamental of Fibers, Fiber Optic Communication system, Optical Time domain Reflecto meter (OTDR),Time domain dispersion measurement, Frequency Domain dispersion measurement, Laser Doppler velocimeter	9	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Pollock	Fundamentals of OPTOELECTRONICS,(1994)
2	A Yariv	Optical Electronics/C.B.S. Collage Publishing, New York, (1985)
3	Jason king	A introduction to data Acquisition

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

Course Title	**POWER PLANT INSTRUMENTATION**				
Course code	**IC- 071/4276**				
Scheme and Credits	L	T	P	C	Semester VII
	3	1	0	4	
Prerequisites(if any)	None Desirable– Knowledge of basic Electronics.				
Course Objectives	• To provide an overview of different methods of power generation with a particular stress on thermal power generation. • To bring out the various measurements involved in power generation plants. • To provide knowledge about the different types of devices used for analysis. • To impart knowledge about the different types of controls and control loops. • To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control.				

Course Outcomes

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

CO1	Understand the basic principles of power generation	Understanding
CO2	Understand about the various methods of power generation in power plant.	Understanding
CO3	Understand about the various Hydropower plants.	Understanding
CO4	To learn about the wind& solar Energy.	Creating
CO5	Understand about the Nuclear power plants.	Understanding

Detailed Contents	**Power Plant Instrumentation IC- 071/4276**		
Module	**Contents**	**L(Hours)**	**T (Hours)**
I	**Energy sources**, their availability, worldwide energy production, energy scenario of India. Introduction to Power generation- Classification: Renewable and non renewable energy generation resources. Renewable: small hydro; modern biomass; wind power; solar; geothermal and bio-fuels. Non renewable: fossil fuels (coal, oil and natural gas) and nuclear power. Boiler : Types of boilers, boiler safety standards. Boiler instrumentation, control and optimization, combustion control, air to fuel ratio control, three element drum level control, steam temperature and pressure control, boiler interlocks, sequence event recorder, data acquisition systems	10	-
II	**Thermal Power Plant** Method of power generation, layout and energy conversion process, Types of Turbines & control, Types of Generators, condensers. Types of pumps and Fans, variable speed pumps and Fans, Material handling system, study of all loops-water, steam, fuel etc.	8	-
III	**Hydro Electric power plant-** Site selection, Hydrology, Estimation electric power to be developed, classification of Hydropower plants, Types of Turbines for hydroelectric power plant, pumped storage plants, storage reservoir plants.	8	-
IV	**Wind Energy:** Power in wind, Conversion of wind power, Aerodynamics of wind turbine, types of wind turbine, and modes of operation, power control of wind turbines, Betz limit, Pitch & Yaw control, wind mill, wind pumps, wind farms, different generator protections, data recording, trend analysis, troubleshooting & safety. **Solar Energy:** solar resource, solar energy conversion systems: Solar PV technology: Block diagram of PV system, advantages and limitations. Solar thermal energy system: Principle, solar collector and its types, solar concentrator and its types, safety.	10	-
V	**Nuclear Power Plant:** Nuclear power generation, control station and reactor control. Comparison of various plants: Comparison of thermal power plant, hydro electric power plant, wind, solar, nuclear power plant on the basis of: Performance, efficiency, site selection, Economics-capital and running, safety standards, pollution, effluent management and handling. Power plant safety, Pollution monitoring, control Sound, Air, smoke, dust, study of Electrostatic precipitator.	9	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	P.K.Nag	Power plant Engineering, Tata McGraw-Hill Education, 3rd edition, 2007.
2	Rajput R.K.	A Text book of Power plant Engineering. 5th Edition,2013

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

Course Title	**ARTIFICIAL NEURAL NETWORK**				
Course code	**IC-072 /4277**				
Scheme and Credits	L	T	P	C	SemesterVII
	3	0	1	4	
Prerequisites(if any)	None.				
Course Objectives	On completion of this course the students will be able to expose themselves towards intelligence systems and knowledge based systems. It also provides knowledge of learning networks.				

Course Outcomes

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

CO1	Recall the functionality of human brain neurons and design the basic artificial model for neuron.	Creating
CO2	Understand the various learning process for artificial neural model	Understanding
CO3	Construct the artificial neural model for pattern mapping, pattern recognition and pattern classification.	Creatiing
CO4	Explain feed forward and feedback network for artificial neural network	Understanding
CO5	Understand about the Statistical Pattern Recognition Bayes' theorem, & RBF network	Understanding
CO6	To learn about the Adaptive Resonance Theory	Creating

Detailed Contents	**Artificial Neural Network IC-072 /4277**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Introduction:** Introduction and history, human brain, biological neuron, models of neuron, signal flow graph of neuron, feedback, network architecture, knowledge Representation, Artificial intelligence and neural networks. Learning Process: Error correction learning, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, learning with and without teacher, learning tasks, memory and adaptation.	10	-
II	**Artificial neurons**, Neural networks and architectures, introduction, neuron Signal function, mathematical preliminaries, Feed forward & feedback architecture. Geometry of Binary threshold neurons and their networks, Pattern recognition, convex sets and convex hulls, space of Boolean functions, binary neurons for pattern classification, non linear separable problems,capacity of TLN, XOR solution.Perceptrons and LMS.	10	-
III	**Learning objective of TLN**, pattern space & weight space, perceptron learning algorithm, perceptron convergence theorem, pocket algorithm, α –LMS learning, MSE error surface, steepest descent search, μ – LMS and application. Back propagation and other learning algorithms Multilayered architecture, back propagation learning algorithm, practical considerations, structure growing algorithms, applications of feed forward neural networks, reinforcement learning.	10	-
IV	**Statistical Pattern** Recognition Bayes' theorem, classical decisions with Bayes' theorem, probabilistic interpretation of neuron function, interpreting neuron signals as probabilities, multilayered networks & posterior probabilities, error functions for classification problems.RBF Networks Regularization networks, generalized RBF networks, RBF network for solving XOR problem, comparison of RBF networks & multilayer perceptrons.Stochastic Machines: Statistical mechanics, simulated annealing, Boltzmann machine.	10	-
V	**Adaptive Resonance Theory:** Building blocks of adaptive resonance, Adaptive Resonance Theory 1.Self Organizing Feature MAP Introduction, Maximal eigenvector filtering, principal component analysis, generalized learning laws, competitive learning, vector quantization, Mexican hat networks.	9	-
	Total	**49**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	S. Raj Sekaran , Vijayalakshmi Pari	Neural networks, Fuzzy logic and Genetic Algorithms", PHI Publication
2	Elaine Rich and Kevin Knight	Artificial Intelligence", TMH Publication

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

Course Title	**FLUID MECHANICS**				
Course code	**IC- 073 / 4278**				
Scheme and Credits	L	T	P	C	Semester VII
	3	1	0	4	
Prerequisites(if any)	None Desirable– Knowledge of basic Electronics.				
Course Objectives	• To learn about the application of mass and momentum conservation laws for fluid flows. • To understand the importance of dimensional analysis • To obtain the velocity and pressure variations in various types of simple flows. • To analyze the flow in water pipe and turbines.				

Course Outcomes

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

CO1	Determine the fluid pressure and use various devices for measuring fluid pressure.	Evaluating
CO2	Apply Bernoulli's equation to fluid flow problems and boundary layer theory to determine lift and drag forces on a submerged body	Applying
CO3	Calculate hydrostatic force and use of law of conservation mass to fluid flow	Evaluating
CO4	Understand about the Boundary Layer Analysis	Understanding
CO5	Apply appropriate equations and principles to analyze pipe flow problems.	Applying

Detailed Contents	**Fluid Mechanics IC- 073 / 4278**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Introduction: Fluids and continuum:** Physical properties of fluids, ideal and rear fluids, Newtonian and non-Newtonian fluids, measurement of surface tension. **Kinematics of Fluid Flow**: Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, one, two and three dimensional flows, streamlines, streak lines and path lines, continuity equation, rotation and circulation, elementary explanation of stream function and velocity potential, graphical and experimental methods of drawing flow nets. **Fluid statics:** Pressure-density height relationship, manometers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies.	10	-
II	**Dynamics of Fluid flow:** Euler's equation of motion along a streamline and its integration, Bernoulli's equation and its applications-Pitot tube, flow through orifices, mouthpieces, nozzles, notches, free and forced vortex, momentum equation and its application to stationary and moving vanes, pipe bends, Problems related to combined application of energy and momentum equations, flow measurements.	9	-
III	**Dimensional Analysis and Hydraulic Similitude:** Dimensional analysis, Buckingham's theorem, important dimensionless numbers and their significance, geometric, Kinematic and dynamic similarity, model studies. Laminar and Turbulent Flow: Equation of motion for laminar flow through pipes, Stoke's law, flow between parallel plates, flow through porous media, fluidization, measurement of viscosity, transition from laminar to turbulent flow, turbulent flow, equation for turbulent flow, eddy viscosity, mixing length concept and velocity distribution in turbulent flow, Hot-wire anemometer and LDA.	10	-
IV	**Boundary Layer Analysis:** Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, smooth and rough boundaries, atmospheric, boundary layer, local and average friction coefficient, separation and its control measurement of shear.	8	-
V	**Pipe Flow:** Nature of turbulent flow in pipes, equation for velocity distribution over smooth and rough surfaces, resistance coefficient and its variation, flow in sudden expansion, contraction, diffusers, bends, valves and siphons, concept of equivalent length, branched pipes, pipes in series and parallel, simple networks. Flow past Submerged Bodies: Drag and lift, drag on a sphere, cylinder and disc, lift Magnus effect and circulation. Compressibility Effects in pipe flow: Transmission of pressure waves in rigid and elastic pipes, water hammer, and analysis of simple surge tank excluding friction.	10	-
	Total	**47**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	M. Franck White	Fluid Mechanics, Tata McGraw Hill, 2017.
2	P.N. Modi and S.M. Seth	Fluid Mechanics (18th edition) Standard Book House,2017
3	A.K. Jain,	Fluid Mechanics, Khanna publishers,2010

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

LABORATORY SEMESTER-7

Course Title	**CONTROL SYSTEM-II LAB**				
Course code	**IC-751 /40282**				
Scheme and Credits	L	T	P	C	Semester VII
	0	0	2	1	
Pre-requisites(if any)	None. Desirable–Knowledge of MATLAB				
Course Objectives	• Understand Discrete Time LTI model. • Evaluate digital DC motor speed control with PID controller. • Design Lead & Lag Compensators and Kalman Filter design. • Write a Matlab Program to find. a. LTI characteristics b. PID control response • Write a program to check for controllability and observability for the second order system.				

Course Outcomes

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

CO1	Explain the concept of sampling & signal conversion and basics of Z-Transform.	Understanding
CO2	Analyze transfer function of system and PID controller.	Analyzing
CO3	Design state space analysis of sampled data systems.	Creating
CO4	Design digital controls using state space analysis.	Creating
CO5	Analyze the control algorithms using microprocessors.	Analyzing

Detailed Contents	**Control System-II Lab IC-751 /40282**
S.No.	**Practical**
1	Discrete Time LTI model
2	Discrete pole locations & transients response
3	Small damping ($\varepsilon = 0.1$ $W_n = 4\pi/5T$) Medium damping ($\varepsilon = 0.4$ $W_n = 11\ \pi\ /5T$) Large damping ($\varepsilon = 0.8$ $W_n = \pi\ /4T$)
4	Digital DC motor Speed control with PID controller
5	To study Lead & Lag Compensators
6	Kalman Filter design
7	State space design for the Inverted pendulum

Course Title	**DATA ACQUISITION AND TRANSMISSION LAB**				
Course code	**IC-752/40283**				
Scheme and Credits	L	T	P	C	Semester VII
	0	0	2	1	
Pre-requisites(if any)	None. Desirable– Knowledge of analog and digital communication				
Course Objectives	To understand concepts of acquiring the data from transducers/input devices, their interfacing and instrumentation system design.				

Course Outcomes

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

CO1	Simulate end-to-end Communication Link	Applying
CO2	Demonstrate their knowledge in base band signaling schemes through implementation of FSK, PSK and DPSK	Understanding
CO3	Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system	Applying
CO4	Simulate & validate the various functional modules of a communication system	Applying
CO5	Apply various techniques in solving communication problems	Applying

Detailed Contents Data Acquisition and Transmission Lab IC-752/40283	
S.No.	**Practical**
1	Measurement of Temperature Using RTD/ Thermistor and amplification to an Appropriate level suitable for Tele transmission.
2	Sampling through a S/H Circuit and reconstruction of the sampled signal. Observe The effect of sampling rate & the width of the sampling pulses.
3	Realization of PCM signal using ADC and reconstruction using DAC using
4	4-bit/8 bit systems. Observe the Quantization noise in each case.
5	Fabricate and test a PRBS Generator.
6	Realization of data in different formats such as NRZ-L, NRZ-M and NRZ-S.
7	Clock recovery circuit from NRZ-L data using PLL.
8	Manchester coding & decoding (Bi phase L) of NRZ-L Data.
9	Coding and decoding NRZ-L into URL-L (Uni polar return to Zero coding).
10	ASK – Modulation and Detection
11	FSK – Modulation and Detection
12	PSK - Modulation and Detection.
13	Error introduction, Error Detection & Correction using Hamming Code.
14	Amplitude modulation and Detection of signal obtained from experiment

Course Title	**INDUSTRIAL TRAINING**				
Course code	**IC-753/40284**				
Scheme and Credits	L	T	P	C	Semester VII
	0	0	4	2	
Pre-requisites(if any)	None.				
Course Objectives	The objectives of industrial training are to provide to students the feel of the actual working environment and to gain practical knowledge and skills, which in turn will motivate, develop and build their confidence.				

Course Outcomes

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

CO1	Asses and appraise engineering practices.	Understanding
CO2	Follow and practice industrial norms.	Applying

Course Title	**MINOR PROJECT**				
Course code	**IC-754/40285**				
Scheme and Credits	L	T	P	C	Semester VII
	0	0	4	2	
Pre-requisites(if any)	None.				
Course Objectives	The objective of the minor project is to provide an opportunity for students to undertake short research training outside the classroom to solve real world issues.				

Course Outcomes

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

CO1	Identify the problem statement through literature survey for project work	Understanding
CO2	Arrive at conceptual project design through brainstorming.	Creating
CO3	Develop design strategy for the project work	Creating
CO4	Apply appropriate modern tools to execute the project work	Applying
CO5	Evaluate the outcome of the project work	Understanding
CO6	Evaluate application of project work with appropriate societal consideration	Applying
CO7	Develop presentation and interpersonal communication skills through project work.	Understanding

THEORY SEMESTER-8

Course Title	**OPTIMAL CONTROL SYSTEMS**				
Course code	**IC- 801/4295**				
Scheme and Credits	L	T	P	C	Semester VIII
	3	0	0	3	
Prerequisites(if any)	None				
Course Objectives	• To provide a basic knowledge of the theoretical foundations of optimal control. • To develop skills needed to design controllers using available optimal control theory and software. • To implement optimization methods for optimal control. • The main objective of optimal control is to determine control signals that will cause a process (plant) to satisfy some physical constraints and at the same time extremize (maximize or minimize) a chosen performance criterion (performance index or cost function)				

Course Outcomes

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

CO1	Understand the role of optimization in a control system plants.	Understanding
CO2	Formulate mathematical models for optimization problems.	Applying
CO3	Analysis of degree of freedom and complexity of solutions to an optimization problem.	Evaluating
CO4	Understand the role of optimal feedback control (linear regulator).	Understanding
CO5	Describe optimal Estimation for linear regulator.	Understanding
CO6	Analysis of Microprocessor and DSP based application.	Understanding

Detailed Contents	**Optimal Control Systems IC-801/4295**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**General Mathematical Procedures:** Formulation of the optimal control Problem, Calculus of variations, Minimum principle, Dynamic Programming, Numerical Solution of Two-point Boundary value problem.	8	-
II	**Optimal Feedback Control:** Discrete-Time linear State regulator, Continuous-Time Linear state Regulator results of solves other linear problems, Suboptimal Linear regulators, Minimum-time Control of Linear Time-Invariant System.	9	-
III	**Stochastic Optimal Linear Estimation and Control:** Stochastic processes and linear systems, Optimal Estimation for Linear Discrete time Systems Stochastic Optimal Linear Regulator.	8	-
IV	**Microprocessor and DSP control Basic computer Architecture:** Microprocessor Control of Control System, Single Board Controllers with Custom Designed Chips, Digital Signal Processors.	9	-
V	Effect of finite World Length and Quantization on Controllability and Closed Loop –Pole Placement, Effects of Quantization, and Time Delays in Microprocessor Based control systems.	8	-
	Total	**42**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	D. Subbaram Naidu, Richard C. Dorf	Optimal Control Systems,Edition1st Edition,First Published2003,eBook Published 31 October 2018.
2	Jasbir Arora	Introduction to Optimum Design, Elsevier Science, Fourth Edition, 28-Apr-2016,

Electronics materials, Web Site, etc:http://nptel.ac.in,www.gateacademy.com

CourseTitle	**BIOMEDICAL INSTRUMENTATION**				
Course code	**IC-802/4296**				
Scheme and Credits	L	T	P	C	Semester VIII
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of basic biology				
Course Objectives	The basic objective of this course is to provide • The fundamental knowledge of Bio-medical Instrumentation, the science associated with the measurement of biological variables such as pressure, temperature etc related to human body, the complexities associated with the measurement of the biological parameters.				

Course Outcomes

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

CO1	Biomedical Signals and Instrumentation Sensors: Learn several signals that can be measured from the human body. Specific examples include temperature, electrical, and pressure signals.	understanding
CO2	Instrumentation Design: Understand theory and design on Wheatstone bridge; inverting, noninverting, differential and instrumentation amplifiers.	Applying
CO3	Instrumentation Application: Review the cardiac, respiratory and neural physiological system.	understanding
CO4	Study the designs of several instruments used to acquire signals from living systems. Examples of instruments studied include ECG, blood pressure monitors, spirometers, EEG, MRI, and ultrasound.	Applying
CO5	The ability to make measurements on and interpret data from living systems	Evaluating

Detailed Contents	**Biomedical Instrumentation IC-802/4296**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Physiological Systems of the Body:** Brief description of musculoskeletal, endocrine, gastrointestinal, nervous, circulatory and respiratory systems; the body as a control system; the nature of bioelectricity, action events of nerve; the origin of biopotentials.	8	-
II	**Bio potential Electrodes:** Signal acquisition; electrodes for biophysical sensing; electrode-electrolyte interface; skin preparation, electrode-skin interface and motion artifact; surface electrodes; microelectrodes; Internal electrodes; electrode arrays; electrodes for electric stimulation of tissues; electrode polarization, electrical interference problems in biopotential measurement; electrical safety.	9	-
III	**The Heart System and Its Measurements:** The heart; electro conduction system of the heart; the ECG waveform; the standard lead system; the ECG preamplifier; ECG machines; Cardiac monitors; Transient protection; common-mode and other interference-reduction circuits. **Physiological Pressure and other Cardiovascular Measurements and Devices:** Physiological pressure; blood pressure measurements; sphygmomanometer; oscillometric and ultrasonic methods; practical problems in pressure monitoring; cardiac output measurement; plethysmography; blood flow measurements; phonocardiography; vector cardiography; defibrillators; pacemakers; heart lung machines.	12	-
IV	**The Human Respiratory System and Its Measurement**: Respiratory anatomy (lungs, conducting airways ,alveoli, pulmonary circulation, respiratory muscles); lung volumes and gas exchange, mechanics of breathing; parameters of respiration; regulation of respiration; unbalanced and diseased states; environmental threats to the respiratory system; respiratory system measurements; respiratory transducers and instruments; spirometry, body plethysmography.	10	-
V	**Measurement of Electrical activity in Neuromuscular System and Brain:** Neuron potential; muscle potential; electromyography (EMG); electroencephalography (EEG); EEG electrodes and the 10- 20 system; EEG amplitude and frequency bands; the EEG system – simplified block diagram; preamplifiers and EEG system specifications; EEG diagnostic uses and sleep patterns; visual and auditory evoked potential recordings; EEG system artifacts	9	-
	Total	**48**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Khandpur R S	Handbook on Biomedical Instrumentation
2	Webster J G	"Encyclopedia of Medical Devices and Instrumentation", Vols. 1-4, New York: Wiley (1988).

OPEN ELECTIVE -III

CourseTitle	**NON- CONVENTIONAL ENERGY RESOURCES**				
Course code	**OE-080 /4286**				
Scheme and Credits	L	T	P	C	Semester VIII
	3	0	0	3	
Pre-requisites(if any)	None. Desirable– Knowledge of basic Environmental Science				
Course Objectives	The objective of nonconventional energy resources is to use renewable energy resources to fulfill the requirement of future energy requirement.				

Course Outcomes

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

CO1	Understand the basic concepts and operation of renewable energy systems.	Understanding
CO2	Remember the ideas and statistics of current RES availability and usage.	Understanding
CO3	Analyze the problems in RES installation in real time.	Applying
CO4	Identify the other NCE S and available source improvement.	Understanding
CO5	Apply the renewable energy systems in real time applications.	Applying

Detailed Contents	**Non Conventional Energy Resources OE-080/4286**		
Module	**Contents**	**L(Hours)**	**T (Hours)**
I	Introduction Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.	9	-
II	Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	9	-
III	Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.	10	-
IV	Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.	11	-
V	**Bio-mass:** Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants	9	-
	Total	**48**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Raja etal	Introduction to Non-Conventional Energy Resources
2	John Twideu and Tony Weir.	Renewal Energy Resources" BSP Publications, 2006
3	R.K rajput	Non conventional Energy resources and utilization

Electronics materials, Web Site, etc:www.nptel.ac.in

Course Title	**COMPUTER NETWORK**				
Course code	**OE -083/4289**				
Scheme and Credits	L	T	P	C	Semester VIII
	3	0	0	3	
Pre-requisites (ifany)	None. Desirable–Basic Computer Science, Microprocessor, Microcontroller				
Course Objectives	• To offer knowledge about computer network related hardware and software using a layered architecture. • To provide good understanding of the concepts of network security, wireless and various emerging network technologies. • To offer knowledge about computer network related hardware and software using a layered architecture. • To Provide good understanding of the concepts of network security, wireless and various emerging network technologies.				

Course Outcomes

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

CO1	Understand computer network basics, network architecture, TCP/IP and OSI reference models.	Understanding
CO2	Identify and understand various techniques and modes of transmission	Understanding
CO3	Describe data link protocols, multi-channel access protocols and IEEE 802 standards for LAN	Understanding
CO4	Describe routing and congestion in network layer with routing algorithms and classify IPV4 addressing scheme	Evaluating
CO5	Understand network security and define various protocols such as FTP, HTTP, Telnet, DNS	Understanding

Detailed Contents	**Computer Network OE-083/4289**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Introduction to Computer Networks**: Use and types of Computer Networks, Network Hardware and Software and Reference Models.	9	
II	**Physical Layer:** Transmission Media and Public Switched Telephone Network. **Data Link Layer:** Design Issues, Error Detection and Correction, Data Link Protocols and Protocol Verification Methods.	9	
III	**Medium Access Control Sub layer:** Channel Allocation Problem, Multiple Access Protocols, Ethernet and Wireless LANs. **Network Layer:** Network layer design issues, Routing Algorithms, Congestion Control Algorithms and Quality of Service.	10	
IV	**Transport Layer:** The Transport Service, Elements of Transport Protocols, A Simple Transport Protocol, The Internet Transport Protocols and Performance Issues. **Application Layer:** Domain Name System, Electronic Mail, World Wide Web and Multimedia.	10	
V	**Network Security:** Cryptography, Symmetric-Key Algorithms, Public-Key Algorithms, Digital Signatures and Authentication Protocols.	8	
		46	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Tanenbaum Andrew S	Computer Networks, Ed Pearson Education 4th Ed. (2003)
2	Kurose James F and Ross Keith W	Computer Networking" Ed Pearson Education (2002)

Course Title	**EMBEDDED SYSTEM**				
Course code	**OE -082/4288**				
Scheme and Credits	L	T	P	C	Semester VIII
	3	0	0	3	
Pre-requisites(if any)	None. Desirable–Basic Computer Science, Microprocessor, Microcontroller				
Course Objectives	• To have knowledge about the basic working of a microcontroller system and its programming in assembly language. • To provide experience to integrate hardware and software for microcontroller applications systems.				

Course Outcomes

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

CO1	Be familiar with the composition, design, and implementation of embedded systems.	Understanding
CO2	Be familiar with both medium level and high-level languages appropriate for embedded systems development techniques (e.g., C and Python).	Evaluating
CO3	Be familiar with reading and understanding processor and component datasheets.	Understanding
CO4	Be familiar with driving use contexts, including human-computer interaction, environmental sensing and actuation, etc.	Applying
CO5	Be familiar with working on a team to create and apply embedded systems.	Applying

Detailed Contents	**Embedded System OE-082/4288**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Embedded Processing Systems** – Introduction, Components of Embedded Systems.	6	
II	**Embedded Processors:** Microprocessors, Microcontrollers, DSP and ASICs, Comparative Assessment of Embedded Processors.	10	
III	**Memory Devices:** ROM family, RAM family, Interfacing memory **Embedded Programming** - C and C++.	12	
IV	**Input-output Ports and Interfacing**, I/O Programming **Interrupts and Their Servicing,** timing devices and interfacing, Analog I/O techniques **Embedded Communications**: Serial Bus, Parallel Bus, Networking and Wireless Standards Introduction to Real- time operating system (RTOS), RTOS: memory management, I/O.	10	
V	**Management and Device Drivers,** scheduling **Software Engineering Practices**: Embedded Software Development Process **Hardware-** Software Co-design in an embedded system Tools and Trends in Embedded systems design	10	
	Total	**48**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Raj Kumar	Embedded Systems: Architecture, Programming and Design", Tata McGraw Hill, Third Reprint, (2003).
2	Michael Barr, O'Reilly	Programming Embedded Systems in C and C ++, (1999).
3	Vahid and Givargis	Embedded System Design", A Unified Hardware/Software Introduction, John Wiley and Sons, (2002).

Electronics materials, Web Site, etc: www.nptel.ac.in

Course Title	**NANO SCIENCE**				
Course code	**OE -081/4287**				
Scheme and Credits	L	T	P	C	Semester VIII
	3	0	0	3	
Pre-requisites(if any)	None. Desirable–Basic material science and chemistry				
Course Objectives	• To foundational knowledge of the Nano science and related fields. • To make the students acquire an understanding the Nano science and Applications • To help them understand in broad outline of Nano science and Nanotechnology				

Course Outcomes

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

CO1	Apply the students the essential role of Nano science.	Applying
CO2	Understand the classification nano structured materials.	Understanding
CO3	Understood the principles and Background to nanotechnology.	Understanding
CO4	Understood the principles and Characterization Techniques.	Understanding
CO5	Understand the basics Electronic Nano material Properties.	Understanding

Detailed Contents Nano Science OE-081/4287

Modules	Contents	L(Hours)	T (Hours)
I	**Introduction:** Definition of Nano-Science and Nano Technology, Applications of Nano-Technology. Introduction to Physics of Solid State: Structure: Size dependence of properties; crystal structures, face centered cubic nano particles; Tetrahedrally bounded semiconductor structures; lattice vibrations. Energy Bands: Insulators, semiconductor and conductors; Reciprocal space; Energy bands and gaps of semiconductors; effective masses; Fermi Surfaces. Localized Particles: Acceptors and deep taps; mobility; Excitons.	9	-
II	**Quantum Theory For Nano Science:** Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Potential box(Trapped particle in 3D:Nanodot), Electron trapped in 2D plane (Nano sheet), Quantum confinement effect in nano materials. Quantum Wells, Wires and Dots Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermi gas; Potential wells; Partial confinement; Excitons; Single electron Tunneling, Infrared electors; Quantum dot laser Super conductivity. Properties of Individual Nano particles Metal Nano clusters: Magic Numbers; Theoretical Modelling of Nano particles; geometric structure; electronic structure; Reactivity; Fluctuations Magnetic Clusters; Bulle to Nano structure. Semi conducting Nano particles: Optical Properties; Photo fragmentation; Columbic explosion. Rare Gas & Molecular Clusters: Inert gas clusters; Super fluid clusters molecular clusters.	12	-
III	**Growth Techniques of Nano materials:** Lithographic and Non lithographic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-CuAlO2 deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition (CVD), Synthesis of carbon nano-fibres and multi-walled carbon nano tubes, Pulsed Laser Deposition, Molecular beam Epitoxy, Sol-Gel Technique (No chemistry required), Synthesis of nano wires/rods, Electro deposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid –Solid (VLS) method of nano wires.	10	-
IV	**Microscopy:** Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy (TEM) **Spectroscopy:** Infra-red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibration Spectroscopy, Luminescence.	10	-
V	**Buckeye Ball:** Nano structures of carbon(fullerene): Carbon nano-tubes: Fabrication, structure. Electrical, mechanical, and vibration properties and applications. Nano diamond, Boron Nitride Nano-tubes, single electron transistors, Molecular machine, Nano-Biometrics, Nano Robots.	9	
	Total	**50**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	AUTHOR	TITLE
1	A.K. Bandyopadhyay	Nano Materials, New Age International
2	Poole C P and Owens F J	Introduction to Nanotechnology

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

DEPARTMENT ELECTIVE-III

Course Title	**COMPUTERISED PROCESS CONTROL**				
Course code	**IC-080 /4290**				
Scheme and Credits	L	T	P	C	Semester VIII
	3	1	0	4	
Pre-requisites (if any)	None. Desirable– Knowledge of basic Process Dynamics and Control				
Course Objectives	The objective of this course is to impart • To introduce students about Role of computers in process control • To understand the specifications Design Steps of Controlling Elements • To learn the basics of Modeling Procedures • To introduce Industrial Applications of Computer aided Process Control				

Course Outcomes

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

CO1	Understand the Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer.	Understanding
CO2	Design Phase Locked Local Loop, Mixers. Time Division Multiplexed System – TDM/PAM system	Understanding
CO3	Realize Process model, Physical model, Control Model. Modeling Procedure.	Designing
CO4	Formulate of Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.	Understanding
CO5	Design Electric Oven Temperature Control, Reheat Furnace Temperature control.	Applying

Detailed Contents	**Computerized Process Control IC-080/4290**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Basics of Computer-Aided Process Control:** Role of computers in process control, Elements of a computer aided Process control System, .Classification of a Computer –Aided Process Control System. Computer-Aided Process –control Architecture: Centralized Control Systems, Distributed control Systems, Hierarchical Computer control Systems. Economics of Computer Aided Process control. Benefits of using Computers in a Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces ,Pulse Interfaces, Standard Interfaces	10	-
II	**Industrial communication System:** Communication Networking, Industrial communication Systems, Data Transfer Techniques, Computer Aided Process control software, Types of Computer control Process Software, Real Time Operating System.	9	-
III	**Process Modeling for computerized Process control:** Process model, Physical model, Control Model, Process modeling. Modeling Procedure: Goals Definition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, and Model Validation.	9	-
IV	**Advanced Strategies For Computerized Process control:** Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.	8	-
V	**Examples of Computerized Process Control:** Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal Rolling, Computer-Aided control of Electric Power Generation Plant	7	-
	Total	**43**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Singh,S.K	Computer Aided Process control /PHI – 2007
2	S.K. Singh	Process Control Concepts Dynamics and Control, PHI
3	Krishna Kant	Computer Based Industrial Control, Second Edition, PHI
4	C.D. Johnson	Process Control Instrumentation Technology ,PHI

Electronics materials, Web Site, etc:http://nptel.ac.in,www.gateacademy.com

Course Title	**BIOMEDICAL SIGNAL PROCESSING**				
Course code	**IC- 081/4291**				
Scheme and Credits	L	T	P	C	Semester VIII
	3	1	0	4	
Prerequisites(if any)	None Desirable– Knowledge of Digital Signal Processing				
Course Objectives	• To learn about the acquiring various Biomedical Signals for analysis. • To Measure the Amplitude and Time Intervals if Biomedical Signals. • To obtain Neurological Signal Processing by applying Compression Algorithms. • To Analyze EEG and EP Evaluation.				

Course Outcomes

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

CO1	Understanding the Acquisition of Biomedical Signals Analyzing them.	Evaluating
CO2	Measurement and Analysis of Amplitudes and Time intervals.	Applying
CO3	Applying Different Algorithms for data reduction and Neurological Signal Processing.	Evaluating
CO4	Analyzing EEG analysis by spectral Estimation.	Understanding
CO5	Evaluating the EP Estimation by adaptive Filters.	Applying

Detailed Contents	**Biomedical Signal Processing IC-081/4291**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Introduction to Bio-Medical Signals:** Classification, Acquisition and Difficulties during Acquisition. Basics of Electrocardiography, Electroencephalography, Electromyography & electro-retino graphy . Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field.	10	-
II	**ECG:** Measurement of Amplitude and Time Intervals, QRS Detection (Different Methods), ST Segment Analysis, Removal of Baseline Wander And Power line Interferences, Arrhythmia Analysis, Portable Arrhythmia Monitors.	9	-
III	**Data Reduction:** Turning Point algorithm, AZTEC Algorithm, Fan Algorithm, Huffman and Modified Huffman Coding, Run Length Coding. EEG: Neurological Signal Processing, EEG characteristic, linear prediction theory, Sleep EEG, Dynamics of Sleep/Wake transition. Study of pattern of brain waves, Epilepsy-Transition, detection and Estimation.	10	-
IV	**EEG Analysis By Spectral Estimation:** The Bt Method, Periodo gram, Maximum Entropy Method & AR Method, Moving Average Method. The ARMA Methods, Maximum Likelihood Method.	8	-
V	**EP Estimation:** by Signal Averaging, Adaptive Filtering:- General Structures of Adaptive filters, LMS Adaptive Filter, Adaptive Noise Cancelling, Wavelet Detection:-Introduction, Detection By Structural features, Matched Filtering, Adaptive Wavelet Detection, Detection of Overlapping Wavelets.	10	-
	Total	**47**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Willis J. Tomkin,	"Biomedical Digital Signal Processing", PHI.
2	D. C. Reddy	"Biomedical Signal Processing", McGraw Hill
3	Crommwell, Weibel and Pfeifer	"Biomedical Instrumentation and Measurement", PHI
4	Rangaraj M. Rangayyan	"Biomedical Signal Analysis A Case Study Approach", John Wiley and Sons Inc.
5	John G. Webster	"Medical instrumentation Application and Design", John Wiley & Sons Inc.

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

Course Title	**ANALYTICAL INSTRUMENTATION**				
Course code	**IC- 082/4292**				
Scheme and Credits	L	T	P	C	Semester VIII
	3	1	0	4	
Prerequisites(if any)	None Desirable– Knowledge of Fundamentals of Measurement and Physical Chemistry				
Course Objectives	• To learn about analytical instrumentation. and Sampling of liquid and gas. • To analyze and estimate Gases • To obtain the measurement of chemical Composition • To Understand Spectrochemical Analysis				

Course Outcomes

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

CO1	Understanding the Applications of Analytical Instrumentations and Sampling systems for fluids.	Understanding
CO2	Analysis of Gas by chromatography and Estimation of Gasses in Binary Complex Gas Mixtures.	Analyzing
CO3	Measurement of Humidity and moisture by Hygrometer, NMR Method	Evaluating
CO4	Measurement of Viscosity and PH	Evaluating
CO5	Apply appropriate equations and principles to analyze pipe flow problems.	Applying

Detailed Contents	**Analytical Instrumentation IC-082/4292**		
Modules	**Contents**	**L (Hours)**	**T (Hours)**
I	**Introduction:** Difference between analytical and other instruments, sampling, sampling system for liquids and gases, sampling components, automatic and faithful sampling	9	-
II	**Gas Analysis:** Gas Chromatography – principles & components, Thermal conductivity gas analyzers, Heat of reaction method, Estimation of Oxygen, Hydrogen, Methane, CO2, Carbon monoxide etc. in binary or complex gas mixtures, paramagnetic oxygen analyzer, Electro chemical reaction method, Polarography, Density measurement.	10	-
III	**Humidity and Moisture Measurements:** Humidity measurement: definitions – absolute, specific, relative humidity and dew point, Dry and wet bulb psychrometer, Hair hygrometer, dew point meter. Moisture Measurement: definitions, electrical methods, NMR method, IR method.	9	-
IV	**Chemical Composition Measurements:** Newtonian and Non Newtonian flow, Measurement of viscosity and consistency, Laboratory and on line methods, Measurement of pH: - definition and methods, redox potential, electrical conductivity, conductivity cell and applications, density measurement: solids, liquids, gages.	9	-
V	**Spectrochemical Analysis:** Classification of techniques, Principles and components, emission spectrometry:-flame emission, atomic absorption type, Dispersive techniques, scheme for UV, IR and near IR analysis, comparison of methods, X-ray analyzers NMR spectrometry, ESR spectroscopy, Mass spectrometry.	10	-
	Total	**47**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Patranbis D,	"Principles of Industrial Instrumentation" , Tata McGraw Hill Pub., New Delhi (2008)
2	R. P.Khare	"Analysis nstrumentation an Introduction" C.B.S. Publication, Delhi (2019)
3	R.S Khandpur	"Handbook of Analytical Instruments 2nd Edn (7th reprint)", Tata McGraw Hill Pub, New Delhi (2000)

Course Title	**FILTER DESIGN**				
Course code	**IC- 083/4293**				
Scheme and Credits	L	T	P	C	Semester VIII
	3	1	0	4	
Prerequisites(if any)	None Desirable– Knowledge of Network Synthesis and Analog Integrated Circuits				
Course Objectives	• To Understand the Operation and Classifications of Filters • To Design Analog filter and Compare characteristics of different Approximations. • To Design BiQuad and evaluate its parameters • To Apply Switched Capacitors to obtain Higher order Programmable Filters.				

Course Outcomes

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

CO1	Review of Operational Amplifier and Classifications of Filters	Understanding
CO2	Design Analog Filters and Applying Filter Approximations and Analyze their Characteristics	Analyzing
CO3	Design BiQuad filters to obtain Multifunction Filters and Evaluating its parameters.	Evaluating
CO4	Applying Tran's conductor Networks to obtain Higher Order Filters Programmable Filters.	Applying
CO5	Designing Filters using Switched capacitors.	Designing

Detailed Contents	**Filter Design IC-083/4293**		
Modules	**Contents**	**L(Hours)**	**T (Hours)**
I	**Review of op-amps circuits, Categorization of filters**-Low-pass filter, High-pass filter, bandpass filter, band-reject filter, Gain equalizers, and Delay equalizers	9	-
II	**Approximation Theory:** Butterworth approximation, Chebyshev approximation, Inverse Chebyshev approximation, Basic of sensitivity, Frequency Transformations.	8	-
III	**Three amplifier Bi quad:** Basic low pass and band pass circuit, realization of the general Bi quadratic Functions, summing of four Amplifier bi quad, feed forward three amplifier bi quad, Passive Ladder structures, Inductor Substitution using Gyrator, Transformation of elements using the FDNR. Active ladder filters. Active R filters.	10	-
IV	Elementary trans conductor building blocks, resistors, integrators, amplifiers, summers, gyrator, First and second order filters, higher order filters.	8	-
V	**Switched capacitor filters:** The MOS switch, The switched capacitor, first order building blocks, second order sections, sampled data operation, Switched capacitor first and second order filters, Bilinear transformation based SC filter design.	10	-
	Total	**45**	**-**

L: Lecture, T: Tutorial, P: Practical, C: Credits, CO: Course Outcomes

Suggested Books

S.N.	**AUTHOR**	**TITLE**
1	Gobind Daryanani	"Principles of active network synthesis and design",John Wiley & Sons
2	R. Schaumann, M. E. Van Valkenburg	"Design of analog filters", Oxford University
3	Rolf Schaumann	"Analog Filter Design"2nd Indian Edition, Oxford Publications

Electronics materials, Web Site, etc: http://nptel.ac.in,www.gateacademy.com

LABORATORY SEMESTER-8

Course Title	**BIOMEDICAL INSTRUMENTATION LAB**				
Course code	**IC-851 /40298**				
Scheme and Credits	L	T	P	C	Semester VIII
	0	0	2	1	
Pre-requisites(if any)	None. Desirable– Knowledge of basic human anatomy and physiology				
Course Objectives	The course is designed to make the participants capable of testing, calibration & repairing of various medical electronics equipment's.				

Course Outcomes

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

CO1	Differentiate and analyze the biomedical signal sources	Understanding
CO2	Elucidate cardiovascular system and related measurements.	Applying
CO3	Explain the respiratory and nervous systems and related measurements	Understanding
CO4	Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc.	Applying
CO5	Analyze the different types of therapies for suitable applications.	Evaluate

Detailed Contents	**Biomedical Instrumentation Lab IC-851/40298**
S.No.	**Practical**
1	Data acquisition and analysis system a) To become familiar with the format of data display in the BIOPAC Student Lab data window b) To learn how to position data within the data window by using software tools and pull-down menus. c) To learn how to select and use the correct measurement tools for extracting information from the data. d) To learn how to use the journal to record measurements and write notes.
2	Electroencephalography: Alpha, Beta, Delta and Theta rhythms a) To record an EEG from an awake, resting subject with eyes open and eyes closed b) To identify and examine alpha, beta, delta and theta components of the EEG complex.
3	Electrocardiography-I: elements of electrocardiogram a) To become familiar with the electrocardiograph as a primary tool for evaluating electrical events within the heart. b) To correlate electrical events as displayed on the electrocardiogram with the mechanical events that occur during the cardiac cycle. c) To observe changes in the electrocardiogram associated with breathing, body position, exercise, body size and age. d) To anticipate the nature of changes in the electrocardiogram associated with pathology of the heart.
4	Systemic blood pressure a) To use an auscultatory method for an indirect determination of systemic arterial systolic and diastolic blood pressures and to correlate the appearance and disappearance of vascular sound with systolic and diastolic pressures, respectively. b) To measure, record, and compare systemic arterial blood pressure in the right arm and the left arm of the same subject under identical conditions.
5	The cardiac cycle and heart sounds a) To listen to human heart sounds and qualitatively describe them as to intensity or loudness, pitch, and duration. b) To correlate the human heart sounds with the opening and closing of cardiac values during the cardiac cycle and with systole and diastole of the ventricles.
6	The electrocardiogram and the peripheral pressure pulse a) To become familiar with the principle of plethysmography and its usefulness in qualitatively assessing peripheral changes in blood volume. b) To observe and record changes in peripheral blood volume and pressure pulse under a variety of both experimental and physiologic conditions.
7	The respiratory cycle a) To observe and record normal respiratory rate and depth utilizing pneumograph and air temperature transducers.
8	Pulmonary function tests: volumes and capacities a) To observe experimentally, record, and /or calculate selected pulmonary volumes and capacities. b) To compare the observed values of volume and capacity with predicted normal. c) To compare the normal values of pulmonary volumes and capacities of subjects differing in sex, age, weight, and height.
9	Pulmonary function tests: forced expiratory capacity, maximum voluntary ventilation a) To observe experimentally, record, and/or calculate forced vital capacity (FVC), forced expiratory volume (FEV), and maximal voluntary ventilation (MVV).

Course Title	**Project**				
Course code	**IC-852/40297**				
Scheme and Credits	L	T	P	C	Semester VIII
	0	0	16	8	
Pre-requisites(if any)	None. Desirable– Knowledge of basic PCB Lab				
Course Objectives	The course is designed to make the participants capable of testing, calibration & repairing of various medical electronics equipment's.				

Course Outcomes

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

CO1	Demonstrate a sound technical knowledge of their selected project topic	Understanding
CO2	Identify the problem, formulation and solution	Evaluating
CO3	Design engineering solutions to complex problems utilizing a systems approach	Understanding
CO4	Develop an engineering project	Applying
CO5	Demonstrate the knowledge skills and attitude of a professional engineer	Understanding
CO6	Improve the managerial skills to meet the industry	Understanding