Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/ Sci./College/NEP-2020/79/2024

It is hereby inform to all concerned that, the syllabus prepared by the Board of Studies and recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 08 April 2024 has accepted the Syllabus of First and Second Year M.Sc.Electronics (Ist to IVth semester) under the Faculty of Science & Technology as per Norms of National Education Policy – 2020 run at the Affiliated Colleges, Dr.Babasaheb Ambedkar Marathwada University** as appended herewith.

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Chhatrapati Sambhajinagar
-431 004.
REF.NO. SU/SCI./2024/25597-605
Date:- 07.06.2024.

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Deputy Registrar,
Academic Section.

Copy forwarded with compliments to :-

1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,

2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation, Dr.Babasaheb Ambedkar Marathwada University,Chhatrapati Sambhajinagar.

2] The Section Officer,[M.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University,Chhatrapati Sambhajinagar.

3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University,Chhatrapati Sambhajinagar.

5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University,Chhatrapati Sambhajinagar.

6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR -431004 (MS), INDIA

FACULTY OF SCIENCE AND TECHNOLOGY

Master of Science in Electronics

(M. Sc. in Electronics)

(2 Years P.G. Program)

As Per

National Education Policy-2020

Course Structure and Curriculum
(Outcome-based Curriculum)

For University Department and Affiliated Colleges

Dr. Babasaheb Ambedkar Marathwada University,
Chhatrapati Sambhajinagar–431004, (M.S.)

Effective from the Academic Year 2024-25

PREFACE

The National Education Policy (NEP) 2020, implemented in India, marks a significant stride towards a holistic and transformative educational framework. This policy aims to revolutionize the country's education system by fostering a learner-centric approach, promoting critical thinking, and nurturing creativity among students. With its emphasis on early childhood education, vocational training, and multi-disciplinary learning, the NEP 2020 seeks to equip students with relevant skills for the 21st-century world. It also focuses on bridging the digital divide and leveraging technology for effective teaching and learning. By encouraging flexibility in curriculum and assessment methods, promoting the mother tongue as a medium of instruction, and ensuring inclusive education, the NEP 2020 endeavors to build a robust and inclusive education ecosystem that prepares learners for the challenges and opportunities of the future.

On the other hand Outcome Based Education (OBE) is the educational approach which focuses on student centric education in the context of the development of personal, social, professional and knowledge (KSA) requirements in one's career and life. It is the decade ago curriculum development methodology. The educational triangle of *LEARNING-ASSESSMENT-TEACHING* is the unique nature of the OBE approach. The curriculum practices such as the Competency Based Curriculum, Taylor's Model of Curriculum Development, Spadys' Curriculum principles, Blooms taxonomy and further use of assessment methodologies like, Norm-reference testing and Criterion reference testing, etc is being practiced since decades. It is also interesting to know that, globally, different countries and universities adopts the curriculum development models/approaches such as, CDIO (Conceive-Design-Implement-Operate), Evidenced Based Education, Systems' Approach, etc as the scientific and systematic approaches in curriculum design.

The authorities of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S.) in-lieu of accreditation standards of National Assessment and Accreditation Council, decided to opt for National Education and Policy and Outcomes Based Education (OBE). As the part of the decision, different meetings, workshops and presentations were held at the campus of university.

This document is the outcome of different meetings and workshops held at university level and department level. The detailed document is designed and the existing curriculum of the department is transformed in to the framework of NEP with OBE. This is the first step towards the implementation of NEP with OBE in the university departments and affiliated colleges. The document will serve all stakeholders in the effective implementation of the curriculum. The OBE is continuous process for quality enhancement and it will go a long way in order to enhance the competencies and employability of the graduates/Post-graduates of the university departments and affiliated colleges.

Course and Credit Distribution Structure for
Two Years Post Graduate Programme with Multiple Entry Exit Options

Class: M. Sc. First Year ; First Semester, Subject: Electronics

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Discipline Specific Core Course (DSC) Mandatory	ELET/DSC/500	Electronic Devices	2	--	2	--	14
	ELET /DSC/501	Industrial Electronics	2	--	2	--	
	ELET /DSC/502	Sensor Fundamentals	2	--	2	--	
	ELET /DSC/503	Network Analysis and Synthesis	2	--	2	--	
	ELEP /DSC/526	Practical Based on ELET/DSC/500	--	4	--	2	
	ELEP /DSC/527	Practical Based on ELET/DSC/501	--	4	--	2	
	ELEP /DSC/528	Practical Based on ELET/DSC/502	--	4	--	2	
DSE (Choose any one from pool of Courses)	ELET/DSE/504	Principle of Digital Electronics and circuits	2		2		4
	ELEP /DSE/529	Practical Based on ELET/DSE/504		4		2	
	OR						
	ELET/DSE/505	Control Systems	2		2		
	ELEP/DSE/530	Practical Based on ELET/DSE/505		4		2	
RM	ELET/RM/506	Research Methodology	2	---	2	----	4
	ELET/RM/531	Practical Based on ELET/RM/506		4		2	
			12	20	12	10	22

Course and Credit Distribution Structure for
Two Years Post Graduate Programme with Multiple Entry Exit Options

Class: M. Sc. First Year ; Second Semester, Subject: Electronics

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Discipline Specific Core Course (DSC) Mandatory	ELET/DSC/550	8086 Microprocessor and Programming	2	--	2	--	14
	ELET /DSC/551	Embedded System and Programming	2	--	2	--	
	ELET /DSC/552	Advanced Sensor Technology	2	--	2	--	
	ELET /DSC/553	Properties of Electronic Materials	2	--	2	--	
	ELEP /DSC/576	Practical Based on ELET /DSC/550	--	4	--	2	
	ELEP /DSC/577	Practical Based on ELET /DSC/551	--	4	--	2	
	ELEP /DSC/578	Practical Based on ELET /DSC/552	--	4	--	2	
DSE (Choose any one from pool of Courses)	ELET /DSE/554	Interfacing of 8086 Microprocessor and 8051 Microcontroller	2		2		4
	ELEP /DSE/579	Practical Based on ELET /DSE/554		4		2	
	OR						
	ELET /DSE/555	Signal Conditioning Circuits	2		2		
	ELEP /DSE/580	Practical Based on ELET/DSE/555		4		2	
	OR						
OJT/FILED PROJECT	ELEP /OJT/FP/596		--	8	--	4	4
			10	24	10	12	22

Course and Credit Distribution Structure for
Two Years Post Graduate Programme with Multiple Entry Exit Options

Class: M. Sc. Second Year ; Third Semester ; Subject: Electronics

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Discipline Specific Core Course (DSC) Mandatory	ELET/DSC/600	Programmable Logic Controllers	2	--	2	--	14
	ELET /DSC/601	Internet of Things	2	--	2	--	
	ELET /DSC/602	Electrical, Electrochemical and Spectroscopic Characterization Techniques for Electronic Devices	2	--	2	--	
	ELET /DSC/603	Fabrication Techniques for Electronic Devices	2	--	2	--	
	ELEP /DSC/626	Practical Based on ELET /DSC/600	--	4	--	2	
	ELEP /DSC/627	Practical Based on ELET /DSC/601	--	4	--	2	
	ELEP /DSC/628	Practical Based on ELET /DSC/602	--	4	--	2	
DSE (Choose any one from pool of Course)	ELET/DSE/604	Structural and Morphological Characterization Techniques for Electronic Devices	2		2		4
	ELEP /DSE/629	Practical Based on ELET /DSE/604		4		2	
		OR					
	ELET/DSE/605	Instrumentation in Process Control	2		2		
	ELEP/DSE/630	Practical Based on ELET /DSE/605		4		2	
RESEARCH PROJECT	ELEP /RP-I /646		--	8	--	4	4
			10	24	10	12	22

Course and Credit Distribution Structure for
Two Years Post Graduate Programme with Multiple Entry Exit Options

Class: M. Sc. Second Year ; Forth Semester ; Subject: Electronics

Course Type	Course Code	Course Name	Teaching Scheme (Hrs./Week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Discipline Specific Core Course (DSC) Mandatory	ELET/DSC/650	Advance Communication Systems	2	--	2	--	12
	ELET /DSC/651	Fundamentals of Energy Storage Devices	2	--	2	--	
	ELET /DSC/652	Optoelectronics	2	--	2	--	
	ELEP /DSC/676	Practical Based on ELET /DSC/650	--	4	--	2	
	ELEP /DSC/677	Practical Based on ELET /DSC/651	--	4	--	2	
	ELEP /DSC/678	Practical Based on ELET /DSC/652	--	4	--	2	
DSE (Choose any one from pool of Course)	ELET /DSE/653	Electrochemical Energy Storage Systems	2		2		4
	ELEP /DSE/679	Practical Based on ELET /DSE/653		4		2	
	OR						
	ELET /DSE/654	Micro-electromechanical System and Applications	2		2		
	ELEP /DSE/680	Practical Based on ELET/DSE/654		4		2	
	OR						
RESEARCH PROJECT	ELEP /RP-II/696		--	12	--	6	6
			08	28	08	14	22

Structure and Curriculum for Master of Science (M. Sc.) in Electronics

(As per NEP 2020)

Two-Year Post-graduate Program

Course and Credits Distribution of Two years/One Year PG/Master's Degree Program with Entry & Exit Option

Faculty of Science & Technology

Year / level	Sem.	Major subject		RM	OJT /FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First year 6.0	I	3(4) +2=14	4	4			22	PG Diploma (after 3 years degree)
	II	3(4) +2=14	4		4		22	
Cum. Cr. For PG Diploma		28	08	4	4		44	
Exit option with Post-graduate Diploma (44 credits) after first year or two semester with completion of courses equivalent to 44 credits								
Second Year 6.5	III	3(4)+2=14	4			4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3(4)=12	4			6	22	
Cum. Cr. For 1 year PG Degree		28	8	4	4	--	44	
Cum. Cr. For 2 years PG Degree		54	16	4	4	10	88	
2 Years - 4 sem.PG Degree (88 credits) after three year UG Degree or 1 Year - 2 sem. PG Degree (44 credits) after four year UG degree								
8.0			Course work Min.12 credits (3 * 4)		Training in teaching /education/pedogogy:4	16+ Ph.D. Work		Ph.D.in subject

Note- DSC-is Discipline specific Core courses and are mandatory

ABBREVIATION:

Major – Comprising Mandatory – based on core subjects
DSE- Discipline Specific Elective based on specialization
OJT – On-the- Job Training
FP – Field Project (Corresponding to the Major (Specialization) Subject
RP – Research Project (Corresponding to the Major (Specialization) Subject
Internship/Apprenticeship - (Corresponding to the Major (Specialization) Subject

Code Details:

1) Paper Codes have been started from 500 for Post Graduate first year and from 600 for Post Graduate second year
2) First Semester : Theory : 500 – 525 ; Practical : 526-545 ; Project : 546-549
3) Second Semester : Theory : 550 – 575 ; Practical : 576-595 ; Project : 596-599
4) Third Semester : Theory : 600 – 625 ; Practical : 626-645 ; Project : 646-649
5) Fourth Semester : Theory : 650 – 675 ; Practical : 676-695 ; Project : 696-699

Preamble:

Dr. Babasaheb Ambedkar Marathwada University proposes to offer a two years / one year Master programme in Science (M. Sc.) in Electronics. The curriculum design of this program is undertaken in the following framework (assumptions).

a) Although there has been remarkable progress in all sectors of education in last couple of decades, there has been increasing crisis for truly able manpower to address the growing demands for work sectors. This has led to the widening gap between the supply and demand for skilled manpower across teaching institutions, R&D organizations and industries. Such inadequacy of knowledge acquisition and dissemination has translated directly into unemployment among an increasing number of post-graduates who pass-out every year and are forced to bare-trained in order to become marketable.

   A scientifically designed framework, which will enable students at post graduate level to be ready to face the challenges of the demand driven socio-economic profile is therefore, a call of the day. Such a course should not be occupation specific and should enable students to choose from a variety of options for their career.

   This programme is designed to produce a skilled manpower in Electronics with Sensors and process control as specialized sectors of training to improve the opportunities for the unemployed youths in both the private and public sectors.

b) According to a study conducted by the Associated Chambers of Commerce and Industry of India (ASSOCHAM), there will be a deficit of 40 million working professionals and the employers would face the difficulty of filling positions because of the dearth of suitable talent and skilled person all in their industry. **This programme aims to provide some solution for this problem and this would facilitate to improve:**

   (i) Quality of training
   (ii) High drop-out rates
   (iii) Linkages with Universities and industry
   (iv) Inadequacy ofresources.

c) **This programme is intended to offer practical training and skills needed to pursue an occupation straight away. It will provide options to the students to be trained in directions which are directly aligned to land a job in a chosen profession or a skilled trade.**

d) **This program is intended to offer students with life-long independent and reflective learning skills in their career.**

Vision

To structure the Department of Electronics of University and affiliated colleges to be an Epitome of Excellence in Research and Development in the area of Sensor Technology by creating and imparting time responsive Quality Education to address Changing Scenario, keeping Research and Development at its core, for 'Anyone' at 'Anytime' and 'Anywhere'.

Mission

To achieve the vision, the Department / affiliated colleges will:

- Provide a platform for the students with broad spectrum of diversity to achieve Academic Excellence with in-built Employability in the area of Sensor Technology.
- Establish a unique learning environment to enable the students to face the challenges in the area of Sensor Technology.
- Identify the gaps between academics and industry, design the courses to impart technical and life skill as per the requirements of the region so as to improve employability and develop entrepreneurial capabilities.
- Adopt a perennial process for bringing in excellence in teaching pedagogy by providing ICT based state-of-the-art infrastructural facilitation
- Provide student centric learning environment and to establish platform for inclusive research leading to the development of creative thought process amongst research scholars keeping in mind societal needs.
- Establish centre of excellence in the area of Electronics devices (viz. Sensors, Sensor Networks, semiconductor devices, photovoltaic devices etc) to nurture innovative ideas shaping into products facilitating the spinoff and creating awareness to protect Intellectual Property (IP).
- Provide ethical and value based education by promoting activities addressing the societal needs.

Program Educational Objectives:

The objectives of M. Sc. (Electronics) program are to produce graduates who -

1. Are equipped with time relevant knowledge of Sensor Technology to address multi-disciplinary demands of R & D organizations, educational institutes and automated process in modern industries in capacity of Scientist, Education Professionals, System Developers and System Integrators.
2. Have sound background to practice advanced concepts of electronics in the areas sensor technology, Semiconductor Devices in R & D organizations, educational institutes, industry and Government settings meeting the growing expectations of stakeholders.
3. Have an ability to pursue higher studies and succeed in academic and professional careers.
4. Have the ability to address professional demands individually and as a team member communicating effectively in technical environment using modern tools.
5. Recognize the need for and possess the ability to engage in lifelong learning and will be sensitive to consequences of their work both ethically and professionally for productive professional career.

Programme Outcomes (POs):

Graduates of the M. Sc. (Electronics) program are expected to -

PO1. **The citizenship and society:** Apply broad understanding of ethical and professional skill in electronics technology in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.

PO2. **Environment and sustainability**: Apply broad understanding of impact of electronics technology in a global, economic, environmental and societal context and demonstrate the knowledge of, and need for sustainable development.

PO3. **Ethics:** Apply ability to develop sustainable practical solutions for electronics technology related problems within positive professional and ethical boundaries.

PO4. **Individual and team work:** Function effectively as a leader and as well as team member in diverse/ multidisciplinary environments.

PO5. **Communication:** Communicate effectively on complex electronics technology related activities with the scientific community in particular and with the 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.

PO6. **Project management and finance**: Demonstrate knowledge and understanding of the first principles of electronics technology and apply these to one's own work as a member and leader in a team, to complete project in any environment.

PO7. **Life-long learning**: Recognize the need for lifelong learning and have the ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO1. **Domain knowledge:** Apply the knowledge of electronics fundamental, Sensor Technology, and Semiconductor Devices to provide comprehensive solution of problems in complex electronics.

PSO2. **Problem Analysis:** Identify electronics related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using first principles of Sensor Technology, Semiconductor Devices and scientific literature.

PSO3. **Design Development of solutions:** Design/ develop solutions for problems at varied complexity in the area Sensor Technology, and Semiconductor Devices to address changing challenges put forward by market demand/ stakeholder

PSO4. **Conduct Investigation of complex problems:** Use research-based knowledge and methods to design of experiments, analyze resulting data and interpret the same to provide valid conclusions.

PSO5. **Modern tools:** Create, select, and apply appropriate techniques, resources, and modern electronics and relevant IT tools including prediction and modeling to complex electronics technology related activities with clear understanding of the limitations

Course - Program outcome Matrix:

The Program Outcomes are developed through the curriculum (curricular/co-curricular-extra-curricular activities). The program outcomes are attained through the course implementation. As an educator, one must know, ***"to which POs his/her course in contributing?"*** So that one can design the learning experiences, select teaching method and design the tool for assessment. Hence, establishing the Course-PO matrix is essential step in the OBE. The course-program outcomes matrix indicates the co-relation between the courses and program outcomes. The CO-PO matrix is the map of list of courses contributing to the development of respective POs.

The CO-PO MATRIX is provided in the below table.

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO 4	PSO5
DSC-1	√			√			√	√	√	√	√	√
DSC-3	√			√			√	√	√	√	√	√
DSC-5	√			√			√	√	√	√	√	√
DSC-7	√			√			√	√	√	√	√	√
DSE-1	√				√	√	√	√	√	√	√	√
DSC-2	√			√	√	√	√					
DSC-4	√			√	√	√	√					
DSC-6	√				√	√	√	√	√	√	√	√
RM-1	√				√	√	√	√	√	√	√	√
DSE-1	√											
DSC-8		√					√					
DSC-10		√		√			√	√	√	√	√	√
DSC-12		√		√			√	√	√	√	√	√
DSC-14		√		√			√	√	√	√	√	√

DSE-3		√		√			√	√	√	√	√	√
DSC-9		√		√			√	√	√	√	√	√
DSC-11		√			√	√	√	√	√	√	√	√
DSC-13		√			√	√	√	√	√	√	√	√
DSE-4		√			√	√	√	√	√	√	√	√
DSC-15			√	√			√	√	√	√	√	√
DSC-17			√	√			√	√	√	√	√	√
DSC-19			√	√			√	√	√	√	√	√
DSC-21			√	√			√	√	√	√	√	√
DSE-5			√	√			√	√	√	√	√	√
DSC-16			√	√			√	√	√	√	√	√
DSC-18	√	√	√		√	√	√	√	√	√	√	√
DSC-20	√	√	√		√	√	√	√	√	√	√	√
DSE-6	√	√	√		√	√	√	√	√	√	√	√
DSC-22		√		√	√	√	√	√	√	√	√	√
DSC-24		√		√			√	√	√	√	√	√
DSC-26		√		√			√	√	√	√	√	√
DSE-7		√			√	√	√	√	√	√	√	√
DSC-23		√			√	√	√	√	√	√	√	√
DSC-25	√	√	√		√	√	√	√	√	√	√	√
DSC-27	√	√	√		√	√	√	√	√	√	√	√

Target levels for Attainment of Course Outcomes:

The course outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning & teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment are measured/calculated. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.

Target level for Attainment of Program Outcomes:

The program outcome attainment is assessed in order to track the graduates' performance w.r.t target level of performance. The CO-PO attainment is the tool used for continuous improvement in the graduates' abilities through appropriate learning and teaching strategies. In order to assess students' performance with respect to abilities (at the end of course teaching/by the end of program) the course outcome attainment and program outcome attainment is measured/calculated. The program outcome attainment is governed by curricular, co-curricular and extra-curricular activities including the stakeholders' participation. The direct method and indirect method is adopted to calculate the PO attainment. The direct method implies the attainment by course outcomes contributing to respective program outcomes. And indirect method is the satisfaction/feed-back survey of stakeholders. In order to calculate the program outcome attainment, the course outcome attainment is calculated. Prior to that, the course-program outcome mapping is done.

The set target level is the set benchmark to ensure the continuous improvements in the learners/ graduates' performance.

Course Attainment Levels:

a. CO attainment is defined/set at three levels;
b. The CO attainment is based on end term examination assessment and internal assessment;
c. The Co attainment is defined at three levels in ascending order-
    i. e.g. For end term and internal examination;
    ii. Level-1: 20% students scored more than class average
    iii. Level-2: 30% students score more than class average;
    iv. Level-3: 40% students score more than class average.
d. The target level is set (e.g. Level-2). It indicates that, the current target is level-2; 30% students score more than class average. The CO attainment is measured and the results are obtained. Based on the results of attainment, the corrective measures/remedial action are taken.
e. CO Attainment = 80% (Attainment level in end term examination) + 20% (Attainment level in internal examination).

Program attainment Level:

a. PO attainment is defined at five levels in ascending order;
b. The PO attainment is based on the average attainment level of corresponding courses (Direct Method) and feed-back survey (Indirect method);
c. The PO attainment levels are defined / set as stated below;
    i. Level-1: Greater than 0.5 and less than 1.0 (0.5>1) - Poor
    ii. Level-2: 1.0>1.5 - Average
    iii. Level-3: 1.5>2.0 - Good
    iv. Level-4: 2.0>2.5 - Very Good
    v. Level-5: 2.5>3.0 - Excellent
d. The PO attainment target level is set/defined (say, Level-4). It implies that, the department is aiming at minimum level-4 (very good) in the performance of abilities by the graduates. Based upon the results of attainment, the remedial measures are taken;
e. PO Attainment = 80% (Average attainment level by direct method) + 20% (Average attainment level by indirect method).

Examples of CO Attainment:

FOR EXAMPLE: COURSE CODE/TITLE: DSC-12

e.g. For end term and internal examination;

i. Level-1: 20% students scored more than class average
ii. Level-2: 30% students score more than class average;
iii. Level-3: 40% students score more than class average

Average of Total Marks in Examination: 61.00 % Students score more than 61 is 4/12 i.e. 33.33% i.e. Levl-2

A (CO) DSC-12 = 100(2)

= 2.00

Hence, the attainment level is Level-2 and the set target level is Level-2 and therefore the CO is fully attained.

Table No. 1.0: CO Attainment Level

Course Code	CO attainment Value	Attainment	Fully Attained/Not attained	Remedial measures
DSC-1	1	2	Not Attained	Assignment, tutorials, exercise and Remedial coaching.
DSC-3	2	2	Fully Attained	
DSC-5	1	2	Not Attained	Assignment, tutorials, exercise

				and Remedial coaching.
DSC-7	3	2	Fully Attained	
DSE-1	3	2	Fully Attained	
RM-1	2	2	Fully Attained	
DSC-8	0	2	Not Attained	Assignment, tutorials, exercise and Remedial coaching.
DSC-10	3	2	Fully Attained	
DSC-12	3	2	Fully Attained	
DSC-14	1	2	Not Attained	Assignment, tutorials, exercise and Remedial coaching.
DSE-3	3	2	Fully Attained	
DSC-15	2	2	Fully Attained	
DSC-17	3	2	Fully Attained	
DSC-19	0	2	Not Attained	Assignment, tutorials, exercise and Remedial coaching.

Example of PO Attainment:

The attainment of PO will have to be calculated after declaration of IInd year result every year.

Table No. 2.0 PO Attainment Level

PO/PSO number	Description of PO/PSO	Attainment level	Target level	Fully attained/ Not Attained	Remedial Measures

i) Planned Actions for Course Attainment:

ii) Planned Actions for Program Outcome Attainment:

After calculating attainment of COs and POs, gap needs to be identified and a comprehensive plan needs to be prepared for bridging the gaps.

Eligibility:

Candidates seeking admission to the first Semester of M. Sc. in Electronics must possess following eligibility criteria.

- Must have passed B. Sc., (10 + 2 + 3) degree with Electronics OR Physics as one of the optional subjects OR have passed B. Sc. (Hons.) with electronics OR Physics.

  OR

- Must have passed B. Voc degree with Industrial Automation

  OR

- Must have passed B. E. / B. Tech with Electronics & Telecommunication Engineering / Electronics Engineering / Instrumentation Engineering

Course Fees:

As decided by the University

Number of Seats: 20 (University Department)

The Intake capacity of M. Sc. Electronics will be 20 as under 'Self Finance Mode'

Admission / Promotion Process: (University Department)

In response to the advertisement for registration, interested students will have to register themselves. One of the following methods will be adopted for admission.

- Admission will be done on the basis of performance of students at Common Entrance Test (CET). The CET will be conducted in the month of June every year.

  OR

- Admission process declared by the University

There is Full Carry on for M. Sc i.e. **irrespective** of individual performance in first year; a student will be promoted to Second Year. However, for obtaining M. Sc. Degree, a student will have to complete all semesters successfully within N+ 2 years, where N stands for duration of the Programme. It also offers multiple exit/entry. Students can exit after completion of one year and can enter into the system (second year) with 5 years from the date of first time registration.

Dropout students will be allowed to register for respective semester as and when the concerned courses are offered by the department, **HOWEVER HE / SHE SHOULD NOT EXCEED MORE THAN TWICE THE DURATION OF THE COURSE FROM THE DATE OF FIRST REGISTRATION AT PARENT DEPARTMENT / COLLEGE.** The admission of the concern student will be automatically cancelled if he / she fail to complete the M. Sc. degree within a period of maximum four years / eight semesters.

Choice Based Credit System (CBCS):

The choice based credit system is going to be adopted by the University. This provides flexibility to make the system more responsive to the changing needs of our students, the professionals and society. It gives greater freedom to students to determine their own pace of study. The credit based system also facilitates the transfer of credits. Students will have to earn 88 credits for the award of two years Master of Science (M. Sc.)

Credit-to-contact hour Mapping:

(a) One Credit would mean equivalent of 15 periods of 60 minutes each for theory lecture.

(b) For lab course/ workshops/internship/field work/project, the credit weightage for equivalent hours shall be 50% that for lectures /workshop

(c) For self-learning, based on e-content or otherwise, the credit weightage for equivalent hours of study should be 50% or less of that for lectures/workshops.

Attendance:

Students must have 75 % of attendance in each course for appearing examination, otherwise he / she will be strictly not allowed for appearing the semester examination of each course. Frequent absence from regular lecture/practical course may lead to disqualification from continuous assessment test (CAT)process in respective subject.

Departmental Committee:

The Departmental Committee (DC) of the Department will monitor smooth functioning of the program.

Results Grievances / Redressal Committee

Grievances / redressal committee will be constituted in the department to resolve all grievances relating to the evaluation. The committee shall consist of Head of the department, the concerned teacher of a particular course and senior faculty member of Department of Committee. The decision of Grievances / redressal committee will have to be approved by Department committee.

Evaluation Methods:

- The assessment will be based on **40:60 ratio** of **continuous assessment test (CAT) / Continuous Internal Assessment (CIA) and end semester examination**. **Separate and independent passing in continuous assessment test (CAT) and end semester examination will be mandatory**. In case of failure in CAT of a particular course, students will have to appear for the same CAT, at his/her own responsibility in the next academic year, when the same course is offered during regular academic session. However, in case of failure in **end semester examination** in particular course(s), exam will be conducted in immediate subsequent semester.

- In case a student fails in certain course(s) in a particular semester and the same course(s) are modified/ revised/ removed from the curriculum in due course, the student will have to appear as per the newly framed curriculum and/or pattern in subsequent semester, at his/her own responsibility.

Continuous Assessment Test (CAT)/ Continuous Internal Assessment (CIA):

Three CIA, each of 20% marks would be conducted at different phases (25 %, 50% and 75% of completion of syllabus OR 25, 50 and 75 working days out 90 working days of the semester) throughout the semester. Each concurrent assessment (CIA-I, II, III) will be mapped to the course learning outcomes. Total performance in CIA (i.e. 40 %) would be based on best two out of three CIA examination. Course teacher will have liberty to choose variety of assessment tools/methods (class test, individual assignment, tutorial, seminar presentation, group discussion, case study, participatory & industry-integrated learning, field work, practical activity, problem solving exercises, participation in academic events, mini project work, quiz etc.) which may be deemed to be appropriate for assessing the relevant course outcome. Total performance in CIA (i.e. 40%) would be based on best two out of three CIA examinations and taking average of best two CIA.

The outline for distribution of marks for continuous assessment activities for CIA (I), CIA (II) and CIA (III) of a course shall be as under.

Table-I : DISTRIBUTION OF MARKS FOR CONTINUOUS ASSESSMENT ACTIVITIES

Sr. No.	Particulars	25% of completion of syllabus OR 25 working days out of 90 working days of semester (CIA-I)	50% of completion of syllabus or 50 working days out of 90 working days of semester (CIA-II)	75% of completion of syllabus or 75 working days out of 90 working days of semester (CIA-III)	Average of Best Two out of three CIA
1	Session Test	10% marks	10% marks	10% marks	20% marks
2	Seminar presentation/ Activity/Case Study/Assignments/Field Project/Project work etc.	10% marks	10% marks	10% marks	20% marks
	Total	**20% marks**	**20% marks**	**20% marks**	**40% marks**

End Semester Examination:

- Upon first-time examination for a semester, candidates must register for all the papers of that semester. For both summative and formative assessments, candidates must be enrolled and apply for the semester examination by paying the required fees. Additionally, candidates are required to register for all papers or any previously failed papers for that semester.
- The university will conduct semester-end examinations, accounting for 60% of the maximum marks allotted for theory, practical/professional skill-based activities, and research projects, after the completion of academic activities of the semester. Evaluation of the SEE (End Semester End Examination) of OJT (On-the-Job Training) will occur during the 5th week of the summer break of the second semester, comprising 60% of the marks.
- Research Project Semester End Examination: A 60 marks are allocated for the Semester End Research Project Evaluation, to be conducted jointly by internal and external examiners.
- Duration of theory examination shall be 2 hours for 60 marks per course.
- Duration of theory examination shall be 1.30 hour for 45 marks per course.
- Duration of theory examination shall be 1.0 hours for 30 marks per course.
- Duration of practical examination shall be 3 hours for 50 marks per course.
- OJT/Field project/research project examinations will be conducted in accordance with the university's evaluation rules for OJT/Internship/Field projects/research projects mentioned in this guidelines.

Structure / pattern of Question paper:

- Structure / Pattern of semester end examination (SEE) question paper of (theory course) will be as below:

- **Structure / Pattern of 60 Marks Theory Course**

  - The SEE of theory course shall have two parts (20 + 40 = 60 Marks)
  - Part A shall be consisting of 10 questions having 2 marks each (multiple choice questions / fill in the blanks/ answer in sentence) as compulsory questions and it should cover entire course curriculum (20 Marks)
  - Part B shall be consisting of 6 questions (10 marks for each question) (02 questions from each of 03 units / covering the entire syllabus) and students shall have to attempt any 04 questions out of 06 (40 Marks).
  - Wherever possible 20 to 30% weightage can be given to problems/ numerical wherein use of non-programmable scientific calculator may be allowed.
  - Number of sub questions (with allotment of marks) in a question may be decided by the examiner.

- **Structure / Pattern of 45 Marks Theory Course**

  - The SEE of theory course shall have two parts (10 + 35 = 45 Marks)
  - Part A shall be consisting of 5 questions having 2 marks each (multiple choice questions / fill in the blanks/ answer in sentence) as compulsory questions and it should cover entire course curriculum (10 Marks)
  - Part B shall be consisting of 6 questions (7 marks for each question) (02 questions from each of 03 units / covering the entire syllabus) and students shall have to attempt any 05 questions out of 06 (35 Marks).
  - Wherever possible 20 to 30% weightage can be given to problems/ numerical wherein use of non-programmable scientific calculator may be allowed.
  - Number of sub questions (with allotment of marks) in a question may be decided by the examiner.

- **Structure / Pattern of 30 Marks Theory Course**

  - The SEE of theory course shall have two parts (10 + 20 = 30 Marks)
  - Part A shall be consisting of 5 questions having 2 marks each (multiple choice questions / fill in the blanks/ answer in sentence) as compulsory questions and it should cover entire course curriculum (10 Marks)
  - Part B shall be consisting of 6 questions (5 marks for each question) (02 questions from each of 03 units / covering the entire syllabus) and students shall have to attempt any 04 questions out of 06 (20 Marks).
  - Wherever possible 20 to 30% weightage can be given to problems/ numerical wherein use of non-programmable scientific calculator may be allowed.

- Number of sub questions (with allotment of marks) in a question may be decided by the examiner

Earning Credits:

At the end of every semester, a letter grade will be awarded in each course for which a student had registered. A student's performance will be measured by the number of credits that he/she earned by the weighted Grade Point Average (GPA). The SGPA (Semester Grade Point Average) will be awarded after completion of respective semester and the CGPA (Cumulative Grade Point Average) will be awarded at the final exit.

Grading System:

- The grading reflects a student-own proficiency in the course. A ten point rating scale shall be used for the evaluation of the performance of the students to provide letter grade for each course and overall grade for the Master Programme. Grade points are based on the total number of marks obtained by him / her in all heads of the examination of the course. The grade points and their equivalent range of marks are shown in Table-I

Table – I: Ten point grade and grade description

Marks Obtained (%)	(SGPA/CGPA)	Grade Point	Letter Grade	Description
90-100	9.00- 10	10	O	Outstanding
80-89	8.00-8.99	9	A^+	Excellent
70-79	7.00-7.99	8	A	Very Good
60-69	6.00-6.99	7	B^+	Good
55-59	5.50-5.99	6	B	Above Average
50-54	5.00-5.49	5	C	Average
40-49	4.00-4.99	4	P	Pass
Below 40	Below 4.0	0	F	Fail
Absent	Absent	0	Ab	Absent

- Non-appearance in any examination / assessment shall be treated as the students have secured zero marks in that subject examination / assessment.
- Minimum P grade (4.00 grade points) shall be the limit to clear / pass the course / subject. A student with F grade will be considered as "failed" in the concerned course and he / she has to clear the course by appearing in the next successive semester examinations.
- Every student shall be awarded grade points out of maximum 10 points in each subject (based on 10 point scale). Based on the grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and CGPA will be given at final exit.

Computation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)

Grade in each subject / course will be calculated based on the summation of marks obtained in all five modules.

The computation of SGPA and CGPA will be as below

- Semester Grade Point Average (SGPA) is the weighted average points obtained by the students in a semester and will be computed as follows

$$SGPA = \frac{\text{Sum (Course Credits) X Number of Grade Points in concerned Course Gained by the Student}}{\text{Sum (Course Credits)}}$$

The SGPA will be mentioned on the grade card at the end of every semester.

- The Cumulative Grade Point Average (CGPA) will be used to describe the overall performance of a student in all semester of the course and will be computed as under.

$$CGPA = \frac{\text{Sum (All four Semester SGPA)}}{\text{Total Number of Semester}}$$

The SGPA and CGPA shall be rounded off to the second place of decimal.

Grade Card

Results will be declared by the Centre and the grade card (containing the grades obtained by the student along with SGPA) will be issued by the university after completion of every semester. The grade card will be consisting of following details.

- Title of the courses along with code opted by the student.
- Credits associated with the course.
- Grades and grade points secured by the student.
- Total credits earned by the student in a particular semester.
- Total credits earned by the students till that semester.
- SGPA of the student.
- CGPA of the student (at final exit).

Cumulative Grade Card

The grade card showing detail grades secured by the student in each subject in all semesters along with overall CGPA will be issued by the University at final exit.

Semester – I

Semester I

ELET -500 : Electronic Devices

02 credits ; 30 Contact hours ; 50 Marks

Course Objectives:

1. To introduce students to operation of FET, MOSFET, Op-amps, oscillators and converters
2. TO make them understand biasing and amplification as well as linear and non-linear applications of Op-amp
3. To enable students to design and construct filters and converters

Course Outcomes:

After completion of the course students will be able to –

1. Apply the basic concepts in Analog electronics to solve the complex problems in electronic circuits
2. Analyse datasheets and circuit diagrams and identify circuits locks such as Op-amps Amplifiers filters
3. Design an electronic circuits using Op-amp and FET's
4. Design and develop a low cost prototype electronic circuit to address frequently occurring issues in Industries

Course Contents:

Unit – I: Field Effect Transistors (Biasing and Amplifiers) (10 Hrs.)

Introduction to FET biasing, Biasing configuration (Fixed Bias, Self-bias, Voltage divider bias, Common gate bias), D & E type MOSFET biasing, combination networks, universal J-FET bias curve, application

Introduction to FET amplifier, JFET small signal model, various configuration, (Fixed bias, self-bias, Voltage Divider, Common gate, Common drain), D & E type MOSFET, Voltage Divider configuration of D & E type MOSFET, Designing FET amplifier network, Application.

Unit – II: Special Operational Amplifier, OP-AMP Application and Non-linear Function Circuits (10 Hrs.)

High Voltage/high current amplifiers, chopper and choppers stabilized amplifier, instrumentation amplifier, isolation amplifier, bridge amplifier, Application.

Op-Amp application – DC voltmeters, V-I converter with floating load, LED Tester, Furnishing constant current to grounded load, short current measurement and I-V Conversion, Measurement of photoconductor current, current amplifier, Phase shifter, temperature to voltage converter

Nonlinear function circuit: limiters, log/anti-log multiplier/divider, peak detector, comparator Zero crossing detector with hysteresis, voltage level detector with hysteresis, On-OFF control, voltage level

detector with independent adjustment of hysteresis, set-point controller, window detector), true RM/DC converter.

Unit – III: Oscillators, Signal Generator, Timers, Counters (10 Hrs.)

Sinusoidal and relaxation oscillators: phase shift oscillator, Ring oscillator, Wien-bridge oscillator, quadrature oscillator, crystal oscillator and clock circuits, voltage controlled oscillators – sine, square and triangle, frequency synthesizers, Application, Concept of free running and one shot configuration, triangular wave generator, saw tooth wave generator, balanced modulator/demodulator, Universal trigonometric function generator (AD639), Precision sine/square wave generator, application, Timing and counting circuits: digital counters, shift register, analog and digital timers, frequency counters, PLA and PLD applications.

References:

1. Sende, B. S. – Introduction to System design using Integrated Circuits, New Age International (P), New Delhi.
2. Fitchen, F. C. – Integrated Circuits and Systems, Van Nostrand, New York.
3. Robert S. Coughlin, Frederick F. Driscoll- Operational Amplifiers and Linear Integrated Circuits; Prentice Hall of India, New Delhi
4. Ramakant A Gaikwad; 2000; OP-AMP and Liner Integrated Circuits (Fourth Edition); PHI Learning PVT LTD; Delhi (India)
5. Boylestad R. L., Nashelsky L. – Electronic Devices and Circuit Theory, Pearson Education, New Delhi

ELET-501 : Industrial Electronics

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To introduce students to power electronics components
2. To understand them the operating characteristics of these power devices
3. To enable students to design triggering ON-OFF circuits

Course Outcomes:

After completion of the course students will be able to –

a) Apply principles of SCR, Power MOSFET, IGBT, and UJT for various Industrial applications.
b) Design a single phase, three phase full wave and half wave rectifier circuits.
c) Analyse the complex problems in power electronic circuits providing solution to problem.
d) Develop a prototype based power electronic circuits showing the best solution towards a particular problem.

Course Contents:

Unit – I: Thyristor and related power Devices **(10 Hrs.)**

Thyristor fundamentals, Structure of thyristor, Principal of operation of SCR, Static anode cathode characteristics, Gate circuit parameter, Turn-On method of thyristor, Dynamic turn on switching characteristics, turn-off mechanism, TRIAC:the triac, triac firing circuit, Power MOSFET:Introduction, MOSFET characteristics, comparison of MOSFET with BJT.Insulated gate bipolar transistor (IGBT):Basic structure and working, IGBT characteristics, switching characteristics.Unijunction transistor: Introduction, UJT relaxation oscillator. Programmable UJT: Introduction, PUT relaxation oscillator.

Unit – II: Gate Triggering Circuits **(10 Hrs.)**

Introduction, firing of thyristor, pulse transformer, optical isolator, gate triggering circuit, resistance firing circuit, resistance capacitance firing circuit, resistance capacitor full-wave trigger circuit, UJT as an SCR trigger, synchronized triggering (ramp triggering), Phase controlled using pedestal and ramp triggering.

Unit – III: Phase Controlled Rectifiers **(10 Hrs.)**

Introduction,Phase angle control, Single phase half wave controlled rectifier with Resistive load, with inductive load,Effect of freewheeling diode.
Single phase half wave controlled rectifier: with Resistive load, with inductive load, Effect of freewheeling diode. Fully controlled bridge rectifier:with Resistive load, with resistive inductive load. With Resistive load, with inductive load,Effect of freewheeling diode

References:

1. Power Electronics – M. D. Singh, K. Khanchandani, (TMH) 2004, ISBN0-07463369-4
2. Power Electronics, M. S. Jamil Asghar, PHI, 2006, ISBN: 81-203-23963.
3. Principles of Electronics- V. K. Mehta, Rohit Mehta; S. Chand and company Ltd. 2012 ISBN: 81-219-2450-2.
4. Power Electronics – Dr. P. S. Bhimbra, Khanna Publishers, Fifth Edition, 2014 Reprint, New Delhi
5. Electrical circuit and Basic Semiconductor Electronics, Pragati Prakashan Meerut, 2010, ISBN: 978-93-5006-302-6
6. Industrial Electronics, S. N.Biswas, Dhanpatirai and Sons, 1996.

ELET-502 : Sensor Fundamentals

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To facilitate the students to understand
   a) the concepts of sensor
   b) the concept of different principles of sensors
2. To provide an opportunity to the students to enter into sensor research
3. To create enthusiasm among the students to undertake research in sensors

Course Outcome:

Students will be able to -

1. understand and explain Sensors, characteristics of sensors, optical fiber and optical sensors.
2. analyze the system based on sensor and actuators.
3. design and develop sensor devices
4. Students will be capable to undertake research in Sensors.

Course Contents:

Unit - I: Introduction **(10 Hrs.)**

Sensors and Sensor Science, Sensors – Eyes and Ears of Machines, The Term 'Sensor', Optical Sensors, Physical Sensors, Chemical Sensors, elements of chemical sensors, **Sensor Physics**, Solids, Energy Band Model, Lattice Defects, Ionic Conductance, Hopping,Junctions and Potential Barriers, **Primary electronics for sensors** : Amplification by Operational Amplifier, Instruments for electric measurements.

Unit - II: Sensors and Sensor Characteristics **(10 Hrs.)**

Sensors, Signals, and Systems; Ideal sensor curve, ideal sensor requisite, Sensor Classifications; **Sensor Characteristics**: Transfer Function; Span (Full-Scale Input); Full-Scale Output; Accuracy; Calibration; Calibration Error; Hysteresis; Nonlinearity; Saturation ; Repeatability; Dead Band; Resolution; **Parameters of sensors**: Sensitivity, detection limit, response and recovery time, selectivity, dynamic range, linearity, stability

Unit - III: Optical Sensors **(10 Hrs.)**

Introduction of light detectors: Photodiodes, Phototransistor, Photoresistors; photovoltaic cell, Optical waveguides and fibres, types of optical fibers: single mode, multimode and graded index optical fiber, concept of TIR and ATR, Optical fibre sensors: Introduction and classification of sensors with optical

fibres, Optical fibre sensors with amplitude modulation, Sensor with wavelength modulation; Optical chemical sensors: Introduction, Optical sensors: Methods of detection, Evanescent wave sensors.

References:

1. Chemical Sensors: An Introduction for Scientists and Engineers : Grundler, Peter; Springer Berlin Heidelberg New York **(2007),** ISBN 978-3-540-45742-8
2. Modern Sensors Handbook, Editedby Pavel Ripka and AloisTipek; ISTE Ltd, USA **(2007),** ISBN 978-1-905209-66-8.
3. Handbook of Chemical and Biological Sensors; Edited by Richard F Taylor, Arthur D Little Inc., Jerome S Schultz, University of Pittsburgh ; Institute of Physics Publishing Bristol and Philadelphia; **(1996)** ISBN 0 7503 0323 9
4. Hand Book of Modern Sensors : Physics, Designs and Applications By Jacob Fraden Third Edition (Springer-Verlag New York, Inc.) **(2004)**, ISBN 0-387-00750-4.
5. Understanding Smart Sensors By Randy Frank; Second Edition; Artech House Boston . London **(2000),**ISBN 1-58053-398-1.
6. Sensors and Transducers, Third Edition By Ian R. Sinclair; Butterworth-Heinemann publication, Woburn **(2001),** ISBN 0 7506 4932 1
7. Principles of Chemical Sensors : Janata, Jiri 2nd Edition ; Springer Dordrecht Heidelberg London, New York **(2009),** ISBN 978-0-387-69930-1 e-ISBN 978-0-387-69931-8
8. Optoelectronics Devices and System SECOND EDITION by S. C. Gupta; Prentice Hall International**(2011)** ISBN: 978-81-203-5065-6
9. Optical Fibers and fiber optic communication Systems by Subir Kumar Sarkar; S Chand & Company Ltd **(2000),** ISBN:9788121914598
10. Lasers and Optical Fiber Communications by P Sarah; I.K. International Publishing House Pvt Ltd, New Delhi **(2008),** ISBN : 9788189866587 / 8189866583
11. Optoelectronics by R. A. Barapate (Tech-Max Publication) **(2003)**

ELET-503: Network Analysis and Synthesis

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

To equip the students with rigorous theoretical and practical knowledge to analyse and synthesize networks.

Course Outcomes:

- Apply the knowledge of basic circuital law and simplify the network using reduction technique.
- Analyze the circuit using Kirchoff's law and network theorem.
- Infer and evaluate transient response, steady state response, network functions.
- Equip with network synthesis study.

Course Contents:

Unit - I: Network Theorems **(10 Hrs.)**

Applications of Thevenin and Norton's theorem, Reciprocity theorem, Compensation theorem, Superposition theorem &Tellegen's theorem.

Unit - II: Time Domain Analysis of Networks **(10 Hrs.)**

Differential equation approach (first and higher order differential equations), initial conditions in networks, Laplace Transformation: Introduction to the Laplace transform approach, partial fraction expansion, Heaviside's expansion theorem, transform impedance and transform circuits, network functions.

Unit - III: Two Port Network Parameters **(10 Hrs.)**

Transmission and inverse transmission parameters, hybrid and inverse hybrid parameters, relation between parameter sets, and interconnection of two port network, Graph Theory: graph tree, link branches, basic tie and cut set, matrices for planar networks.

References:

1. M. E. Van Valkenburg, "Network Analysis", 3rd ed., Pearson.
2. M. E. Van Valkenburg, "Network Synthesis", PHI.
3. DeCarlo, R. A. and Lin, P. M., "Linear Circuit Analysis: Time Domain, Phasor and Laplace Transform Approaches", Oxford University Press.
4. Hayt, Kemmerley and Durbin, "Engineering Circuit Analysis", 8th Ed. Tata McGraw-Hill.
5. Kuo, F. F., "Network Analysis and Synthesis", 2nd Ed., Wiley India.

ELET-504: Principle of Digital electronics and Circuits

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To understand principle of digital electronics.
2. To introduces student to logic gates, flip-flops and Registers.
3. To enable student to design circuits using digital components.

Course outcome:

After completion of the course students will be able to –

a. Apply the principal of logic gates to design digital circuits.
b. Able to design memory device using flip-flops.
c. Able to undusted computer systems.

Course Content:

Unit – I: Digital Principles and Digital Logic **(10 Hrs.)**

Introduction, **Definitions for Digital:** Analog versus Digital Signals, Binary System, Ideal Digital Signals, **Digital Waveforms:** Voltage levels, Switching Time, Period and Frequency, Duty Cycle, Problems, **Digital logic:** Generating Logic Levels, The Buffer, The Tri-State Buffer, The Inverter (NOT Gate), The Tri-state Inverter, The AND Gate, The OR Gate.

The Basic Gates-NOT, OR, AND: The Inverter (NOT Gate), AND Gate with Timing Diagram, TTL AND Gate, OR Gate with Timing Diagram, TTL OR Gate, Boolean equation, Problems, **Universal Logic Gates**: NOR Gates, bubbled AND Gate, De Morgan's First Theorem, Universality of NOR Gate, Eye of the Beholder, NAND Gates, Bubbled OR Gate, De Morgan's Second Theorem, Universality of NAND Gate.

Unit – II: Flip-Flops and Registers **(10 Hrs.)**

RSFlip-Flops: NOR-Gate latch, NANO-Gate latch, **Gated Flip-Flops:** Clocked RS Flip-Flops, Clocked D Flip-Flops, **Edge-Triggered RSFlip-Flops:** Positive-Edge-Triggered RS Flip-flops, Negative-Edge-Triggered RS Flip-Flops, **Edge-Triggered DFlip-Flops, Edge-Triggered JKFlip-Flops, JK Master-Slave Flip-Flops.**

Types Of Registers: Serial in-serial out, Serial In - Parallel Out, Parallel In - Serial Out, Parallel In-Parallel Out, **Universal Shift Register and Applications:** Ring Counter, Johnson Counter.

Unit - III: Digital Computers and A Simple Computer Design (10hr)

Moving And Storing Digital Information: Memory Elements, Registers, Transferring Digital Data, Magnetic and Optical Memory, Solid state memory, **Arithmetic logic Unit:** Addition and Subtraction, Logic Functions, **Input/Output**, **Building Blocks of Computer:** Memory, Register Array, Important Hardware, Register Transfer Language, **Execution of Instructions, Macro and Micro Operations:** Instruction Cycles, Fetch Cycle, Decode Cycle, Execute Cycle.

References:

1. Digital Principles and Applications: Malvino Leach, Tata McGraw-Hill.
2. Digital Electronics: Jain R.P., Tata McGraw Hill.
3. Digital Fundamentals: Floyd T.M., Jain R.P., Pearson Education

ELET-505 : Control System

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To introduce students to the classifications of control system, controllers and complex modes of operation
2. To make students understand the advantages and limitations of various types of control systems

Course Outcomes:

1. Acquire terminologies in control system.
2. Design Control system by block diagram & Signal flow graph.
3. Estimate the stability of control system.
4. Apply different tuning method according to control operation.

Course Contents:

Unit - I: Element of control system (10 Hrs.)

Classification of control System, operational amplifier as error detector, servomechanism, Transfer function and impulse response function, Automatic control system. Block Diagram algebra; block diagram fundamentals, Canonical or simple form of control system, Block Diagram reduction rules. Signal flow graphs; signal flow graphs terms, properties of SFG, Mason's gain equation, use of mason's gain formula for electrical network.

Unit - II: Control System analysis (10Hrs.)

Transient and steady-state response analysis; first order system, second order system & higher order system. Routh's stability criterion, Root locus plots, Lead compensation & lag compensation, lead-lag compensation, Bode diagrams, Nyquist stability criterion.

Unit - III: Mathematical modelling of control system (10Hrs.)

Mathematical modeling of control system; Mechanical system, Electrical system, liquid level system, pneumatic system, Hydraulic system, Thermal system. Interacting and non interacting system; Step response of single capacity system, Step response of first order systems arranged in non-interacting mode, impulse response of first order systems arranged in non-interacting mode, Step response of first order systems arranged in interacting mode, Impulse response of first order systems arranged in interacting mode.

References:

Text:

1. Katsuhiko Ogata; 2010; Modern Control Engineering (Fifth Edition); PHI Learning PVT LTD; Delhi (India)
2. Bela G. Liptak; Process control (Third Edition), Instrument Engineer'sHandbook.
3. FaridGolnaraghi, Benjamin c. Kuo; 2009; automatic control system; John Wiley & sons, inc.
4. Interacting and non-interacting system;https://www.apexinnovations.co.in.
5. N. Barapate; 2006; Control System; Tech Max publications; Pune(India)

Suggested Reading:

1. I. J. Nagrath, M. Gopal; 2009; Control Systems Engineering (Fifth Edition); New Age International Publishers;India
2. Norman S. Nise; 2004;Control system engineering(Fourth edition);Wileyinternational edition
3. A. Nagoorkani; 2006; Control System; RBA publications; Chennai(India)
4. K. Ogata; 2002; Modern Control Engineering; Prentice Hall; NewDelhi(India)
5. Richard Dorf , Robert Bishop; 2005; Modern Control System; Pearson Education ; New Jersey

ELET-506 : Research Methodology

02 credits ; 30 Contact hours ; 50 Marks

Course Objectives:

1. To define research and describe the research process and research methods
2. To understand qualitative research and methods used to execute and validate qualitative research
3. To know how to apply the basic aspects of the research process in order to plan and execute a research project.
4. To provide insight into the processes that lead to the publishing of research.
5. To be able to present, review and publish scientific articles

Course Outcomes:

Students will be able to -

1. understand and explain research process
2. do systematic literature survey, formulation of a research topic, study design, analysis and interpretation of data.
3. to design a research approach for a specific research issue of their choice.
4. select a suitable analytical method for a specific research approach.
5. demonstrate a good understanding of how to write a research report.
6. critically assess published quantitative research with regard to the statistical methods and approaches adopted
7. create a research document for implementation research project

Course Contents:

Unit - I: Research Fundamentals and Identification of Research Problem: (10 Hrs.)

Research Fundamentals

Introduction: Definition, objectives of the research, characteristics of the research, what makes people to do research, importance of research, Qualitative and Quantitative Research: Qualitative research - Quantitative research - Concept of measurement, causality, generalization, and replication. Merging the two approaches.

Identification of Research Problem

Defining the research problem: Identification of research problems, selection of research problem, facts one should know regarding selection of research problem, the process of research problem definition, some facts involved in defining research problem, Research Design: Concept and Importance in Research - Features of a good research design - Exploratory Research Design

- concept, types and uses, Descriptive Research Designs - concept, types and uses. Experimental Design: Concept of Independent & Dependent variables, Case Studies,

Unit- II: Formulation of Research Problem (10 Hrs.)

Formulation of the problems: steps involved in defining a problem, formulation of the problems, Formulation of hypothesis: Concept of hypothesis, hypothesis testing, developing the research plan: implementation, interpreting and reporting the findings, Importance of hypothesis in decision making, Case Studies. Interpretation of Data. Measurement: Concept of measurement-what is measured? Problems in measurement in research- Validity and Reliability. Levels of measurementNominal, Ordinal, Interval, Ratio.

Unit – III : Research Report and Proposal Writing (10 Hrs.)

Introduction, research proposal writing: costing, the research proposal, rationale for the study, research objectives, research methodology, target respondents, research Centres, sample size and sample composition, sampling procedures, research project execution, research units; An insight into research report and proposal, research project synopsis, research report writing : types of research reports, guidelines for writing reports; Steps in writing report, report presentation, typing the report, documentation and bibliography, formatting guidelines for writing a good research report / research paper, Paper Writing- Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.Case Studies.

References:

1. Research Methodology by Dr. S. L. Gupta, Hitesh Gupta; International Book House Pvt Ltd **(2013),** ISBN-10: 8191064278, ISBN-13: 978-8191064278
2. Basic Research Methods-Gerard Guthrie SAGE Publications, India, Pvt Ltd, New Delhi **(2010),** ISBN-10: 8132104579, ISBN-13: 978-8132104575
3. Research Methodology-methods and techniques By C. R. Kothari, New Age International Publishers **(2011)** ISBN 978-81-224-1522-3
4. Principles of Research Methodology- Phyllis G. Supino, Jeffrey S. Borer; Springer, Verlag New York **(2012),** ISBN-ebook: 1461433592, ISBN (Hardcover): 978-1461433590
5. Research Design Qualitative, Quantitative. and Mixed Methods Approaches- John W. Creswell; SAGE Publications Ltd, UK **(2011),** ISBN-9780857023452
6. Research Methodology -A Step-by-Step Guide for Beginners- Ranjit Kumar; Sage Publications Ltd**(2010)**, ISBN- 1849203016.
7. Scientific Writing and Communication- Angelika Hofmann; Oxford University Press, US **(2010),** ISBN-13-: 978-0 199947560, ISBN-10: 01 99947562
8. Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded- Joshua Schimel, Oxford University Press, **(2011)**, ISBN: 9780199760237
9. Handbook of Scientific Proposal Writing- A.YavuzOruc; CRC Press, Taylor & Francis group **(2011)**, ISBN: 9781439869185

ELEP-526 : Lab Course Based on Electronic Devices (02 Credits)

List of Experiments:

1. Study of Instrumentation amplifier
2. Study of window comparator
3. Study of Phase shift/ Wien bridge oscillator
4. Study of voltage controlled oscillator
5. Study of typical monolithic frequency synthesizer
6. Study of PLI
7. Study of digital counters (any two types, pertinent to topic taught in theory)
8. Study of I-V and V-I converter
9. Study of comparator Zero crossing with hysteresis

(Student should complete at least 06 experiments)

ELEP-527 : Lab course based on Industrial Electronics (02 Credits)

List of Experiments:

1. Study of DC characteristics of SCR.
2. Study of firing circuits for SCR (any one type)
3. Study of DIAC
4. Study of TRIAC
5. Study of effect of variation of RC in R and RC triggering circuit on firing angle and output voltage of SCR
6. Study of the output waveform of single phase full wave controller rectifier with R and RL load, freewheel diode and measure load voltage
7. Study of effect of firing angle on output voltage in DIAC – TRIAC phase controlled
8. Study of Step UP chopper (with SCR/MOSFET/Transistor)
9. Study of Step down chopper (with SCR/MOSFET/Transistor)

(Student should complete at least 06 experiments)

ELEP-528: Lab course based on Sensor Fundamentals (02 credits)

List of experiments:

1. Determination of Numerical Aperture of PMMA optical fiber
2. Losses in Optical fiber.
3. Study of Optical to Electrical (O-E) characteristics of fiber optic Phototransistor converter.
4. Study of Electrical to Optical (E-O) characteristics of fiber optic 660nm an 850nm converter.
5. Optical fiber chemical sensor.
6. Study of Potentiometric sensor
7. Study of Displacement sensor
8. Gas sensor based on OCP (organic Conducting Polymers)
9. Gas Sensor based on Single Walled carbon nanotubes (SWNTs)
10. Study of LVDT as displacement Sensor
11. Study of Hall Effect sensor as an event counter

(Student should complete at least 06 experiments)

ELEP-529: Lab course based on Principles of Digital Electronics and circuits

(2 Credits)

1. Introduction to Digital Laboratory Equipment & IC"s
2. Verification of the truth tables of TTL gates.
3. Verify the universal logic gates.
4. Design and test of an S-R flip-flop using NOR/NAND gates.
5. Verify the truth table of a J-K flip-flop (7476).
6. Verify the truth table of a D flip-flop (7474).
7. Design of 4-bit shift register (shift right).
8. Designing and verification of MOD counters

(Student should complete at least 06 experiments)

ELEP-530 : Lab course based on Control system (2 Credits)

1. Study of open loop system
2. Study of close loop system
3. Design a signal conditioning circuit for analog controller
4. Problem solving using root locus method
5. Study of lead compensator
6. Study of lag compensator
7. Study of lead-lag compensator
8. Study of Bode and Nyquist plot to determine loop system stability
9. Study of close loop control with PID controller
10. Study of PID controller tunning using Ziegler Nichols method

(Student should complete at least 06 experiments)

ELET/RM/531: Practical Based on ELET/RM/506

02 credit

Students are expected to do the Followings

i) Select Broad topic of Research Project (to be implemented from second semester onwards)
ii) Read the Basic concepts / fundaments of broad topic
iii) Identify 10 SCOPUS / WEB OF SCIENCE Indexed Journals related to broad topic
iv) Search and download 20 research articles from above research Journals
v) Do systematic review of above 20 research articles
vi) While doing review of each of above mentioned 20 research articles, students are expected prepare notes on following points
   a) What are the objectives of the research article?
   b) What methodology has been adopted?
   c) What are prominent results?
   d) How these results of relevant to the latest development of the subject?
   e) What is novelty of research article?
   f) What are prominent shortcomings of this research a presented in this research article?
   g) What are your plans to address those shortcoming?

vii) Draft the fine-tuned title of research project
viii) Draft hypothesis
ix) Draft Objectives and Methodology
x) Draft expected outcome of the research project

At the end of semester, students are expected to prepare a report having following points

i) Fine-tuned title of Research Project
ii) Fundamental aspects of the fine-tuned research topic
iii) Hypothesis
iv) Objectives
v) Methodology
vi) Detailed Experimental plan
vii) Expected outcome
viii) References

Semester - II

Semester II

ELET-550 : 8086 Microprocessor and Programming

02 credits ; 30 Contact hours ; 50 Marks

Course Objectives:

1. To facilitate the students to understand
   a) the concepts of microprocessor .
   b) the concept of assembly language programming.
2. To provide an opportunity to the students to enter into entrepreneurship.

Course Outcome:

Students will be able to –

1. understand and explain Microprocessor architecture, physical configuration of memory, logical configuration of memory, and microprocessor programming.
2. analyze the process of Industrial automation
3. start his / her own small scale industry for manufacturing microprocessor based automated devices.
4. start his / her teaching career either in science or engineering colleges / institutes as this course is included in science as well as engineering discipline.

Course Contents:

Unit - I: Introduction **(10 Hrs.)**

Overview of Microcomputer structure and operation, memory, input / output, CPU, address bus, data bus, control bus, 8086 microprocessor family overview, **8086 internal architecture:** execution unit, (flag register, general purpose register, ALU), Bus interface unit, segment register, stack pointer register, pointer and index register [Refer Douglas and Hall book for above articles], **Pin out and pin functions of 8086 :** The pin out, power supply requirements, DC characteristics, input characteristics, output characteristics, pin connections (common pins, maximum mode pins and minimum mode pins) **Addressing Modes**: Data addressing modes: Register addressing, Immediate addressing, Direct addressing, register indirect addressing, base plus index addressing, register relative addressing, base relative plus index addressing, Programme memory addressing modes: Direct program memory addressing, relative program memory addressing, indirect program memory addressing; stack memory addressing modes.

Unit - II:Data Movement, Arithmetic and Logical Instructions **(10 Hrs.)**

MOV revised: machine language, the opcode, MOD field, register assignments, R/M memory addressing, special addressing, **PUSH/POP :** PUSH, POP, initializing the stack; **Miscellaneous**

data transfer instructions: XCHG, IN and OUT, **Arithmetic and Logic Instructions: Addition, subtraction and comparison: Addition:** Register addition, immediateaddition, memory to register addition, array addition,increment addition, addition with carry; **Subtraction:** Register subtraction, immediate subtraction, decrementsubtraction, subtraction with barrow; **Comparison, Multiplication and division**: **Multiplication**: 8 bitmultiplication, 16 bit multiplication; **Division:** 8 bit division,16 bit division; **Basic Logic Instructions:** AND, OR, Ex-OR,TEST, NOT, NEG; **Shift and Rotate: Shift:** left shift, rightshift; **Rotate:** Rotate left, rotate right

Unit - III:Program Control Instructions and Assembly Language Programming (10 Hrs.)

The Jump Group: **Unconditional jump:** short jump, near jump, far jump, indirect jumps using an index; **Conditional Jumps:** LOOP, conditional LOOPs; **Procedures**: CALL, near CALL, far CALL, indirect memory address, RET; **Machine Controland Miscellaneous Instructions:** Controlling the carry flag bit, wait, HLT, NOP; **Assembly Language Programming: Assembler directives:** ASSUME, DB, DD, DQ, DT, DW, END, ENDP, ENDS,EQU, EVEN, EXTRN, GLOBAL, GROUP, INCLUDE,LABEL, LENGTH, NAME, OFFSET, ORG, PROC, PTR,PUBLIC, SEGMENT, SHORT, TYPE [Refer Douglas andHall book for above articles **Assembly Language Programming:** Sum of an array, factorial, largest / smallest from given array, sorting of numeric array, square root.

References:

1. The Intel Microprocessors, Architecture Programming and interfacing, Barry B Brey ; Sixth Edition ; Prentice Hall International, Publications, **(2002),** ISBN-10: 0130607142, ISBN-13: 978-0130607140
2. The Intel Microprocessors, Architecture Programming and interfacing, Barry B Brey ;Eighth Edition ; Prentice Hall International, Publications **(2009),** ISBN 0-13-502645-8
3. Microprocessors and Interfacing: Programming and Hardware, Douglas V Hall : II Edition ; Tata McGraw-Hill **(1990),** ISBN-10: 0070257426, ISBN-13: 978-0070257429.
4. Microcomputer Systems: The 8086 / 8088 Family; Architecture, Programming and Design, Yu-Cheng Liu and Glenn A. Gibson, Prentice Hall International, Publications **(1986),** ISBN-10: 013580499X, ISBN-13: 9780135804995.
5. The 8086/8088 Family: Design, Programming and Interfacing, John, Uffenbeck, Prentice Hall International, Publications **(1986),** ISBN-10: 0132467526, ISBN-13: 978-0132467520

ELET-551: Embedded System and Programming

02 credits ; 30 Contact hours ; 50 Marks

Course Objectives:

Students will facilitate to –

1. understand and explain microcontroller architecture, and programming
2. analyze the process of industrial automation and design automation system using microcontroller
3. provide an opportunity to the students to enter into entrepreneurship

Course outcomes:

After completion of the course students will be able to -

1. Design and develop automated system based on 8051 Microcontroller
2. Apply the basics of number system to solve arithmetic and logical operations of 8051 microcontroller.
3. Develop assembly language programming for 8051 microcontroller.
4. Analyse and debug assembly language programme for 8051 microcontroller
5. Interface I/O devices

Course contents:

Unit - I: 8051 Microcontroller **(10 Hrs.)**

An introduction: microprocessors and microcontrollers, comparing microprocessors and microcontrollers, a microcontrollers survey, development system for microcontrollers, 8051 oscillator and clock, program counter and data pointer, A and B CPU registers, flags and program status word, internal memory, internal RAM, the stack and the stack pointer, special function registers, internal ROM; Input/ Output pins, ports and circuits: port pin circuits, port 0, port 1, port 2, port 3; external memory, counters and timers, serial data input/ output, interrupts.

Unit - II: Moving data and logical operations **(10 Hrs.)**

Move operation: Introduction, addressing modes, external data moves, code memory read only data moves, push and pop op-codes, data exchange, simple programs, logical operation: Introduction, byte level logical operations, bit level logical operation, rotate and swap operations, examples programs.

Unit - III: Arithmetic operations, Jump and call instruction **(10 Hrs.)**

Introduction, flags, instructions affecting flags, incrementing and decrementing, addition: unsigned and signed, multiple byte signed arithmetic, subtraction: unsigned and signed subtraction, multiplication and division, decimal arithmetic, examples programs; Introduction, to the jump and call program range, relative range, short absolute range, long absolute range, jumps, but jumps, byte jumps, unconditional

jumps, calls and subroutine, subroutines, calls and the stacks, calls and returns, interrupts and returns, examples problems.

References:

1. Mazidi M. A., Mazid J. G. I and McKinlay R. D- The 8051 microcontroller and embedded system – Pearson, 2nd edition 2013
2. 8051 architecture, programming and interfacing K. J. Ayala; pen ram international
3. Peat man John B – Design with microcontroller, pearson edition asia, 1998
4. Burns, alan and wellings, andy, real time systemand programming languages, 2013, harlow; Addison- Wesley
5. Raj kamal – embedded systems, TMH, new Delhi

ELET-552 : Advanced Sensor Technology

02 credits ; 30 Contact hours ; 50 Marks

Course Objectives:

1. To introduce materials and their requisite in the perspectives of sensor
2. To make understand the operation of principles of various sensors
3. To make students facilitate manufacturing techniques for sensors
4. To enable students to fabricate sensors through various technologies

Course Outcome:

After completion of the course students will be able to –

1. Classify sensor materials and technologies.
2. Analyze the system based on sensor and actuators.
3. Design experiments for sensor calibration
4. Develop sensor devices and sensor networks.
5. Design and develop sensor devices

Course Contents:

Unit - I: Sensor Materials and Sensor Matrix (10 Hrs.)

Materials: Material selection criteria, fulfillment of ideal sensor requisite, importance of 1-D materials in sensors, importance of surface area enhancement and enhancement in surface activity, Importance of size dependent Properties for sensing applications; Promising sensing materials: Carbon Nanotubes, Organic Conducting Polymers, Porphyrins and metal nanoparticles, Sensor Fabrication Technologies: AC Dielectrophoretic alignment of SWNTs and surface modification of SWNTs by OCP by charge controlled potentiostatic deposition and porphyrins by solid casting, for SWNTs, confirmation of coating by I-V measurements and electrochemical measurements;

Unit - II: Chemical Sensors (10 Hrs.)

Chemical Sensor Characteristics; Specific Difficulties; Classification of Chemical-Sensing Mechanisms; Direct Sensors: Metal-Oxide Chemical Sensors, Chemiresistive and ChemFET sensors, Electrochemical Sensors, Potentiometric Sensors, Conductometric Sensors, Amperometric Sensors, Complex Sensors: Optical Chemical Sensors Biosensor, Multisensor Arrays, Electronic Noses (Olfactory Sensors)

Unit - III: Sensors Technology (Techniques for Sensor Fabrication) (10 Hrs.)

Chemical Methods for preparation of sensor matrix: Chemical bath deposition, SILAR, Physical vapor deposition: Evaporation, Sputtering, Molecular beam epitaxy, Laser ablation deposition; Chemical vapor

deposition: APCVD and LP CVD, PE CVD, Spray pyrolysis; Electrodeposition and electroless deposition: Electroless deposition, Electrodeposition, Potentiostatic, Galvanostatic, Cyclic voltammetry: Chemical sensor fabrication technology: screen printing, spin coating, dip coating, and casting.

References:

1. Modern Sensors Handbook, Editedby Pavel Ripka and AloisTipek; ISTE Ltd, USA **(2007)**, ISBN 978-1-905209-66-8.
2. Handbook of Chemical and Biological Sensors; Edited by Richard F Taylor, Arthur D Little Inc., Jerome S Schultz, University of Pittsburgh ; Institute of Physics Publishing Bristol and Philadelphia; **(1996)** ISBN 0 7503 0323 9
3. Hand Book of Modern Sensors : Physics, Designs and Applications By Jacob Fraden Third Edition (Springer-Verlag New York, Inc.) **(2004)**, ISBN 0-387-00750-4.
4. Understanding Smart Sensors By Randy Frank; Second Edition; Artech House Boston. London **(2000),** ISBN 1-58053-398-1.
5. Sensors and Transducers, Third Edition By Ian R. Sinclair; Butterworth-Heinemann publication, Woburn **(2001),** ISBN 0 7506 4932 1
6. Chemical Sensors: An Introduction for Scientists and Engineers: Grundler, Peter; Springer Berlin Heidelberg New York **(2007),** ISBN 978-3-540-45742-8
7. Principles of Chemical Sensors : Janata, Jiri 2nd Edition ; Springer Dordrecht Heidelberg London, New York **(2009),** ISBN 978-0-387-69930-1 e-ISBN 978-0-387-69931-8
8. Optoelectronics Devices and System SECOND EDITION by S. C. Gupta; Prentice Hall International**(2011)** ISBN: 978-81-203-5065-6
9. Optical Fibers and fiber optic communication Systems by Subir Kumar Sarkar; S Chand & Company Ltd **(2000),** ISBN:9788121914598
10. Lasers and Optical Fiber Communications by P Sarah; I.K. International Publishing House Pvt Ltd, New Delhi **(2008),** ISBN : 9788189866587 / 8189866583
11. Optoelectronics by R. A. Barapate (Tech-Max Publication) **(2003)**

ELET-553 : Properties of Electronic Materials

02 credits ; 30 Contact hours ; 50 Marks

Course Objectives:

1. To make students to understand basic phenomenon as conductivity, reflection and absorption
2. To introduce students to electrical, dielectric, optical and magnetic properties of metal oxides and polymers

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

1. Understand basic phenomenon as conductivity, reflection and absorption
2. Understand electrical, dielectric, optical and magnetic properties of materials
3. Analyze the order of magnetic materials
4. Screen the wide range of materials for desired application
5. Enable to understand the defects in crystals and their effects on various properties

Course Contents:

Unit - I: Electrical and Dielectric Properties of Materials (10 Hrs.)

Conductivity, reflection and absorption, Fermi surfaces, superconductivity, thermoelectric phenomena, Conduction in metals oxides, amorphous materials,Macroscopic electric field, local electric field at anatom, dielectric constant and polarizability, ferroelectricity, antiferroelectricity, phase transition, piezoelectricity, ferroelasticity, electrostriction.

Unit - II: Optical Properties of Materials (10 Hrs.)

Optical constants and their physical significance, Kramers – Kronig Relations, Electronic inter bond and intra bond transitions, Relations between Optical properties and band structure – colour of material (FrenkelExcitons),

Unit – III : Magnetic Properties of Materials (10 Hrs.)

Dimagnetism, paramagnetism, various contributions to para and dia magnetism, Adiabatic demagnetization, Paramagnetic susceptibility; Ferromagnetism, ferrimagnetism, ferrites, antiferromagnetism, Curie point, temperature dependence of saturation magnetization, saturation magnetization at absolute zero, magnons and their thermal excitation, dispersion relation, Neutron Magnetic scattering.

References:

1. Electronic Properties of materials, R. E. Hummel Springer New York publication
2. Solid State Physics, Dekkar, Mcgraw Higher Ed publication
3. Introduction to Solid State Physics, C. Kittle, Wiley publication
4. Solid State Physics, Ashcroft, Mermin,Cengage Learning Publication
5. Principles of Electronic materials &dev, S. O. Kasap, Mcgraw Higher Ed Publication
6. Elementary Solid state physics, M. Ali Omar; Pearson Publication.

ELET-554 : Interfacing of 8086 Microprocessor and 8051 Microcontroller

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To facilitate the students to understand
   c) the concepts of microprocessor and microcontroller interfacing.
   d) the concept of interfacing devices at laboratory as well industrial level
2. To provide an opportunity to the students to enter into entrepreneurship.

Course Outcome:

Students will be able to –

1. understand and explain microprocessor and microcontroller interfacing.
2. analyze the process of Industrial automation
3. design automation system process of using 8086 microprocessor
4. start his / her own small scale industry for manufacturing microprocessor based automated devices.
5. start his / her teaching career either in science or engineering colleges / institutes as this course is included in science as well as engineering discipline

Course Contents:

Unit I :Memory Interfacing (with reference to 8086 Microprocessor) of Memory devices: 10 Hrs

Memory pin connections, ROM memory, static RAM devices, Dynamic RAM memory, Address Decoding: simple NAND gate decoder, the 3 to 8 line decoder, the dual 2 to 4 line decoder, PROM decoder, 8086 memory interface ;

Unit : II : Input / Out Interfacing(with reference to 8086 Microprocessor): 10 Hrs

Introduction to I/O interface, I/O instructions, isolated and memory mapped I/O, basic input and output interfaces, handshaking, I/O port address decoding: decoding of 8-bit I/O addresses, decoding of 16 – bit I/O address; The programmable peripheral interface: basic description of 8255, programming the 8255, mode 0 operation, an LCD display interfaced to 8255, a stepper motor interfaced to 8255, Mode 1 strobed input, mode1 strobedoutput , Mode 2 bisectional operation

Unit – III : 8051 Interfacing 10 Hrs

Interfacing 8051 microcontroller to simple switch, LED, 7-segment display, DAC, ADC, LCD, matrix keyboard and Stepper motor as well as their Assembly language programming

References :

1. The Intel Microprocessors, Architecture Programming and interfacing, Barry B Brey ; Sixth Edition ; PHI
2. Microprocessors and Interfacing : Programming and Hardware, Douglas V Hall : II Edition ; Tata McGraw-Hill
3. Microcomputer Systems : The 8086 / 8088 Family; Architecture, Programming and Design, Yu-Cheng Liu and Glenn A. Gibson ; PHI
4. The 8086/8088 Family:Design, Programming and Interfacing, John Uffenbeck, PHI
5. Mazidi M. A., Mazid J. G. I and McKinlay R. D- The 8051 microcontroller and embedded system – Pearson, 2nd edition 2013
6. 8051 architecture, programming and interfacing K. J. Ayala; pen ram international
7. Peat man John B – Design with microcontroller, pearson edition asia, 1998
8. Burns, alan and wellings, andy, real time systemand programming languages, 2013, harlow; Addison- Wesley
9. Raj kamal – embedded systems, TMH, new Delhi

ELET-555: Signal Conditioning Circuits

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To introduce students to understand both analog and digital signal conditioning
2. To make students able to design the various electronic circuits
3. To enable students to signal condition output of various types of sensors

Course Outcomes:

After completion of the course students will be able to -

1. Describe the type of signal conditioning & its importance in electronic circuits.
2. Evaluate various terminologies used signal conditioning circuit.
3. Assess signal conditioning for specific applications.
4. Design and developed a signal conditioning circuit for resistive, inductive and capacitive sensors.

Course Contents:

Unit - I: Principles of analog and digital signal conditioning (10 Hrs.)

Introduction, signal level and bias changes, linearization, conversation faltering and impedance matching, concept of loading, divider circuits, bridge circuits, lead compensation, RC filters (low pass, high pass), Readout/ meter. Introduction, application of Boolean algebra, Converters (comparators, DAC, ADC), Readout/display

Unit - II: signal conditioning for resistive sensors (10 Hrs.)

Temperature sensor (RTD, Thermistor), load cell, potentiometric sensors, Basic characteristics (principle, linearity, range, power rating and losses), excitation techniques (constant power, current, bridge), detectors and converters (resistance to Current, resistance to voltage, resistance to frequency, resistance to time)

Unit - III: signal conditioning for capacitive sensors (10 Hrs.)

Level sensor, displacement sensor, proximity detector, humidity sensor, differential pressure cell, Basic characteristics (principle, linearity, and range), excitation techniques (constant voltage/current, bridge), detectors and converters (impedance matching, capacitance to frequency, capacitance to time, capacitance to voltage)

References:

1. Paul Horowitz, Winfield Hill, "The Art of Electronics", 2nd Ed., Cambridge University press, 2008.
2. Andrew Parr, " Industrial Control hand book", 3rd ed., Newnes Industrial Press, 2000
3. Walt Kester, " Practical Design Techniques for Sensor Signal" Analog Devices, Inc.,1999
4. John G. Webster, "Sensors and signal conditioning" 2nd ed. Wiley-Inter science Publication, 2001.
5. Curtis D. Johnson, " Process control instrumentation technology" 8th ed. PHI learning Pvt. Ltd., 2010
6. Thomas G. Beckwith, John H. Lienhard V, Roy D. Marangoni, "Mechanical measurements" 6th ed., Pearson Prentice Hall, 2012.
7. Andrew Parr, " Industrial Control hand book", 3rd ed., Newnes Industrial Press, 2000

ELEP-576 : Lab course on 8086 Microprocessor and Programming (02 Credits)

List of Experiments:

1. Data transfer, addition, subtraction, multiplication, and division using 8086 trainer kit.
2. Factorial and square of the number using 8086 trainer kit.
3. Sorting of data (Ascending/Descending), obtaining square root of number using 8086 trainer kit.
4. Arithmetic mean of N numbers and sum of square of Numbers using 8086 trainer kit.
5. Data transfer, addition, subtraction, multiplication, and division using 8086 assembler.
6. Factorial and square of the number using 8086 assembler.
7. Sorting of data (Ascending/Descending), obtaining square root of number using 8086 assembler.
8. Arithmetic mean of N numbers and sum of square of Numbers using 8086 assembler.

(Students should complete at least 06 experiments)

ELEP-577: Lab course on Embedded system and Programming (02 Credits)

1. Data transfer, addition, subtraction, multiplication, and division using 8051 microcontroller trainer kit.
2. Sorting of data (Ascending/Descending), obtaining square root of number using 8051 trainer kit.
3. Factorial and square of the number using 8051 trainer kit.
4. Arithmetic mean of N numbers and sum of square of Numbers using 8051 trainer kit.
5. Data transfer, addition, subtraction, multiplication, and division using 8051 assembler.
6. Sorting of data (Ascending/Descending), obtaining square root of number using 8051 assembler.
7. Factorial and square of the number using 8051 assembler.
8. Arithmetic mean of N numbers and sum of square of Numbers using 8051 assembler.

(Students should complete at least 06 experiments)

ELEP-578 : Lab course on Advanced Sensor Technology (02 Credits)

1. Study of characteristics of photovoltaic cell
2. Study of characteristics of Phototransistor.
3. Study of characteristics of Photoconductive cell
4. Study of characteristics of PIN Photodiode
5. Study of characteristics of IC temperature sensor (LM 335)
6. Study of K (chromel – alumel) type Thermocouple
7. Characteristics of Platinum RTD (Resistance – Temperature Detector)
8. Characteristics of NTC (negative Temperature Coefficient) Thermistor
9. Study of Optical fiber Pressure sensor
10. Gas sensor based on OCP (organic Conducting Polymers)
11. Gas Sensor based on Single Walled carbon nanotubes (SWNTs)

(Students should complete at least 06 experiments)

ELEP-579 : Lab course on Interfacing of 8086 Microprocessor and 8051 Microcontroller (02 Credits)

1. Interfacing of SPDT switches and seven segment display as a position encoder/decoder to 8086 trainer kit.
2. Interfacing of stepper motor with 8086 trainer kit.
3. Interfacing of DC motor with 8086 trainer kit.
4. Interfacing of DAC with 8086 trainer kit to generate ramp wave, triangular wave, and square wave.
5. Interfacing of 8 bit ADC with 8086 trainer kit.
6. Interfacing of LCD display with 8086 trainer kit.
7. Program for temperature control interface using 8051 microcontroller.
8. Program to interface simple switch and LED using 8051 microcontroller
9. Program to interface an seven segment display using 8051 microcontroller
10. Program for analog to digital converter interfacing using 8051 microcontroller.
11. Program to generate ramp, square and triangular wave using DAC interfaced to 8051 microcontroller.
12. Program for interfacing stepper motor with 8051 microcontroller.
13. Program to interface an LCD using 8051 microcontroller
14. Program to interface matrix keyboard using 8051 microcontroller

(Students should complete at least 06 experiments)

ELEP-580 : Lab course on Signal Conditioning Circuits (02 Credits)

1. Design and implementation of electronic thermometer using PT100
2. Design and implementation of temperature indicator using thermocouple with cold junction compensation technique
3. Design and implementation of weighing machine using load cell
4. Design and implementation of liquid level indicator using electromechanical system.
5. Design and implementation of liquid level indicator using capacitive transducer.
6. Design and implementation of digital control logic for process using electronic hardware / software.
7. Demonstration and characterization of stroboscope.
8. Design and implementation of through beam/ reflected beam type optical proximity switch.
9. Design and implementation of signal conditioning scheme for position and/or direction detection for optical encoder.
10. Design and implementation of signal conditioning scheme for displacement measurement using LVDT.

(Students are expected to complete at least 06 experiments)

OJT/FP(ELEFP-596) : On Job Training / Field Project (04 Credits)

Students are expected to visit Industries and undertake training based one of the courses studied during first and second semester

OR

Student can undertake field Project related to one of courses studied during first and second semester

Semester - III

Semester III

ELET-600 : Programmable Logic Controllers

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To introduce students with programmable logic components and systems
2. To make students understand various instructions required for PLC
3. To enable students to program PLCs for various applications

Course Outcomes:

After completion of the course students will be able to –

a) Evaluate PLCs for various applications
b) Apply and explain basic concepts of ladder logic, its relationships with PLC instruction sets.
c) Develop a simple ladder logic program for timer and counter applications
d) Design a small prototype based production line using PLC

Course Contents:

Unit - I: Programmable Logic Controllers (PLC) **(10 Hrs.)**

Introduction to PLC, definition, PLC system and components of PLC input output module, advantages and disadvantages of PLC. Ladder diagram & PLC programming fundamentals: Basic components and other symbols, Fundamentals of ladder diagram, Difference between physical components and program components in PLC

Unit - II: PLC Instructions **(10 Hrs.)**

Bit Logic Instructions: NO, NC, Set, Reset, Falling Edge Pulse, rising edge Pulse RS, SR, NOP, OUTPUT. Clock: READ, RTC, SET_RTC. Logical operation Instructions: INVERT BIT, BYTE, WORD DOUBLE WORD. OR: BIT, BYTE, WORD DOUBLE WORD.AND: BIT, BYTE, WORD DOUBLE WORD.X-OR: BIT, BYTE, WORD DOUBLE WORD.

Unit - III: PLC Programming **(10 Hrs.)**

PLC input Instructions, outputs, coils, indicators, operational procedures, Contact and coil input output, programming example, fail safe circuits, Simple industrial applications. PLC Functions PLC timer functions Introduction, timer functions, industrial applications, industrial process Timing applications, PLC control functions –PLC counters and its industrial applications, nesting of ladders.

References:

1. John W. Webb, Ronold A Reis, "Programmable Logic Controllers, Principles and Applications"; 5th Edition, Prentice Hall of India Pvt. Ltd.
2. Programmable Logic Controllers Programming Method and Applications by JR.
3. Hackworth, "Programmable Logic Controller", 1st edition.

4. Frank Petruzella. D "Programmable Logic Controllers", Tata McGraw Hill
5. Bolton. W, "Programmable Logic Controllers" Fifth Edition, 2009.

ELET-601 : Internet of Things

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To introduce students to the concept of internet of things
2. To make them understand the things, protocols and IoT devices
3. To introduce students to the concept of industrial internet of things

Course Outcomes:
After completion of course, student will able to-

a. Analyse basic protocols in wireless sensor network
b. Explain architectural design for IoT for specific application
c. Choose between available technologies and devices for stated IoT challenge
d. Design and Implement IoT applications in different domain
e. Describe the concept of industrial internet of things

Course Contents:

Unit - I: Introduction to Internet of Things (IoT) **(10 Hrs.)**

Definition and characteristics of IoT, Internet of Things: Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT Issues and Challenges, Applications.

Unit - II: IoT Protocols and Devices **(10 Hrs.)**

Protocol Standardization for IoT, M2M and WSN Protocols, SCADA and RFID Protocols, BACNet Protocol, Modbus, KNX, Zigbee Architecture Network layer, Issues with IoT Standardization, MAC protocol survey, Survey routing protocols,

IoTDevices : IoT Physical Devices and Endpoints: Basic building blocks of and IoT device, **WSN**: The internet of transducer, **RFID**: The internet of objects, **M2M**: The internet of devices, **SCADA**: The internet of controllers.

Unit - III: Design, Implementation and Application of IoT. **(10 Hrs.)**

Introduction to different IoT tools, Developing applications through IoT tools, Implementing IoT concepts with Arduino/python, Home automation, Industry applications, Surveillance applications, Other IoT applications.

References:

1. Al-Fuqahaet. al, "Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications", IEEE Communication Surveys & Tutorials, Vol. 17, No. 4, 2015.
2. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
3. Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.
4. Charles Bell, "Beginning Sensor Networks with Arduino and Raspberry Pi", Apress, 2013.

ELET-602 : Electrical, Electrochemical and Spectroscopic Characterization Techniques for Electronic Devices

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To introduce and make understand the operation of various characterization techniques and associated instrumentation to employ them for entire investigation of the materials

Course Outcomes:

After completion of the course students will be able to –

a) Describe the various spectroscopy techniques and their applications.
b) Performed experiments with X-Ray diffraction technique and its applications
c) Perform structural, profile analysis, particle size analysis of samples from data obtained using various spectroscopy techniques.
d) Analyse the graph obtained from XRD technique, perform its interpretation.

Course Contents:

Unit - I: Electrical Techniques **(10 Hrs.)**

Electrical: Introduction to ohms law and determination of resistance, resistivity, conductance, conductivity by Voltage-Current (I-V) characteristics, advantages of 4-probe over 2-probe technique, Hall effect, Capacitance-Voltage (CV) Characteristics, Field Effect Transistor output and transfer characteristics.

Unit II : Electrochemical Techniques **(10 Hrs.)**

Introduction to electrochemistry, oxidation and reduction, balancing redox reactions, electrochemical cells, Nernst equation, Conductance of Electrolytic Solutions, Electrolytic Cells and Electrolysis, reference electrodes (aqueous, non-aqueous and Pseudo reference electrodes), role of counter, working and reference electrodes, Electrochemical Techniques: Potentiostatic, Galvanostatic, Chronopotentiometry, Chronoamperometry, Electrochemical Impedance Spectroscopy (EIS)

Unit - III: Spectroscopic Techniques **(10 Hrs.)**

Basics of Spectroscopy, Interaction of radiation with matter, Theory, working principle and applications of spectroscopic techniques viz. Fourier Transform Infrared spectroscopy, RAMAN Spectroscopy, UV-Visible Spectroscopy, photoluminescence (PL) spectroscopy, ultraviolet photoelectron spectroscopy (UPS), X-Ray Photoelectron Spectroscopy, X-ray absorption spectroscopy, Auger Electron Spectroscopy, Energy dispersive spectroscopy (EDS).

References:

1. Elements of X-ray Diffraction B. D. Cullity, Addison Wesley, 1977
2. Transmission Electron Microscopy: A Textbook for Materials Science David B Williams, C

Barry Carter, (1996) Plenum Press, New York
3. Impedance Spectroscopy: Theory, Experiment, and Applications, E. Barsoukov and J. Ross Macdonald (Editors) (2000) John Wiley & Sons (P) Ltd.
4. Fundamentals of Fourier Transform Infrared Spectroscopy, Brian C Smith, (1995) CRC Press
5. Nanoindentation, By Anthony C Fischercripps, Anthony C., Springer science and Bussiness media publications, 2011
6. Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers, Daniel L. Schodek, Paulo Ferreira, Michael F. Ashby, Elsevier, 2009.

ELET-603: Fabrication Techniques for Electronic Devices

02 credits; 30 Contact hours; 50 Marks

Course Objectives

1. To introduce students to semiconductor materials and its fabrication techniques
2. To make them understand various processes such as oxidation, photolithorgraphy, etching, diffusion etc in the process of fabrication

Course Outcomes:

1. Apply the basic knowledge in Microelectronic fabrication technique
2. Know the fundamental challenges in fabrication technique
3. Differentiate and analyze tradeoffs in processing parameters to optimize process parameters
4. Design and develop mask level silicon based device.

Course Contents:

Unit - I: Introduction to Semiconductor material and Fabrication Techniques (10Hrs.)

Semiconductor materials, semiconductor devices, basic fabrication steps, oxidation, photolithography and etching, diffusion and ion implantation, metallization, silicon crystal growth from the Melt, Silicon Float Zone process, GaAs Crystal growth technique, material characterization, wafer shaping, crystal characterization.

Unit - II: Silicon Oxidation and Photolithography (10Hrs.)

Thermal oxidation process, impurity redistribution during oxidation, masking properties of silicon dioxide, oxide thickness characterization, Basics of Photolithography, optical lithography- The clean room, Exposure tools, mask, photoresist, pattern transfer, resolution enhancement, Next generation lithographic methods, Electron beam lithography, extreme ultraviolet lithography, X-Ray lithography, Ion beam lithography

Unit - III: Etching and Diffusion (10 Hrs.)

Wet chemical etching- silicon etching, silicon dioxide etching, silicon nitride and polysilicon etching, aluminum etching, gallium arsenide etching, Dry etching-plasma Fundamentals, Reactive plasma Etching, Aluminum Basic diffusion process, diffusion equation, diffusion profiles, evaluation of diffused layers, extrinsic diffusion, lateral diffusion.

References:

1. GARY S May, Simon .M. Sze "Fundamental of Fabrication", ISBN 0-471-23279-3.
2. S.M. Sze (2nd Edition) "VLSI Technology", McGraw Hill companies Inc.
3. Stephen, Campbell, "The science and Engineering of Microbalance Fabrication", second Edition, Oxford University Press.
4. James D. Plummer, Michel D. Deal, "Silicon VLSI Technology" Pearson Education.

ELET-604: Structural and Morphological Characterization Techniques for Electronic Devices

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To introduce and make understand the operation of various characterization techniques and associated instrumentation to employ them for entire investigation of the materials

Course Outcomes:

After completion of the course students will be able to –

a) Describe the various spectroscopy techniques and their applications.
b) Performed experiments with X-Ray diffraction technique and its applications
c) Perform structural, profile analysis, particle size analysis of samples from data obtained using various spectroscopy techniques.
d) Analyse the graph obtained from XRD technique, perform its interpretation.

Course Contents:

Unit - I: X-ray Diffraction **(10 Hrs.)**

Basics of crystallography, Working principle of X-Ray diffraction, X-Ray Powder diffraction, X-Ray Thin film Diffraction, Grazing Incidence XRD, X-ray powder diffraction –Quantitative determination of phases; Structure analysis, single crystal diffraction techniques -Determination of accurate lattice parameters -structure analysis-profile analysis -particle size analysis using Scherer formula.

Unit - II: Morphological Characterization Techniques –I **(10 Hrs.)**

Scanning Tunneling Microscopy (STM), Atomic Force Microcopy (AFM) Scanning Electron Microscopy (SEM), Field Emission - Scanning Electron Microscopy (FE-SEM),

Unit - II: Morphological Characterization Techniques –II **(10 Hrs.)**

Transmission Electron Microscopy (TEM), Electron – solid interactions, TEM instrument component, Major difference between SEM and TEM, Working, Sample preparation.

References:

1. Elements of X-ray Diffraction B. D. Cullity, Addison Wesley, 1977
2. Transmission Electron Microscopy: A Textbook for Materials Science David B Williams, C Barry Carter, (1996) Plenum Press, New York
3. Impedance Spectroscopy: Theory, Experiment, and Applications, E. Barsoukov and J. Ross

Macdonald (Editors) (2000) John Wiley & Sons (P) Ltd.
4. Fundamentals of Fourier Transform Infrared Spectroscopy, Brian C Smith, (1995) CRC Press
5. Nanoindentation, By Anthony C Fischercripps, Anthony C., Springer science and Bussiness media publications, 2011
6. Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers, Daniel L. Schodek, Paulo Ferreira, Michael F. Ashby, Elsevier, 2009.

ELET-605 : Instrumentation in Process Control

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

To introduce students to the multifaceted challenges in industrial process measurements and advanced field instrumentation

Course Outcomes:

On completion of the Course, students should be able to-

1. Explain basic building block of instrumentation systems
2. Recognize challenges in process variable monitoring and measurements
3. Describe operation of application specific instrumentation for temperature, level, pressure and flow
4. Describe operation of special application sensors especially for safety applications

Course Contents:

Unit - I: Introduction of Instrumentation (10 Hrs.)

Introduction of Instrumentation: Block diagram of Instrumentation, Transducer, Classification of Transducers, Parameter of Electrical Transducer, Sensor, Characteristics of sensor, Selection of sensor, **Basic Sensors:** Displacement, Location and Position Sensor: Resistive, capacitive and inductive sensor, LVDT, RVDT. Strain sensor: strain and stress, strain gauge sensor, metal strain gauge, semiconductor strain gauge. Motion sensor, Proximity sensor, Encoder-Incremental, Rotary

Unit - II: Process Variable Measurement-Temperature and Level (10 Hrs.)

Temperature Measurement: Bimetallic Thermometer, Calibration and Simulators, Fiber Optic Thermometer, Filled-Bulb and Glass-Stem Thermometer, Integrated Circuits (IC) Transistors and Diodes, Miscellaneous Temperature Sensor, Pyrometric Cones, Radiation and Infrared Pyrometers, Temperature Switches and Thermostats, Thermo wells, Ultrasonic Thermometers, Applications and Selection.

Level Measurement: Capacitance and Radio Frequency (RF) Admittance Probes, Conductivity and Field Effect Level Switches, Diaphragm Level Detector, Differential Pressure Level Detector, Displacer level detector, Float level devices, Laser level sensor, Microwave level switch, Optical level devices, RADAR level transmitter and Gauges, Radiation level sensor, Thermal level sensor, Vibrating level switch, Application and selection

Unit - III: Process Variable Measurement-Flow and Pressure (10 Hrs.)

Flow Measurement: BTU flow meter for heat exchangers, Elbow taps, Flow switches, Laminar flow meter, Mass flow meter - Coriolis, Miscellaneous, Thermal, Positive displacement gas flow meter, segmental wedge flow meter, Sight flow indicators, Turbine and other rotary element flow meter, Variable-area, gap and vane flow meter, Venturi tubes, flow tubes and flow nozzles, applications and selections.

Pressure Measurement: Bellows type pressure sensor, Bourdon and helical pressure sensor, Diaphragm or capsule type sensor, Differential pressure instruments, electronic pressure sensor, high pressure sensor, pressure repeaters, vacuum sensors, Applications and Selections.

References:

Text:

1. Process Measurement and Analysis- Bela G. Lipta, Instrument Engineers Handbook, Third Edition.
2. Electronics Instrumentation- H. S. Kalsi; Second Edition, 2004, Tata McGraw Hill Publishing Co. Ltd; N. Delhi.
3. Process Control Instrumentation Technology- Curtis D. Johnson, Eastern Economy Edition, PHI Learning Pvt. Ltd. New Delhi.
4. Instrumentation and control- D. Patranabis; publishing PHI Learning Private Limited, New Delhi.
5. Electrical and Electronics Measurement and Instrumentation- A. K. Sawhney; DhanpalRi and Sons.
6. Industrial Instrumentation and Control-S. K. Singh; Second Edition, Tata McGraw Hill Publishing Co. Ltd; N. Delhi.

Web:

1. https://nptel.ac.in/courses/108105062/
2. https://nptel.ac.in/courses/103103037/

ELEP-626: Lab Course on Programmable Logic Controller (02 Credits)

1. Develop ladder programming to implement (i) basic logic gates and (ii) sequencing operations employing timers (lamp output)
2. Develop ladder programming to implement counter operation (proximity sensor to be used as event indicator) for triggering an enunciator after a certain batch of count is over
3. Develop ladder programming to operate a conveyor based liquid vending station
4. To study operation of
5. Develop ladder programming to operate a density based traffic light arrangement
6. Develop ladder programming to operate an X-Y plotter
7. Develop ladder programming to address different sequence of operation in a real time batch process unit (should contain at least two liquid tanks as main storage, one mixing tank, stirrer, heater, liquid dispenser, conveyor based handling, liquid level indicators etc.).
8. Develop program for at least two real time industrial processes with ITS – PLC virtual platform

(Students are expected to complete at least 06 experiments)

ELEP-627 : Lab course based on Internet of Things (02 Credits)

1. Study of physical and soft component in a IoT System
2. Shell scripting programming for IoT
3. Study of Arduino/Python programming
4. Study of hardware (Sensors and Actuators) interfacing protocol for IoT
5. Controlling an LED using ESP8266 module
6. Reading data from GPIO pin of ESP8266 module
7. Study of Communication protocols (at least 2)
8. System development for agriculture/ ambient atmospheric condition

(Students are expected to complete at least 06 experiments)

ELEP-628 : Lab course based on Electrical, Electrochemical and spectroscopic Characterization Techniques for Electronic Devices (02 Credits)

1. Characterization and analysis of ethanol using Fourier Transform Infrared Spectroscopy (FTIR)
2. Characterization and analysis of ethanol using Uv-Visible spectroscopy
3. I-V measurement using Keithley SCS 4200
4. FET measurement using Keithley SCS 4200
5. I-V and FET measurement of two terminal and three terminal devices
6. Measurement and analysis of thin film using Electrochemical Impedance Spectroscopy (EIS)
7. Probing Raman active nodes using Raman Spectroscopy
8. Imaging using Raman Spectroscopy

(Students are expected to complete at least 06 experiments)

ELEP-629 : Lab course based on Structural and Morphological Characterization Techniques for Electronic Devices (02 Credits)

1. Characterization and finding lattice parameters (hkl) parameters of NaCl crystal using powder X ray diffraction (PXRD) method
2. Characterization and finding lattice parameters (hkl) parameters of given thin film using Grazing Incidence X-ray diffraction (GIXRD) method
3. XRD Characterization and analysis of TiO2 thin film and TiO2 powder sample.
4. Estimating Crystallite Size Using XRD
5. Sample preparation for AFM.
6. Surface topography using AFM.
7. Measurement of height profile using AFM.
8. SEM image analysis by ImageJ software.

(Students are expected to complete at least 06 experiments)

ELEP-630 : Lab course based on Instrumentation in Process Control (02 Credits)

1. Study of Displacement sensor
2. Study of Potentiometric sensor
3. Study of LVDT as displacement Sensor
4. Study of digital encoder
5. Study of characteristics of IC temperature sensor (LM 35)
6. Study of ultrasonic sensor for level/distance measurement

7. Study of pressure sensor
8. Study of Gas sensor based on metal oxide semiconductor
9. Study of proximity sensor

(Students are expected to complete at least 06 experiments)

RP-1 (ELERP-646) : Research Project Part – I (04 Credits)

Students are expected formulate research topic by doing comprehensive literature review and start working on the fine-tuned research topic

Semester - IV

Semester IV

ELET-650 : Advance Communication Systems

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To introduce the students to advanced topics in digital communications.
2. To recognize different communication systems
3. To provide the students with understanding of the fundamental concepts and techniques, used in the performance analysis, and implementation of current communication systems in the development of the communication systems of the future.

Course Outcomes:

On completion of the course, students should be able to-

1. understand the basics and technology of advanced communication system
2. understand concept of mobile communication system and satellite communication system
3. understand concept of telecommunication switching and networks
4. understand the difference between analog and digital communication systems
5. understand the construction, principle of operation and applications of advanced optical components
6. know the different types of optical sensors

Course Contents:

Unit - I: Mobile Communication (10 Hrs.)

Cellular concept: Introduction to basic cellular system, Cellular coverage planning, Mobile radio propagation, frequency reuse, Co-channel interference, Diversity, fading channels, spreading codes, power control, handoff, types of handoff, Multiple access. **Wireless networking:** Wireless systems and standards, WAP and other protocols for internet access. Blue-tooth and other wireless networks, system comparison. Spread spectrum concept. Basics of CDMA. Applications of CDMA to cellular communication systems. Second and third generation CDMA systems/ standards. Multicarrier CDMA. Synchronization and demodulation. Diversity techniques and rake receiver. **Mobile Unit** : Block diagram and operation of mobile unit, block diagram of cellular network, GSM architecture, making a call, receiving a call, GSM and CDMA technology and their applications.

Unit - II: Telecommunication Switching and Networks (10 Hrs.)

Principles of circuit switching and signaling schemes, space time and space time division switching, single stage and multistage switching network. Traffic engineering and tele-traffic theory, Markov processes representing traffic, calculation of blocking probability.

Unit - III: Advanced Optical communication **(10 Hrs.)**

Analog and Digital communication link design, WDM, DWDM, optical couplers, Mach-Zehnder interferometer multiplexer, optical add/drop multiplexers, isolators, circulators, optical filters, tunable sources and tunable filters, arrayed waveguide grating, diffraction grating, optical amplifiers, optical integrated circuits, OTDR, SONET: frame format, overhead channels, payload pointer, multiplexing hierarchy. SDH: Standards, frame structure and features. Optical switching, WDM networks, Classification of optical sensors, Intensity modulated, phase modulated and spectrally modulated sensors

Text/Reference Books:

1. An introduction to fiber optic systems (IInd edition) By John Powers, Irwin Publications, Chicago (1993 & 1997)
2. Understanding fiber optics (IInd edition) By Jeff Hecht (BPB publications) 1997
3. Principles and Applications of Optical Communications, By Max Ming-Kang Liu, Irwin Publications, Chicago
4. Mobile cellular Telecommunications: Analog and Digital Systems (IInd edition) By William C.Y. Lee, McGraw-Hill, Inc. New York, 1995
2. Optical Communication System, John Gower, Prentice Hall, India

ELET-651 : Fundamentals of Energy Storage Devices

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To introduce students to basic concepts of Battery
2. To make them understand crucial performance parameters as well as manufacturing of batteries
3. To facilitate students to understand super capacitors and fuel cells

Course Outcomes:

On completion of the course, students should be able to-

a) understand the basics concept of batteries
b) understand the performance criteria of batteries
c) understand various manufacturing aspects of batteries
d) develop super-capacitors and fuel cells

Course Contents:

Unit - I: Basic Concepts and Batteries **(10 Hrs)**

Reversible cells and irreversible cell reactions, Parameters for characterizing batteries, Primary and Secondary cells, Chemistry and materials used for various components (electrodes, electrolytes, separator, and binders) of different types of batteries: Leclanche/Dry/Alkaline cell, Silver cell, Mercury cell

Unit II: Types of Batteries **(10 Hrs)**

Lead-acid battery: safety and design; Edison Cell, Ni-Cd battery, Ni Metal Hydride (Ni-MH) battery, Ni-Hydrogen battery, Sodium-Sulfur battery, Lithium-ion/Lithium-polymer/ Li-S battery, Metal-air batteries, and its applications

Unit - III: Performance and Manufacturing of Batteries **(10 Hrs)**

Charge-Discharge characteristics, Energy/power density, overcharging, Mechanics of battery cells and materials, Manufacturing of batteries, Battery safety and Abuse tolerance, Coupling with other energy storage devices

References:

1. A. J. Bard, L.R. Faulkner, Electrochemical Methods, Fundamentals and Application. Wiley, 2001.
2. C. Daniel and Jurgen O. Besenhard, Handbook of Battery Materials, Wiley-VCH Verlag, 2011

3. K. E. Aifantis, S. A. Hackney, and R. V. Kumar (Ed.) High Energy Density Lithium Batteries Materials, Engineering,
4. Applications, WILEY-VCH Verlag GmbH & Co. KGaA, 2010.
5. A. Yu, V. Chabot, and J. Zhang, Electrochemical Supercapacitors for Energy Storage and
6. Delivery Fundamentals And Applications, Taylor & Francis Group, 2013.
7. F. Beguin and E. Frackowiak, Supercapacitors- Materials, Systems, and Applications. Wiley- VCH Verlag GmbH & Co. 2013.
8. V. Hacker, S. Mitsushima(Eds.), Fuel Cells and Hydrogen: From Fundamentals to Applied Research, **Elsevier**

ELET-652 : Optoelectronics

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. A introduce students to various optoelectronic sources and detectors
2. To introduce students to basics of fiber optics communication
3. To make them understand the modal analysis of fiber optics

Course Outcomes:

On completion of the course, students should be able to-

1. understand various optoelectronic systems
2. understand various concepts of Optical fibres
3. develop optical fiber communication systems

Course Contents:

Unit - I: **(10 Hrs.)**

Lamps and illumination systems, LEDs – working principle and applications, LED lighting, Display devices, indicators, numeric, alphanumeric and special function displays, Liquid Crystal Display elements, Plasma Displays, Multimedia projectors, Semiconductor lasers, Fabry-Perot lasers, Distributed Feedback, (DFB) lasers, Distributed Bragg Reflection (DBR) lasers

Unit - II: **(10 Hrs.)**

Photo-detectors types and applications, PN and PIN Photodiodes, Avalanche Photodiodes (APD)
Opto-couplers, Opto-interrupters, LASCR, used in safety interlocks, power isolators, rotary and linear encoders and remote control, Intrinsic and Extrinsic Fiber optic sensors.

Unit - III: **(10 Hrs.)**

Optical Fiber Theory, Parameters of Optical Fibers, Types of Optical Fibers-Single Mode and Multi ModeFibers, Step Index & Graded Index Fibers. Modal Properties-Waveguide Parameter (V Number), Cut-off wavelength, Dispersion-Intermodal and Intramodal dispersion Loss, Mechanism in Optical Fibers-Adsorption and Scattering, Fresnel Reflection, Micro bending & Macro bending, Connector types and Splices, Misalignment and Mismatch losses

Text / Reference Books:

1. Optical Engineering Fundamentals B.H. Walker, PHI

2. Electro-Optical Instrumentation Sensing and Measuring with Lasers: SilvanoDonati, Pearson
3. Fiber optics and Optoelectronics: R.P. Khare, Oxford Press.
4. Optical Fiber Communication Principles and Systems A. Selvarajan, S.Kar and Srinivas, TMH
5. Optical Fiber Communications G. Keiser, TMH

ELET-653 : Electrochemical Energy Storage Systems

02 credits; 30 Contact hours; 50 Marks

Course Objectives:

1. To introduce students to basic concepts of Battery
2. To make them understand crucial performance parameters as well as manufacturing of batteries
3. To facilitate students to understand super capacitors and fuel cells

Course Outcomes:

On completion of the course, students should be able to-

a) understand the basics concept of batteries
b) understand the performance criteria of batteries
c) understand various manufacturing aspect of batteries
d) develop super-capacitors and fuel cells

Course Contents:

Unit - I: Super/ultra-capacitors **(10 Hrs)**

Fundamentals of Electrochemical Supercapacitors, the concept of a supercapacitor- classification of supercapacitors- working of electrochemical double layer capacitors (EDLC), Pseudo capacitors and hybrid supercapacitors –the difference between capacitor, supercapacitor and battery - advantages, disadvantages and applications of supercapacitors.

Unit - III: Supercapacitor Characteristics and fabrication **(10 Hrs)**

Electrode and electrolyte interfaces and their capacitances, Charge-Discharge characteristics, Energy/power density, Design, Fabrication, operation and evaluation, Thermal management; Supercapacitor stack manufacturing and construction, Coupling with batteries and fuel cells; Applications

Unit - III: Fuel cells **(10 Hrs)**

Overview of key fuel cell technologies- various types of fuel cells, materials for electrodes, electrolytes and other components, working mechanisms, hydrogen generation and storage; limitations, recent progress in fuel cells.

References:

1. A. J. Bard, L.R. Faulkner, Electrochemical Methods, Fundamentals and Application. Wiley, 2001.
9. C. Daniel and Jurgen O. Besenhard, Handbook of Battery Materials, Wiley-VCH Verlag, 2011
10. K. E. Aifantis, S. A. Hackney, and R. V. Kumar (Ed.) High Energy Density Lithium Batteries Materials, Engineering,

11. Applications, WILEY-VCH Verlag GmbH & Co. KGaA, 2010.
12. A. Yu, V. Chabot, and J. Zhang, Electrochemical Supercapacitors for Energy Storage and
13. Delivery Fundamentals And Applications, Taylor & Francis Group, 2013.
14. F. Beguin and E. Frackowiak, Supercapacitors- Materials, Systems, and Applications. Wiley- VCH Verlag GmbH & Co. 2013.
15. V. Hacker, S. Mitsushima(Eds.), Fuel Cells and Hydrogen: From Fundamentals to Applied Research, **Elsevier**

ELET-654: Micro-electromechanical System and Applications

02 credits; 30 Contact hours; 50 Marks

Course Objectives:
To introduce students to-

a) Various MEMS fabrication technologies
b) MEMS-specific design issues and constraints
c) Dynamics and modeling of microsystems
d) Applications of microsensors and microactuators
e) Getting access to fabrication and testing in academia and industry

Course Outcomes:
On completion of this course, the student will be able to-

a) Explain the operation of microdevices, microsystems and their applications
b) Design the microdevices, microsystems using the MEMS fabrication process.
c) Establish the basic approaches for various sensor and actuator design
d) Develop experience in micro/nanosystems for photonics.

Course Contents:

Unit - I: Introduction to Micro-electromechanical systems and MEMS design (10 Hrs)

What is MEMS? MEMS technology, a brief history of MEMS, MEMS design tools, bulk-micromachining based MEMS design, surface-micromachining based MEMS design.

Unit - II: Material issues for microsystems (10hrs)

Failure mechanisms of materials used in Microsystems, methods for measuring mechanical properties of materials used in Microsystems structure materials for Microsystems, materials for the micro-tribological application.

Unit - III:MEMS processing and fabrication techniques and technology (10 Hrs)

Silicon-based micromachining, surface micromachining technology: standard surface micromachining technology and multilayer polysilicon, metallization, isolation, monolithic integrated surface micromachining technology, 3D surface machining, other materials, bulk micromachining.

References:

1. Microsystems and nanotechnology, Zhaoying Zhou, Zhonglin Wang, Liwei Lin, Springer.
2. MEMS AND Microsystems: Design And Manufacture 1st Edition, Tai-Ran Hsu, Mcgraw Hill Education.
3. Mems and Nems, Lyshevski, CRC press.

4. Advanced Mechatronics and MEMS Devices 1st Edition, Dan Zhang, Springer New York.
5. MEMS, MAHALIK N P, Mcgraw Hill Education.