SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Department of Instrumentation and Control Engineering

Minutes of 8th BoS Meeting (UG)

Venue	:	Seminar Hall, Department of ICE, Sri Manakula Vinayagar Engineering College
Date & Time	:	2nd September, 2024 at 11:30 A.M

Department of Instrumentation and Control Engineering

Minutes of Eighth Meeting of the Board of Studies

The **Eighth meeting** of the Board of Studies in the Department of Instrumentation and Control Engineering was held on **2nd September 2024 at 11:30 A.M** in the Seminar Hall, Department of Instrumentation and Control Engineering, Sri Manakula Vinayagar Engineering College with the Head of the Department in the Chair.

The following members were present in the BoS meeting

Sl. No	Name of the Member with Designation and official Address	Responsibility in the BoS
1	Dr. L.M. Varalakshmi Professor and Head Department of ICE, SMVEC	Chairperson
External Member		
2	Dr. G. Sakthivel Professor and Director i/c in EMMC (Educational Multimedia Centre) Department of Electronics and Instrumentation Engineering, Annamalai University	External Member (University Nominee)
3	Dr. S. Mourouga Prakash Professor and Head Department of Electronics and Instrumentation Engineering Pondicherry Technological University	External Member (Academic Expert)
4	Dr. A. Asokan Professor Department of Electronics and Communication Government college of Engineering Sengipatti –Thanjavur	External Member (Academic Expert)
5	Dr. V. Nagarajan Professor Department of Electronics Engineering School of Engineering & Technology Pondicherry University	External Member (Academic Expert - Special Courses)

6	Mr. K. Ruba Anand Quality Manager Benlab	Industry Member
7	Mr. Ankit Shah Instrumentation Engineer Forbes Marshal	Alumni
Internal Members		
8	Dr. D. Sivanandakumar Associate Professor Department of ICE, SMVEC	Internal Member
9	Dr. K. Naveenkumar Associate Professor Department of ICE, SMVEC	Internal Member
10	Dr. M. Rekha Associate Professor Department of ICE, SMVEC	Internal Member
11	Prof. T. Sudha Assistant Professor Department of ICE,SMVEC	Internal Member
12	Prof. J. Jeevanantham Assistant Professor Department of ICE, SMVEC	Internal Member
13	Prof. S. Karthikeyan Assistant Professor Department of ICE, SMVEC	Internal Member
14	Prof. P. Kiruthika Assistant Professor Department of ICE, SMVEC	Internal Member
15	Prof. V. Udayavalli Assistant Professor Department of ICE, SMVEC	Internal Member
16	Prof. W. Godfrey Daniel Assistant Professor Department of ICE, SMVEC	Internal Member
17	Prof. A. Sai Nishhok Krrishnaa Assistant Professor Department of ICE, SMVEC	Internal Member
18	Prof. G. Laxminarayanan Assistant Professor Department of ICE, SMVEC	Internal Member
19	Prof. C. Muthupraba Assistant Professor Department of ICE, SMVEC	Internal Member
20	Prof. S. Sathiyapoobalan Assistant Professor Department of ICE, SMVEC	Internal Member

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21	Prof. R. Vijayarajan Assistant Professor Department of ICE, SMVEC	Internal Member
22	Prof. V. Kamalanathan Assistant Professor Department of ICE, SMVEC	Internal Member
23	Dr. K. Karthikeyan Associate Professor, Department of Chemistry, SMVEC	Internal Member
24	Dr. S. Rajakumar Professor, Dept. of Mathematics, SMVEC	Internal Member
25	Dr. D. Devi Professor, Department of English, SMVEC	Internal Member
26	Prof. S. Geetha Assistant Professor Department of Physics, SMVEC	Internal Member

Agenda 1/BoS/8/2024/ICE/UG	
	Welcome Address by chairperson, Board of Studies (BoS).
Agenda 2/BoS/8/2024/ICE/UG	
	To confirm the minutes of meeting of the seventh Board of Studies held on 01.03.2024.
Agenda 3/BoS/8/2024/ICE/UG	
	To consider and approve the B.Tech. Degree Curriculum and Syllabi of fifth and sixth semesters for the B.Tech. – Instrumentation and Control Engineering students admitted from the academic year 2023-24.
Agenda 4/BoS/8/2024/ICE/UG	
	To consider and approve the professional elective / open elective / skill enhancement course / mandatory of the fifth and sixth Semester for R2023.
Agenda 5/BoS/8/2024/ICE/UG	
	To consider and approve the curriculum and syllabus of all the courses and equivalent NPTEL courses for the Honours and Minor degree for B. Tech. students admitted from the academic year 2023-24.
Agenda 6/BoS/8/2024/ICE/UG	
	To consider and approve the equivalence for the B.Tech. - Instrumentation and Control Engineering programme to facilitate the students for higher studies.
Agenda 7/BoS/8/2024/ICE/UG	
	To discuss the professional elective / open elective / employability enhancement courses / Swayam / MOOC Courses / Mandatory courses offered to III/V, and IV/VII semester students under R-2020 regulation during the period July 2024 to Nov 2024.
Agenda 8/BoS/8/2024/ICE/UG	
	To discuss and approve the academic calendar for the odd semester 2024.
Agenda 9/BoS/8/2024/ICE/UG	
	To discuss the department activities for the odd semester July 2024 to Nov 2024.
Agenda 10/BoS/8/2024/ICE/UG	
	To apprise the result analysis of End Semester Examination May / June 2024.
Agenda 11/BoS/8/2024/ICE/UG	
	To discuss and recommend the panel of examiners to the Academic Council.
Agenda 12/BoS/8/2024/ICE/UG	
	Any other additional points with the permission of chair.

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Minutes of the Meeting

Dr. L. M. Varalakshmi, Chairperson, BoS initiated the meeting by welcoming the external members and the internal members and thanked them for the detailed deliberations on the agenda items that had been approved by the Chairperson.

Minutes 1/BoS/8/2024/ ICE/UG

Welcome Address by chairperson, Board of Studies (BoS).

The meeting began with a welcome address by the chairperson of the BoS.

Minutes 2/BoS/8/2024 /ICE/UG

To confirm the minutes of the seventh Board of Studies Meeting held on 01.03.2024.

The minutes of the previous BoS meeting were confirmed. **BoS noted the agenda.**

Minutes 3/BoS/8/2024 /ICE/UG

To consider and approve the B.Tech. Degree Curriculum and Syllabi of fifth and sixth semesters for the B.Tech. – Instrumentation and Control Engineering students admitted from the academic year 2023-24. (Annexure – I)

The following suggestions were given by the experts in the curriculum.

Table 1: List of courses need to be modified in V and VI semester

S. No	Sem	Subject and Code	Type	Unit	Particulars
1	V	Industrial Instrumentation U23ICT505	Core	III	Radar Level transmitters can be added.
2	V	Embedded System Design Lab U23ICT506	Core	-	Real time application experiments may be added.
3	VI	Analytical Instrumentation U23ICT607	Core	IV	ORP sensors can be added.
4	VI	Power Plant Instrumentation U23ICT608	Core	II	Steam and water analyzer, ORP Control may be added.
5	VI	Process Control U23ICT609	Core	V	• The title of the fifth unit can be

2.A.5.10

					rephrased as Advanced Control Techniques. • Case study such as top and bottom product output distillation column can be added.
6	VI	Internet of Things for Automation (Theory cum Practical) U23ICB603	Core	IV	Water flow and level experiments can be combined in the lab component.
7.	VI	Instrumentation System Design Lab U23ICP608	Core	-	• Calibration can be removed in the experiment title. • RTD experiment can be modified into RTD signal conditioning circuits.
8.	VII	Computer Control of Processes U23ICE713	Core	-	This course can be shifted to elective.
9.	VII	Computer Control of Processes Laboratory	Core	-	This course can be **removed**.

The above corrections were incorporated and the updated syllabi of V and VI Semesters were approved by the BoS members for the students admitted from the academic year 2023- 24 onwards. **(Annexure – I)**

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Minutes 4/BoS/8/2024 /ICE/UG	**To consider and approve the professional elective / open elective / skill enhancement course / mandatory of the fifth and sixth Semester for R2023.** (Annexure II)

The following suggestions were given by the experts in the electives.

Table 2: List of elective courses need to be modified

S. No	Sem	Subject and Code	Type	Unit	Particulars
1.	IV	Hybrid Electric Vehicles	Elective	-	This course can be **removed** from professional elective and can be opted in open elective.
2.	IV	Industrial Electronics	Elective	-	• This course can be **removed.** • Network related course can be added.
3.	V	Instrumentation symbols and Standards U23ICE508	Elective		Shifted from VII semester to V semester.
4.	V	Wireless Instrumentation	Elective	-	• Wireless Instrumentation course can be removed. Instead "Software Design Tools for sensing and Control" **U23ICE509** can be added.
5.	VI	Soft Computing Techniques U23ICEC02	Elective	V	• Case study can be added in the fifth unit.

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					• Genetic Algorithm can be shifted to first unit.
6.	VI	Micro Electromechanical Systems	Elective	-	• Course is modified into MEMS and NEMS **U23ICE610**. • Shifted to VI semester
7.	VI	Piping and Instrumentation Diagram U23ICE612	Elective	-	• Shifted to VI semester from VIII semester
8.	VII	Fiber optics and Laser Instrumentation U23ICE714	Elective	-	• Shifted to VII semester from VI. • Title of the units to be rephrased.
9.	VI	Instrumentation in Process Industries U23ICE716	Elective	-	This course has been introduced in the elective.
10.	VII	Instrumentation in Petrochemical Industries U23ICE820	Elective	-	This course has been introduced in the elective
11.	VIII	Green Electronics U23ICE819	Elective	-	This course has been introduced in the elective
12.	VIII	Advanced Industrial Automation Systems	Elective	-	This Course has been replaced with Cybersecurity in Industrial Automation **U23ICE823**
13.	VIII	Building	Elective	-	This course has

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		Automation			been replaced by Condition Monitoring **U23ICE822**
14.	VIII	Automotive Instrumentation and Control U23ICE821	Elective	-	Shifted to VIII semester from VII.

The open electives to be modified as follows

S. No	Sem	Subject and Code	Type	Unit	Particulars
1.	V	Sensors and Transducers U23ICOC01	Open Elective	-	The title to be modified as Sensors for Engineering Applications.
2.	V	Fuzzy Logic and Neural Networks U23ICOC02	Open Elective	-	Shifted to VII open elective.
3.	VII	Embedded Systems for AI Applications U23ICOC03	Open Elective	-	Introduced a new course instead of Instrumentation for Industry 4.0

The above corrections were incorporated for Professional and Open Electives were approved by the BoS members for the students admitted from the academic year 2023-24 onwards. **(Annexures – II)**

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Minutes 5/BoS/8/2024/ICE/UG	**To consider and approve the curriculum and syllabus of all the courses and equivalent NPTEL courses for the Honours and Minor degree for B. Tech. students admitted from the academic year 2023-24.** The honours and minor degree syllabus was approved and the NPTEL equivalent courses were verified. **(Annexure III)**
Minutes 6/BoS/8/2024/ICE/UG	**To consider and approve the equivalence for the B.Tech. - Instrumentation and Control Engineering programme to facilitate the students for higher studies.** The members approved the equivalence of B.Tech. Instrumentation and Control Engineering to B. Tech Electronics and Instrumentation Engineering for R-2020, R-2019 and R-2013.
Minutes 7/BoS/8/2024/ICE/UG	**To discuss the professional elective / open elective / employability enhancement courses / Swayam / MOOC Courses / Mandatory courses offered to III/V, and IV/VII semester students under R-2020 regulation during the period July 2024 to Nov 2024.** The professional elective / open elective / employability enhancement courses were discussed with the panel members for the period July 2024 to Nov 2024. **Professional Elective** **V Semester:** Industrial Unit Operations (U20ICE510) **VII Semester:** Power Plant Instrumentation (U20ICE716) **Open Elective** **V Semester:** Product Development and Design (U20HSO501) **VII Semester:** Artificial Intelligence Applications (U20ADO706) **Certification Course** **V Semester:** Introduction to C++ Programming (U20ICCX58) Online Swayam/MOOC courses for students under R-2020 regulation and faculties (July 2024 to Nov 2024) were approved by the BoS members. • Introduction to internet of things • Introduction To Industry 4.0 and Industrial Internet of Things • The Joy of computing using python • Power Plant Engineering

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Minutes 8/BoS/8/2024 /ICE/UG	**To discuss and approve the academic calendar for the odd semester 2024.** The academic calendar for the odd semester 2024 was discussed and approved.**(Annexure IV)**
Minutes 9/BoS/8/2024 /ICE/UG	**To discuss the department activities for the odd semester July 2024 to Nov 2024.** The department activities for the odd semester July 2024 to Nov 2024 **till date** were reviewed. No. of international journal publications 5 No of international conference publications 4 No of book chapters accepted 5 No of research proposals submitted 2 No of guest lectures conducted 4
Minutes 10/BoS/8/2024 /ICE/UG	**To apprise the result analysis of End Semester Examination May / June 2024.** The End Semester Examination result analysis of May / June 2024 was discussed.
Minutes 11/BoS/8/2024/ICE/UG	**To discuss and recommend the panel of examiners to the Academic Council.** The panel of examiners was discussed and recommended to the Academic Council. **(Annexure V)**
Minutes 12/BoS/8/2024/ICE/UG	**Any other additional points with the permission of chair.** The Courses with same contents among the various departments were identified and those courses were made as common to all departments. Due to this, some of the Course Name/ Code of Core and Professional / Open Elective of Instrumentation and Control Engineering department were modified / rearranged.

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Table 6: List of Common courses offered by Instrumentation and Control Engineering

Sl. No	Offering Department	Year / Semester	Course Code	Course Name	Departments opting the Courses
1	ICE	II / III	U23ICTC01	Linear Integrated Circuits	Common to ICE and BME
2	ICE	II / III	U23ICTC02	Digital Logic Circuits	Common to ICE and BME
3	ICE	II / IV	U23ICTC03	Linear Control Systems	Common to ICE and Mechatronics
Practical					
4	ICE	II / III	U23ICPC01	Linear and Digital Integrated Circuits Laboratory	Common to ICE and BME
Professional Elective					
5	ICE	III / VI	U23ICEC01	Virtual Instrumentation	Common to ICE and Mechatronics
6	ICE	III / VI	U23ICEC02	Soft Computing Techniques	Common to ICE and BME
7	ICE	IV/VII	U23ICEC03	Intelligent Robotic Systems	Common to ICE and ECE

The syllabi of Common Courses offered by the Department of Instrumentation and Control Engineering to the other branches of Engineering **(given in Table 6)** were discussed **(Annexure – VI)** and **approved by the BoS members.**

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2.A.5.24

The meeting concluded at 01.30 PM with vote of thanks by **Dr. L. M. Varalakshmi**, Head of Department, Instrumentation and Control Engineering

Sl.No	Name of the Member with Designation and official Address	Responsibility in the BoS	Signature
1	Dr. L.M. Varalakshmi Professor and Head Department of ICE,SMVEC	Chairperson	
External Members			
2	Dr. G. Sakthivel Professor and Director i/c in EMMC (Educational Multimedia Centre Department of Electronics and Instrumentation Engineering, Annamalai University	External Member (University Nominee)	
3	Dr. S. Mourouga Prakash Professor and Head Department of Electronics and Instrumentation Engineering Pondicherry Engineering College	External Member (Academic Expert)	
4	Dr. A. Asokan Professor Department of Electronics and communication Government college of Engineering Sengipatti –Thanjavur	External Member (Academic Expert)	
5	Dr. V. Nagarajan Professor Department of Electronics Engineering School of Engineering & Technology Pondicherry University	External Member (Academic Expert - Special Courses)	
6	Mr. K. Ruba Anand Quality Manager Benlab	Industry Member	02/09/2024
7	Mr. Ankit Shah Instrumentation Engineer Forbes Marshal	Alumni	
Internal Members			
8	Dr. D. Sivanandakumar Associate Professor Department of ICE, SMVEC	Internal Member	

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9	Prof. K. Naveenkumar Assistant Professor Department of ICE, SMVEC	Internal Member	
10	Dr. M. Rekha, Associate Professor Department of ICE, SMVEC	Internal Member	
11	Prof. T. Sudha Assistant Professor Department of ICE,SMVEC	Internal Member	
12	Prof. J. Jeevanantham Assistant Professor Department of ICE, SMVEC	Internal Member	
13	Prof. S. Karthikeyan Assistant Professor Department of ICE, SMVEC	Internal Member	
14	Prof. P. Kiruthika Assistant Professor Department of ICE, SMVEC	Internal Member	
15	Prof. V. Udayavalli Assistant Professor Department of ICE, SMVEC	Internal Member	
16	Prof. W. Godfrey Daniel Assistant Professor Department of ICE, SMVEC	Internal Member	
17	Prof. A. Sai Nishhok Krrishnaa Assistant Professor Department of ICE, SMVEC	Internal Member	
18	Prof. G. Laxminarayanan Assistant Professor Department of ICE, SMVEC	Internal Member	
19	Prof. C. Muthupraba Assistant Professor Department of ICE, SMVEC	Internal Member	
20	Prof. S. Sathiyapoobalan Department of ICE, SMVEC	Internal Member	

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21	Prof. R. Vijayarajan Assistant Professor Department of ICE, SMVEC	Internal Member	
22	Prof. V. Kamalanathan Assistant Professor Department of ICE, SMVEC	Internal Member	
23	Dr. K. Karthikeyan Associate Professor, Department of Chemistry, SMVEC	Internal Member	
24	Dr. S. Rajakumar Professor, Dept. of Mathematics, SMVEC	Internal Member	
25	Dr. D. Devi Professor, Department of English, SMVEC	Internal Member	
26	Prof. S. Geetha Department of Physics, SMVEC	Internal Member	

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2.A.5.30

Annexure I

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(An Autonomous Institution)

Puducherry

B.TECH.

INSTRUMENTATION AND CONTROL ENGINEERING

ACADEMIC REGULATIONS 2023 (R-2023)

CURRICULUM AND SYLLABI VOLUME 3

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation, and research for the transformation of lives to serve the society.

Mission

M1: Quality Education: To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation: To foster value- based research and innovation in collaboration with industries and Institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship: To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values: To Instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

Vision

To provide quality education, training and research in the area of Instrumentation and Control Engineering to meet the industrial and societal needs with ethical values.

Mission

M1: Quality education: To impart technical knowledge, leadership and managerial skills to meet the current industrial and societal needs.

M2: Research and Innovation: To foster innovation, research and development for the benefit of global community.

M3: Employability and Entrepreneurship: To enhance the employability skills and inculcate entrepreneurial attitude.

M4: Ethical Values: To provide extension services to rural society and instill ethical values among the students.

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PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis:

Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions:

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage:

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

PO6: The engineer and society:

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

PO7: Environment and sustainability:

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

PO8: Ethics:

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication:

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

PO11: Project management and finance:

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

PO12: Life-long learning:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Core Competency:

Solve real-life engineering problems, design and development of innovative and cost-effective products exhibiting a solid foundation in Instrumentation and Control Engineering fundamentals to cater needs of society.

PEO 2: State of the art technology:

To impart state of the art technology to the students in the field of Instrumentation and Control Engineering to meet the industrial needs.

PEO 3: Multi-disciplinary skills:

To develop Multi-disciplinary skills and acquire leadership qualities along with professional and ethical values.

PEO 4: Innovation and entrepreneurship:

To promote innovation and entrepreneurship in designing and developing instrumentation systems to address social and technical challenges.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Basic Knowledge in ICE:

Apply the knowledge of Instrumentation and Control Engineering to relate the fundamental concepts of Instrumentation (measurement, control, operation, monitoring and maintenance) to varied measurement systems and models.

PSO2: Advanced Tools for industrial automation:

Apply the knowledge of hardware and software tools for industrial automation systems

PSO3: Design and development of Instrumentation systems:

Ability to design and develop instrumentation systems to solve real time applications.

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STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAMME

Sl. No	Course Category	Breakdown of Credits
1	Humanities and Social Sciences including Management courses (HS)	15
2	Basic Science Courses (BS)	20
3	Engineering Science Courses (ES)	28
4	Professional Core Courses (PC)	67
5	Professional Elective Courses (PE)	18
6	Open Elective Courses (OE)	9
7	Project Work and Internship (PA)	13
8	Ability Enhancement Courses (AEC*)	-
9	Mandatory Courses (MC*)	-
	Total	**170**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl. No	AICTE Suggested Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Science Courses	3	5	1	1	2	-	-	3	15
2	Basic Science Courses (BS)	7	4	5	4	-	-	-	-	20
3	Engineering Science Courses (ES)	8	5	4	7	4	-	-	-	28
4	Professional Core Courses (PC)	4	8	13	8	8	15	11	-	67
5	Professional Elective Courses (PE)	-	-	-	3	3	3	3	6	18
6	Open Elective Courses (OE)	-	-	-	-	3	3	3	-	09
7	Project Work (PA)	-	-	-	-	1	1	2	8	12
8	Internship (PA)	-	-	-	-	-	-	1	-	01
9	Ability Enhancement courses (AEC*) Courses (AEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory Courses (MC*)	-	-	-	-	-	-	-	-	-
	Total	**22**	**22**	**23**	**23**	**21**	**22**	**20**	**17**	**170**

**** AEC and MC are not included for CGPA calculation***

HONOURS / MINOR DEGREE PROGRAMME:

The student is permitted to opt for earning an honours / minor degree in the same discipline of engineering in addition to the degree in his/her own discipline. To earn an honours / minor degree the student is required to earn an additional 18 - 20 credits (over and above the total 170 credits prescribed in the curriculum) starting from fourth semester onwards by completing 5 additional courses offered in respective semesters. A student is eligible to exercise this option if he/she has passed all the courses offered upto third semester in the first attempt itself and has earned a CGPA / GPA* (*for lateral entry) of not less than 8.0. The prescribed courses offered for Honours / minor degree are given in **Annexure V**.

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	SEMESTER – I									
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC01	Engineering Mathematics - I	BS	3	1	0	4	25	75	100
2	U23BSTC01	Physical Science for Engineers	BS	3	0	0	3	25	75	100
3	U23ESTC01	Basics of Civil and Mechanical Engineering	ES	3	0	0	3	25	75	100
4	U23CSTC02	Problem Solving Approach	ES	3	0	0	3	25	75	100
5	U23ICT101	Fundamentals of Electrical Machines	PC	3	0	0	3	25	75	100
Theory cum Practical										
6	U23ENBC01	Communicative English - I	HS	2	0	2	3	50	50	100
Practical										
7	U23ESPC02	Design Thinking and IDEA Lab	ES	0	0	2	1	50	50	100
8	U23ICP101	Problem Solving Approach Laboratory	ES	0	0	2	1	50	50	100
9	U23ICP102	Fundamentals of Electrical Machines Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
10	U23ICC1XX	Certification Course I**	AEC	0	0	4	-	100	-	100
Mandatory Course										
11	U23ICM101	Induction Programme	MC	2 Weeks			-	-	-	-
							22	425	575	1000

	SEMESTER – II									
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC02	Engineering Mathematics - II	BS	3	1	0	4	25	75	100
2	U23CSTC01	Programming in C	ES	3	0	0	3	25	75	100
3	U23BMTC01	Electron Devices and Circuits	PC	3	0	0	3	25	75	100
4	U23ICT202	Transducer Engineering	PC	3	0	0	3	25	75	100
5	U23HSTC01	Universal Human Values - II	HS	2	0	0	2	25	75	100
Theory cum Practical										
6	U23ENBC02	Communicative English - II	HS	2	0	2	3	50	50	100
Practical										
7	U23ESPC03	Engineering Graphics using AutoCAD	ES	0	0	2	1	50	50	100
8	U23CSPC01	Programming in C Laboratory	ES	0	0	2	1	50	50	100
9	U23BMPC01	Electron Devices and Circuits Laboratory	PC	0	0	2	1	50	50	100
10	U23ICP203	Transducer Engineering Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
11	U23ICC2XX	Certification Course II**	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23ICM202	Sports Yoga and NSS	MC	0	0	2	-	100	-	100
							22	575	625	1200

***** Certification Courses are to be selected from the list given in Annexure III***

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SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC03	Probability and Statistics	BS	3	1	0	4	25	75	100
2	U23ADTC01	Programming in Python	ES	3	0	0	3	25	75	100
3	U23ICTC01	Linear Integrated Circuits	PC	3	0	0	3	25	75	100
4	U23ICTC02	Digital Logic Circuits	PC	2	1	0	3	25	75	100
5	U23ICT303	Electrical and Electronic Instrumentation	PC	3	0	0	3	25	75	100
Theory cum Practical										
6	U23ICB301	Circuit Theory	PC	2	0	2	3	50	50	100
Practical										
7	U23ENPC01	General Proficiency - I	HS	0	0	2	1	50	50	100
8	U23MAPC01	Engineering Mathematics Laboratory	BS	0	0	2	1	50	50	100
9	U23ADPC01	Programming in Python Laboratory	ES	0	0	2	1	50	50	100
10	U23ICPC01	Linear and Digital Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
11	U23ICC3XX	Certification Course III**	AEC	0	0	4	-	100	-	100
12	U23ICS301	Skill Enhancement Course I*	AEC	0	0	2	-	100	-	100
Mandatory Course										
13	U23ICM303	Climate Change	MC	2	0	0	-	100	-	100
							23	675	625	1300

SEMESTER – IV										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23MATC04	Numerical Methods and Optimization	BS	3	1	0	4	25	75	100
2	U23CSTC03	Data Structures	ES	3	0	0	3	25	75	100
3	U23ICTC03	Linear Control Systems	PC	2	1	0	3	25	75	100
4	U23ICT404	Microcontroller Based System Design	PC	3	0	0	3	25	75	100
5	U23ICE4XX	Professional Elective I #	PE	3	0	0	3	25	75	100
Theory cum Practical										
6	U23ICB402	Solid and Fluid Mechanics	ES	2	0	2	3	50	50	100
Practical										
7	U23ENPC02	General Proficiency - II	HS	0	0	2	1	50	50	100
8	U23CSPC02	Data Structures Laboratory	ES	0	0	2	1	50	50	100
9	U23ICP404	Microcontroller Based System Design Laboratory	PC	0	0	2	1	50	50	100
10	U23ICP405	Simulation Laboratory	PC	0	0	2	1	50	50	100
Ability Enhancement Course										
11	U23ICC4XX	Certification Course IV**	AEC	0	0	4	-	100	-	100
12	U23ICS402	Skill Enhancement Course II*	AEC	0	0	2	-	100	-	100
Mandatory Course										
13	U23ICM404	Right to Information and Good Governance	MC	2	0	0	-	100	-	100
							23	675	625	1300

 # Professional Electives are to be selected from the list given in Annexure I

**** Skill Enhancement Courses (1 and 2) are to be selected from the list given in Annexure IV***

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SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23HSTC02	Research Methodology	HS	2	0	0	2	25	75	100
2	U23ITTC02	Programming in Java	ES	3	0	0	3	25	75	100
3	U23ICT505	Industrial Instrumentation	PC	3	0	0	3	25	75	100
4	U23ICT506	Embedded System Design	PC	3	0	0	3	25	75	100
5	U23ICE5XX	Professional Elective II #	PE	3	0	0	3	25	75	100
6	U23XXOCXX	Open Elective I $	OE	3	0	0	3	25	75	100
Practical										
7	U23ITPC02	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
8	U23ICP506	Embedded System Design Laboratory	PC	0	0	2	1	50	50	100
9	U23ICP507	Industrial Instrumentation Laboratory	PC	0	0	2	1	50	50	100
Project Work										
10	U23ICW501	Micro Project	PA	0	0	2	1	100	-	100
Ability Enhancement Course										
11	U23ICC5XX	Certification Course V**	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23ICM505	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	600	600	1200

SEMESTER – VI										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23ICT607	Analytical Instrumentation	PC	3	0	0	3	25	75	100
2	U23ICT608	Power Plant Instrumentation	PC	3	0	0	3	25	75	100
3	U23ICT609	Process Control	PC	3	0	0	3	25	75	100
4	U23ICE6XX	Professional Elective III #	PE	3	0	0	3	25	75	100
5	U23XXOCXX	Open Elective II $	OE	3	0	0	3	25	75	100
Theory cum Practical										
6	U23ICB603	Internet of Things for Automation	PC	2	0	2	3	50	50	100
Practical										
7	U23ICP608	Instrumentation System Design Laboratory	PC	0	0	2	1	50	50	100
8	U23ICP609	Process Control Laboratory	PC	0	0	2	1	50	50	100
9	U23ICP610	Virtual Instrumentation Laboratory	PC	0	0	2	1	50	50	100
Project Work										
10	U23ICW602	Mini Project	PA	0	0	2	1	100	-	100
Ability Enhancement Course										
11	U23ICC6XX	Certification Course VI**	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23ICM606	Gender Equality	MC	2	0	0	-	100	-	100
							22	625	575	1200

$ Open Electives are to be selected from the list given in Annexure II

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SEMESTER – VII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23ICT710	Industrial Safety	PC	3	0	0	3	25	75	100
2	U23ICT711	Instrumentation in Biomedical Applications	PC	3	0	0	3	25	75	100
3	U23ICT712	Logic and Distributed Control System	PC	3	0	0	3	25	75	100
4	U23ICE7XX	Professional Elective IV #	PE	3	0	0	3	25	75	100
5	U23XXOCXX	Open Elective III $	OE	3	0	0	3	25	75	100
Practical										
6	U23ICP711	Logic and Distributed Control System Laboratory	PC	0	0	2	1	50	50	100
7	U23ICP712	Technical Seminar	PC	0	0	2	1	100	-	100
Project Work										
8	U23ICW703	Project Phase I	PA	0	0	4	2	50	50	100
9	U23ICW704	Internship / Inplant Training	PA	0	0	2	1	100	-	100
							20	425	475	900

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23HSTC03	Entrepreneurship and Business Management	HS	3	0	0	3	25	75	100
2	U23ICE8XX	Professional Elective V #	PE	3	0	0	3	25	75	100
3	U23ICE8XX	Professional Elective VI #	PE	3	0	0	3	25	75	100
Project Work										
4	U23ICW805	Project Phase II	PA	0	0	16	8	50	100	150
							17	125	325	450
Total Credits							**170**			

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Annexure – I

PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U23BMEC01	Communication Systems
2	U23ICE401	Energy Harvesting Techniques
3	U23ICE402	Fundamentals of Computer Networks
4	U23ICE403	Fundamentals of Pneumatics and Hydraulics
5	U23ICE404	Signal Processing for Instrumentation
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U23ICE505	Calibration Systems
2	U23ICE506	Industrial Unit Operations
3	U23ICE507	Instrumentation Buses and Data Networks
4	U23ICE508	Instrumentation Symbols and Standards
5	U23ICE509	Software Design Tools for Sensing and Control
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U23ICEC01	Virtual Instrumentation
2	U23ICEC02	Soft Computing Techniques
3	U23ICE610	MEMS and NEMS
4	U23ICE611	Non-Linear Control Systems
5	U23ICE612	Piping and Instrumentation Diagram
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U23ICEC03	Intelligent Robotic Systems
2	U23ICE713	Computer Control of Processes
3	U23ICE714	Fiber Optics and Laser Instrumentation
4	U23ICE715	Field Instruments for Process Control
5	U23ICE716	Instrumentation in Process Industries
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U23BMEC02	Wearable Technology
2	U23ICE817	Artificial Intelligence for Process Control
3	U23ICE818	Design of Process Control System Components
4	U23ICE819	Green Electronics

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5	U23ICE820	Instrumentation in Petrochemical Industries
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U23ICE821	Automotive Instrumentation and Control
2	U23ICE822	Condition Monitoring
3	U23ICE823	Cybersecurity in Industrial Automation
4	U23ICE824	Instrumentation in Agriculture and Food Processing Industries
5	U23ICE825	System Identification and Adaptive Control

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Annexure - II

OPEN ELECTIVE COURSES

Open Elective- I (Offered in Semester V/ VI)				
S. No	**Course Code**	**Course Title**	**Offering Department**	**Offered Department**
Open Elective – I/ Open Elective – II (Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE, CSE &BS**)				
1	U23ICOC01	Sensors for Engineering Applications	ICE	EEE, ECE, CSE, IT, MECH, CCE, CSE&BS, AI&DS
2	U23ICOC02	Fuzzy Logic and Neural Networks	ICE	CSE, IT, MECH, CCE, CSE&BS, AI&DS
Open Elective- II (Offered in Semester VII)				
1	U23ICOC03	Embedded Systems for AI Applications	ICE	CSE, IT, BME, CCE, CSE&BS, AI&DS
2	U23ICOC04	Industrial Automation	ICE	ECE, CSE, IT, MECH, CCE, CSE&BS, AI&DS

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Annexure – III

ABILITY ENHANCEMENT COURSES – CERTIFICATION COURSES

S. No	Course Code	Course Title	Certified By
1	U23ICCX01	Adobe Photoshop	Adobe
2	U23ICCX02	Adobe Animate	Adobe
3	U23ICCX03	Adobe Dreamweaver	Adobe
4	U23ICCX04	Adobe After Effects	Adobe
5	U23ICCX05	Adobe Illustrator	Adobe
6	U23ICCX06	Adobe InDesign	Adobe
7	U23ICCX07	Autodesk AutoCAD -ACU	Autodesk
8	U23ICCX08	Autodesk Inventor - ACU	Autodesk
9	U23ICCX09	Autodesk Revit - ACU	Autodesk
10	U23ICCX10	Autodesk Fusion 360 - ACU	Autodesk
11	U23ICCX11	Autodesk 3ds Max - ACU	Autodesk
12	U23ICCX12	Autodesk Maya - ACU	Autodesk
13	U23ICCX13	Cloud Security Foundations	AWS
14	U23ICCX14	Cloud Computing Architecture	AWS
15	U23ICCX15	Cloud Foundation	AWS
16	U23ICCX16	Cloud Practitioner	AWS
17	U23ICCX17	Cloud Solution Architect	AWS
18	U23ICCX18	Data Engineering	AWS
19	U23ICCX19	Machine Learning Foundation	AWS
20	U23ICCX20	Robotic Process Automation / Medical Robotics	Blue Prism
21	U23ICCX21	Advance Programming Using C	CISCO
22	U23ICCX22	Advance Programming Using C ++	CISCO
23	U23ICCX23	C Programming	CISCO
24	U23ICCX24	C++ Programming	CISCO
25	U23ICCX25	CCNP Enterprise: Advanced Routing	CISCO
26	U23ICCX26	CCNP Enterprise: Core Networking	CISCO
27	U23ICCX27	Cisco Certified Network Associate - Level 2	CISCO
28	U23ICCX28	Cisco Certified Network Associate- Level 1	CISCO
29	U23ICCX29	Cisco Certified Network Associate- Level 3	CISCO
30	U23ICCX30	Fundamentals Of Internet of Things	CISCO
31	U23ICCX31	Internet Of Things / Solar and Smart Energy System with IoT	CISCO
32	U23ICCX32	Java Script Programming	CISCO
33	U23ICCX33	NGD Linux Essentials	CISCO
34	U23ICCX34	NGD Linux I	CISCO
35	U23ICCX35	NGD Linux II	CISCO
36	U23ICCX36	Advance Java Programming	Ethnotech
37	U23ICCX37	Android Programming / Android Medical App Development	Ethnotech
38	U23ICCX38	Angular JS	Ethnotech
39	U23ICCX39	Catia	Ethnotech
40	U23ICCX40	Communication Skills for Business	Ethnotech
41	U23ICCX41	Coral Draw	Ethnotech
42	U23ICCX42	Data Science Using R	Ethnotech
43	U23ICCX43	Digital Marketing	Ethnotech
44	U23ICCX44	Embedded System Using C	Ethnotech

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45	U23ICCX45	Embedded System with IOT / Arduino	Ethnotech
46	U23ICCX46	English For IT	Ethnotech
47	U23ICCX47	Plaxis	Ethnotech
48	U23ICCX48	Sketch Up	Ethnotech
49	U23ICCX49	Financial Planning, Banking and Investment Management	Ethnotech
50	U23ICCX50	Foundation Of Stock Market Investing	Ethnotech
51	U23ICCX51	Machine Learning / Machine Learning for Medical Diagnosis	Ethnotech
52	U23ICCX52	IOT Using Python	Ethnotech
53	U23ICCX53	Creo (Modelling & Simulation)	Ethnotech
54	U23ICCX54	Soft Skills, Verbal, Aptitude	Ethnotech
55	U23ICCX55	Software Testing	Ethnotech
56	U23ICCX56	MX-Road	Ethnotech
57	U23ICCX57	CLO 3D	Ethnotech
58	U23ICCX58	Solid works	Ethnotech
59	U23ICCX59	Staad Pro	Ethnotech
60	U23ICCX60	Total Station	Ethnotech
61	U23ICCX61	Hydraulic Automation	Festo
62	U23ICCX62	Industrial Automation	Festo
63	U23ICCX63	Pneumatics Automation	Festo
64	U23ICCX64	Agile Methodologies	IBM
65	U23ICCX65	Block Chain	IBM
66	U23ICCX66	Devops	IBM
67	U23ICCX67	Artificial Intelligence	ITS
68	U23ICCX68	Cloud Computing	ITS
69	U23ICCX69	Computational Thinking	ITS
70	U23ICCX70	Cyber Security	ITS
71	U23ICCX71	Data Analytics	ITS
72	U23ICCX72	Databases	ITS
73	U23ICCX73	Java Programming	ITS
74	U23ICCX74	Networking	ITS
75	U23ICCX75	Python Programming	ITS
76	U23ICCX76	Web Application Development (HTML, CSS, JS)	ITS
77	U23ICCX77	Network Security	ITS & Palo alto
78	U23ICCX78	MATLAB	MathWorks
79	U23ICCX79	Azure Fundamentals	Microsoft
80	U23ICCX80	Azure AI (AI-900)	Microsoft
81	U23ICCX81	Azure Data (DP -900)	Microsoft
82	U23ICCX82	Microsoft 365 Fundamentals (SS-900)	Microsoft
83	U23ICCX83	Microsoft Security, Compliance and Identity (SC-900)	Microsoft
84	U23ICCX84	Microsoft Power Platform (PI-900)	Microsoft
85	U23ICCX85	Microsoft Dynamics Fundamentals 365 – CRM	Microsoft
86	U23ICCX86	Microsoft Excel	Microsoft
87	U23ICCX87	Microsoft Excel Expert	Microsoft
88	U23ICCX88	Securities Market Foundation	NISM
89	U23ICCX89	Derivatives Equinity	NISM
90	U23ICCX90	Research Analyst	NISM
91	U23ICCX91	Portfolio Management Services	NISM
92	U23ICCX92	Cyber Security	Palo alto

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93	U23ICCX93	Cloud Security	Palo alto
94	U23ICCX94	PMI – Ready	PMI
95	U23ICCX95	Tally – GST & TDS	Tally
96	U23ICCX96	Advance Tally	Tally
97	U23ICCX97	Associate Artist	Unity
98	U23ICCX98	Certified Unity Programming	Unity
99	U23ICCX99	VR Development	Unity

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Annexure – IV

ABILITY ENHANCEMENT COURSES – SKILL ENHANCEMENT COURSES (SEC)

Sl. No	Course Code	Course Title
1.	U23ICS301	**Skill Enhancement Course 1 ***
		• Troubleshooting of Electronic Equipments
		• Calibration of Measuring Instruments
		• Application of Arduino
2.	U23ICS402	**Skill Enhancement Course 2 ***
		• Applications using Raspberry Pi
		• PLC Programming
		• AutoCAD for Instrumentation

**** Any one Skill Enhancement course to be selected from SEC 1 and SEC 2.***

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Annexure – IV

HONOURS / MINOR PROGRAMME - SENSORS TECHNOLOGY

COURSE DETAILS											
Sl. No.	Semester	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
					L	T	P		CAM	ESM	Total
Theory											
1	IV	U23ICX401	Smart Sensors	PC / IC	3	1	0	4	25	75	100
2	V	U23BMX502	Nano Biosensors	PC / IC	3	1	0	4	25	75	100
3	VI	U23ICX603	Embedded Sensing Technologies	PC / IC	3	1	0	4	25	75	100
4	VII	U23ICX704	IoT and Sensor Networks	PC / IC	3	1	0	4	25	75	100
5	VIII	U23BMX805	Wearable Devices and its Applications	PC / IC	3	1	0	4	25	75	100
	Total							**20**	**125**	**375**	**500**
Equivalent NPTEL courses##											
1	**Course Code** U23XXXN01		Sensors and Actuators					**3**	**12 Weeks Course**		
2			Biophotonics					**3**			
3			Embedded Systems Design					**3**			
4			Design for internet of things					**3**			
5			Sensor Technologies: Physics, Fabrication, and Circuits					**3**			

The student shall be given an option to earn 3 credits through one equivalent 12 week NPTEL course instead of any one course listed for honours / minor degree programme that should be completed before the commencement of eighth semester. The equivalent courses are subject to change based on its availability as per NPTEL course list.

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	SEMESTER – V									
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23HSTC02	Research Methodology	HS	2	0	0	2	25	75	100
2	U23ITTC02	Programming in Java	ES	3	0	0	3	25	75	100
3	U23ICT505	Industrial Instrumentation	PC	3	0	0	3	25	75	100
4	U23ICT506	Embedded System Design	PC	3	0	0	3	25	75	100
5	U23ICE5XX	Professional Elective II #	PE	3	0	0	3	25	75	100
6	U23XXOCXX	Open Elective I $	OE	3	0	0	3	25	75	100
Practical										
7	U23ITPC02	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
8	U23ICP506	Embedded System Design Laboratory	PC	0	0	2	1	50	50	100
9	U23ICP507	Industrial Instrumentation Laboratory	PC	0	0	2	1	50	50	100
Project Work										
10	U23ICW501	Micro Project	PA	0	0	2	1	100	-	100
Ability Enhancement Course										
11	U23ICC5XX	Certification Course V**	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23ICM505	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	600	600	1200

	SEMESTER – VI									
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U23ICT607	Analytical Instrumentation	PC	3	0	0	3	25	75	100
2	U23ICT608	Power Plant Instrumentation	PC	3	0	0	3	25	75	100
3	U23ICT609	Process Control	PC	3	0	0	3	25	75	100
4	U23ICE6XX	Professional Elective III #	PE	3	0	0	3	25	75	100
5	U23XXOCXX	Open Elective II $	OE	3	0	0	3	25	75	100
Theory cum Practical										
6	U23ICB603	Internet of Things for Automation	PC	2	0	2	3	50	50	100
Practical										
7	U23ICP608	Instrumentation System Design Laboratory	PC	0	0	2	1	50	50	100
8	U23ICP609	Process Control Laboratory	PC	0	0	2	1	50	50	100
9	U23ICP610	Virtual Instrumentation Laboratory	PC	0	0	2	1	50	50	100
Project Work										
10	U23ICW602	Mini Project	PA	0	0	2	1	100	-	100
Ability Enhancement Course										
11	U23ICC6XX	Certification Course VI**	AEC	0	0	4	-	100	-	100
Mandatory Course										
12	U23ICM606	Gender Equality	MC	2	0	0	-	100	-	100
							22	625	575	1200

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Department	**Management Studies**	Programme: **B.Tech**						
Semester	**V**	Course Category Code: **HS**				*End Semester Exam Type: **TE**		
Course Code	**U23HSTC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Research Methodology**	**2**	**0**	**0**	**2**	**25**	**75**	**100**

Common to ALL Branches

Prerequisite	**Nil**		
Course Outcomes	***On completion of the course, the students will be able to***		**BT Mapping (Highest Level)**
	CO1	Interpret the different types of research and explain how research methods can be used to address engineering problems.	**K2**
	CO2	Discuss the research problems, conduct comprehensive literature reviews, and utilize tools and services for effective information retrieval.	**K2**
	CO3	Apply appropriate methods to design experiments, analyze data, and interpret results using both numerical and graphical techniques.	**K3**
	CO4	Analyze and apply ethical guidelines to structure and write research papers and dissertations, ensuring academic integrity and avoiding plagiarism.	**K4**
	CO5	Examine the fundamentals of intellectual property rights to protect and enforce them, with emphasis on their role in fostering innovation and entrepreneurship in engineering.	**K3**

UNIT-I	**Introduction to Research**	**Periods: 6**	
Meaning and Importance of Research, Types of Research: Overview of Basic, Applied, and Developmental Research, Overview of the Research Process, Defining a Research Problem: Key Considerations, Setting Research Objectives and Research Questions, Introduction to Research Design: Basic Concepts, Approaches to Research: Quantitative vs. Qualitative.			**CO1**
UNIT-II	**Problem Formulation and Literature Review**	**Periods: 6**	
Identifying and Formulating Research Problems, conducting a Literature Review: Essential Steps, Referencing and Citation Methods: Basic Techniques. Sources of Information: Overview of Libraries and Online Databases.			**CO2**
UNIT-III	**Research Methods and Data Analysis**	**Periods: 6**	
Introduction to Experimental Research, Developing Hypotheses: Basic Approach. Data Collection Methods: Sampling and Surveys, Basics of Data Analysis: Numerical and Graphical Analysis, Introduction to Inferential Statistics.			**CO3**
UNIT-IV	**Writing and Presenting Research**	**Periods: 6**	
Preparing a Research Report: Key Sections (Abstract, Introduction, Methodology, Results, Discussion, Conclusion). Referencing and Citation: Brief Overview.			**CO4**
UNIT-V	**Ethics and Intellectual Property in Research**	**Periods: 6**	
Ethical Considerations in Research: Introduction to Scientific Misconduct. Basics of Intellectual Property Rights - Introduction to Patents, Copyrights, and Trademarks – Case studies on ethical dilemmas in research.			**CO5**

Lecture Periods: 30	**Tutorial Periods:**	**Practical Periods:**	**Total Periods: 30**

Text Books

1. Kumar, R. Research Methodology: A Step-by-Step Guide for Beginners, 5th Edition, SAGE Publications, 2019.
2. Ram Ahuja, *Research methods*, Rawat Publications, 2nd edition, 2022
3. Creswell, J. W., and Creswell, J. D. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 5th Edition, SAGE Publications, 2018.

Reference Books

1. Thiel DV. Research methods for engineers. Cambridge: Cambridge University Press; 2014.
2. Ganesan R. Research methodology for engineers. Chennai: MJP Publishers; 2024.
3. Agarwal C, Sharma V. Research methodology in sociology. New Delhi: Commonwealth Publishers; 2012.
4. Thody A. Writing and presenting research. 2nd edition, London: SAGE Publications; 2006.
5. Kothari CR. Research methodology – methods and techniques. 5th edition, New Delhi: New Age International Publishers; 2023.

Web References

1. https://conjointly.com/kb/
2. https://owl.purdue.edu/owl/research_and_citation/conducting_research/writing_a_literature_review.html

Dr. L. M. Varalakshmi

B.Tech – Instrumentation and Control Engineering

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3.	https://files.eric.ed.gov/fulltext/ED536788.pdf
4.	https://researcheracademy.elsevier.com/
5.	https://www.wipo.int/
6.	https://www.scholastic.com /7-steps-to-successful-research-report.html
7.	https://www.futurelearn.com/info/courses/business-research-methods- investigation.
8.	https://articles.manupatra.com/article-details/Patent-Types-Laws-related-to-them-in-India

COs/POs/PSOs Mapping

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Program Specific Outcomes (PSOs)		
													PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	2	-	-	2	2	3	-	1	1
CO2	3	1	1	3	1	-	2	-	-	1	2	-	-	1	1
CO3	1	3	3	1	3	-	2	-	-	2	2	-	-	1	1
CO4	-	-	1	2	-	-	2	3	2	2	-	2	-	1	1
CO5	2	2	2	2	2	2	3	3	2	2	3	2	-	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

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Department	**Information Technology**	Programme: **B.Tech.**						
Semester	**V**	Course Category Code: **ES**			*End Semester Exam Type: **TE**			
Course Code	**U23ITTC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Programming in Java**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

(Common to All Branches)

Prerequisite	Basic knowledge of Object-Oriented Programming Principles

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
CO1	Articulate the concept of Java fundamentals, OOPs and Strings	**K2**
CO2	Demonstrate the principles of inheritance, packages and interfaces with real time applications	**K2**
CO3	Create real time applications using exception handling and thread programming.	**K3**
CO4	Build distributed applications using Collections and IO streams	**K3**
CO5	Design and build simple GUI programs using AWT, Swings and build database applications	**K3**

Unit- I	**Introduction**	**Periods:09**
Introduction: Java: History – Features – JVM - JRE – JDK – Java Compilation and Execution – Data Types - Variables, Types, Expressions, Assignment Statements, Input / Output Statements: Scanner/System class, Type Casting(Primitives to Primitives), Conditional and Iterative Control Structures - Arrays **OOPs with Java:** Introduction to OOPs Concepts - Class – Objects – Methods - Access Modifiers – Creating Class and Objects, Object Life-Cycle - Garbage Collection-Constructors - this – static – Array of Objects – Nested Classes. **String**: String Class– Built-in Methods – String Builder – String Buffer		**CO1**

Unit- II	**Inheritance, Interfaces and Packages**	**Periods:09**
Inheritance: Types of Inheritance – is-a Relationship, has-a Relationship – super keyword – final keyword – Polymorphism - Method overloading and Method overriding – Abstract Class **Interfaces:** Define – Extend – Implement – Access - Interfaces vs Abstract classes, Type Conversions (Primitives to Objects vice-versa): Autoboxing and Auto unboxing **Packages:** Define – Create – Access – Import		**CO2**

Unit- III	**Exception Handling and Multithreading**	**Periods:09**
Exception Handling: Exception Hierarchy – Checked and Unchecked Exceptions – try, catch, throws, throw and finally – User Defined Exceptions. **Multithreading:** Thread – Life cycle – Defining and Running – Implementation Types – Thread Priorities – Thread Synchronization - Inter-Thread Communication		**CO3**

Unit- IV	**Collections and I/O Streams**	**Periods:09**
Collections: List: Array List and Linked List. Set: Hash Set and Tree Set. Map: Hash Map – Stack – Queue. Lambda Expressions. **I/O Streams:** Streams – Byte Streams and Character Streams – File Input Stream and File Output Stream – File Reader and File Writer. Object Serialization : Object Input Stream and Object Output Stream		**CO4**

Unit- V	**GUI and JDBC**	**Periods:09**
AWT: Components – Controls – Event Handling **SWING**: Swing Components – Layout Management. **JDBC:** JDBC Architecture – JDBC Driver Types – Implementation of JDBC.		**CO5**

LecturePeriods:45	**Tutorial Periods:**	**Practical Periods:**	**TotalPeriods:45**

Text Books

1. Allen B. Downey and Chris Mayeld, "Think Java - How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2020
2. Herbert Schildt, "Java: The Complete Reference", TMH Publishing Company Ltd, 11th Edition, 2018.
3. H.M. Dietel and P.J. Dietel, "Java How to Program", 11th Edition, Pearson Education/PHI, 2017
4. Cay S. Horstmann, Gary Cornell, "Core Java Volume - I Fundamentals", 9th Edition, Prentice Hall, 2013.

Reference Books

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1. Sagayaraj, Denis, Karthik, Gajalakshmi, "JAVA Programming for core and advanced learners", Universities Press Private Limited, 2018.
2. PoaulDeitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
3. P.J. Dietel and H.M Dietel, "Java for Programmers", Pearson Education, 9th Edition, 2011.
4. Steven Holzner, "Java 2 Black book", Dreamtech Press, 2011.

Web References

1. https://www.javatpoint.com/java-tutorial
2. https://docs.oracle.com/en/java/
3. https://www.studytonight.com/java/
4. https://onlinecourses.nptel.ac.in/

COs/POs/PSOs Mapping

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	-	2	3	2	1
2	3	3	3	-	3	-	-	-	-	-	-	2	3	2	1
3	3	3	3	1	3	-	-	-	-	-	-	2	3	2	1
4	3	3	3	1	3	-	-	-	-	-	-	2	3	2	1
5	3	3	3	1	3	-	-	-	-	-	-	2	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

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Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V**	Course Category Code: **PC**			*End Semester Exam Type: **TE**			
Course Code	**U23ICT505**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Industrial Instrumentation**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite	Transducer engineering, Electrical and Electronic Measurements							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Familiarize with different temperature scales and their applications	**K2**
	CO2	Utilize Various Pressure Measurement Devices	**K2**
	CO3	Comprehend different methods of level measurement	**K2**
	CO4	Understand Electrical and Modern Flow Meters	**K2**
	CO5	Utilize various sensors and instruments for accurate and reliable measurements	**K2**

UNIT –I	**Temperature Measurement**	**Periods:9**	
Introduction to the industrial instrumentation- Need for industrial instrumentation-Industrial process variables- Temperature scales, Bimetallic thermometer, filled- in Thermometers, Vapour pressure thermometers, Resistance DC thermometers, Thermistors, Thermostat, Thermocouples - types and ranges, characteristics, laws of thermocouples, cold junction compensation, IC temperature sensors AD 590, Pyrometers - radiation and optical pyrometers.			**CO1**
UNIT –II	**Pressure Measurement**	**Periods:9**	
Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules - Electrical methods: Elastic elements with LVDT and strain gauges - Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, lionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester			**CO2**
UNIT –III	**Level Measurement**	**Periods:9**	
Level measurement: Float gauges - Displacer type – D/P methods -Bubbler System-Load cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement: – Differential pressure method and Hydrastep method - Solid level measurement.			**CO3**
UNIT –IV	**Flow Measurement**	**Periods:9**	
Variable Head Type Flow meter: Orifice plate: different types of orifice plates – Cd variation – pressure tappings – Venturi tube – Flow nozzle – Dall tube – Pitot tube- Positive displacement flow meters:Nutating disc, Reciprocating piston and oval gear flow meters – Inferential meter – Turbine flow meter- Mass flow meter, Coriolis type mass flow meters – Calibration of flow meters: – Dynamic weighing method. Electrical type flow meter: Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer			**CO4**
UNIT –V	**Smart Transmitters & Miscellaneous Measurements**	**Periods:9**	
Pneumatic transmitter: Operation - Electronic transmitter: Study of 2 wire and 4 wire transmitters – Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters – Radar level transmitter-Installation and Calibration of smart and conventional transmitters. Speed measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators - Stroboscope. Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers Humidity: Dry and wet bulb psychrometers – Dew cell Moisture: Different methods of moisture measurements –Thermal, Microwave, IR and NMR sensors.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill publishing company, 2012.
2. R.K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 2019.
3. D. Patranabis, "Principles of Industrial Instrumentation", Tata McGraw Hill Publishing Company Ltd, 2013.

Reference Books

1. A.K. Sawhney and P. Sawhney, "A Course on Mechanical Measurements, Instrumentation and Control", Dhanpath Rai and Co, 2013.
2. S.K. Singh, "Industrial Instrumentation and Control", Tata McGraw Hill, 2014.
3. D.P. Eckman, "Industrial Instrumentation", Wiley Eastern Ltd., 2012.
4. P.Holman, "Experimental Methods for Engineers", International Student Edition, McGraw Hill Book Company, 2013.

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5. Andrew W.G, "Applied Instrumentation in Process Industries – A survey", Vol. 1 & Vol.2, Gulf Publishing Company, Houston, 2012.

Web References

1. https://lecturenotes.in/subject/42/industrial-instrumentation-ii
2. https://www.scribd.com/i/260674587/Industrial-Instrumentation-Notes.
3. https://nptel.ac.in/courses/108/105/108105064/.
4. https://www.youtube.com/playlist?list=PLUtfVcb-iqn_Dq6RnkCaOaLjPDu3cmxpo.
5. https://nptel.ac.in/courses/108/106/108106074/

*TE – Theory Exam, LE –Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	-	1	-	-	-	-	-	-	-	3	2	2
2	3	2	3	-	1	-	-	-	-	-	-	-	3	2	2
3	3	2	3	-	1	-	-	-	-	-	-	-	3	2	3
4	3	2	3	-	1	-	-	-	-	-	-	-	3	2	3
5	3	2	3	-	1	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 – Medium, 3 - High

Evaluation Methods

Assessment	Continuous Assessment Marks(CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

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B.Tech – Instrumentation and Control Engineering

2.A.5.75

2.A.5.76

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V**	Course Category Code: **PC**			*End Semester Exam Type: **TE**			
Course Code	**U23ICT506**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Embedded System Design**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite	Microprocessor and Microcontroller							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping(Highest Level)
	CO1	Understand the fundamentals of embedded system, its features and applications.	**K2**
	CO2	Explain the ARM cortex-M series architecture.	**K2**
	CO3	Configure, program and debug the STM32F4XX series microcontroller	**K3**
	CO4	Understand and implement the principles of embedded networking protocols	**K2**
	CO5	Describe the concepts of real-time operating systems	**K3**

UNIT –I	**Embedded System Fundamentals**	**Periods:09**	
Introduction to embedded systems, Embedded systems vs general computing system, classification of embedded system, Challenges and design considerations of embedded systems, - selection of microcontrollers- Major application areas of embedded system – IDE, Embedded Firmware development tools -Compiler/Assembler, linker/locator, Simulator/Emulator.			**CO1**
UNIT –II	**ARM-Cortex M Series Architecture**	**Periods:09**	
ARM 32-bit microcontroller architecture—technology overview, Architectural Features of ARM Cortex M series (STM32F4XX series): Block Diagram, CPU modes, register organization, ROM, RAM, data and address bus, Memory mapped I/O and I/O mapped I/O. CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture, instruction set, pipelining, exceptions, and its handling.			**CO2**
UNIT –III	**ARM-Cortex development tools**	**Periods:09**	
STM32F4XX series -Nucleo or discovery development board, -CubMX I/O programming-LED interfacing, switch interfacing, sensor Interfacing, Timers- PWM and Interrupt programming. ADC , DAC			**CO3**
UNIT –IV	**Embedded Networking**	**Periods:09**	
Buses & Protocols – Serial and Parallel communication protocols - RS 232, RS-485, I2C, SPI, UART, USB, CAN, AMBA. Ethernet, WLAN, Bluetooth, Zigbee.			**CO4**
UNIT –V	**Real-Time Operating system**	**Periods:09**	
OS Concepts and types, tasks & task states, process, threads, multiprocessing and multitasking, scheduling, task communication, task synchronization, RTOS Selection, Case studies- Air bag deployment system, Home automation.			**CO5**
Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Alexander G. Dean, Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach, ARM Education media, 2021.
2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian, "COMPUTER ORGANIZATION AND EMBEDDED SYSTEMS, Sixth Edition, McGraw Hill, 2012.
3. Johnathon M Valvano, Embedded Systems: Introduction to ARM Cortex M Microcontrollers, 5th Edition, 2017.

Reference Books

1. Haung, H.W., "The HCS12 / 9S12: An Introduction to Software and Hardware Interfacing, Delmar Learning", 2010.
2. Steve Furber, "ARM System-on-Chip Architecture, Second Edition, PEARSON, 2013.
3. Andrew N. Sloss, Dominic Symes, Chris Wright "ARM System Developers Guide, Designing and Optimizing System Software", Elsevier Publication, 2004.
4. Milan Sanka, Vaclav Halavac, Roger Boyle "Image Processing, analysis and machine vision", Springer Publisher, 2013.
5. Ray, A.K., "Advance Microprocessors and Peripherals – Architecture", Programming and Interfacing, Tata McGraw-Hill, 2009.

Web References

1. https://www.geeksforgeeks.org/real-time-operating-system-rtos/
2. https://developer.arm.com/Processors/Cortex-M4
3. https://developer.arm.com/documentation/100166/0001/Programmers-Model
4. https://embedthreads.com/wp-content/uploads/2023/09/Muhammad-Ali-Mazidi.pdf

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	-	-	-	-	-	-	-	-	-	3	2	2
2	3	3	2	-	1	-	-	-	-	-	-	-	3	2	2
3	3	3	3	-	-	-	-	-	-	-	-	-	3	2	3
4	3	2	3	-	1	-	-	-	-	-	-	-	3	2	3
5	3	2	2	-	1	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 – Medium, 3 - High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

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B.Tech – Instrumentation and Control Engineering

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2.4.5.80

Department	**Information Technology**	Programme: **B.Tech**						
Semester	**V**	Course Category Code: **ES**			*End Semester Exam Type: **LE**			
Course Code	**U23ITPC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Programming in Java Laboratory**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
(Common to All Branches)								
Prerequisite	Basic concepts of Object-Oriented Programming Principles							

Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Apply and practice logical formulations to solve simple problems leading to specific applications.	**K3**
	CO2	Demonstrate the use of inheritance, interface and package in relevant applications	**K3**
	CO3	Implement robust application programs in Java using exception handling and multithreading	**K3**
	CO4	Build java distributed applications using Collections and IO streams.	**K3**
	CO5	Implement Graphical User Interface based application programs by utilizing event handling features and Swing in Java.	**K3**

List of Exercises

1. Develop simple programs using java
2. Develop a java program that implements class and object.
3. Write a java program to find the frequency of a given character in a string
4. Write a java program to demonstrate inheritance and interfaces.
5. Develop a java program that implements the Packages.
6. Create java applications using Exception Handling for error handling.
7. Develop a simple real life application program to illustrate the use of Multi-Threads.
8. Implement simple applications using Collections.
9. Develop application using the concept of I/O Streams
10. Write a Java Program to demonstrate AWT and Swing Components
11. Develop a simple application and use JDBC to connect to a back-end database.

Lecture Periods: -	**Tutorial Periods:** -	**Practical Periods:30**	**Total Periods:30**

Reference Books

1. Allen B. Downey and Chris Mayeld, "Think Java - How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2020
2. Sagayaraj, Denis, Karthik, Gajalakshmi, "JAVA Programming for core and advanced learners", Universities Press Private Limited, 2018
3. Cay.S.Horstmann and Gary Cornell, "Core Java 2", Vol 2, Advanced Features, Pearson Education, 7th Edition, 2010

Web References

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM's tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog.
5. https://www.geeksforgeeks.org.

* TE – Theory Exam, LE – Lab Exam

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
2	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
4	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1
5	3	2	1	1	3	-	-	-	-	-	-	-	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Instrumentation and Control Engineering**	Programme:**B.Tech**						
Semester	**V**	Course Category: **PC**			*End Semester Exam Type: **LE**			
Course Code	**U23ICP506**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Embedded System Design Laboratory**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
		ICE						
Prerequisite	**Microprocessor and Microcontroller**							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Interface I/O device with STM32F4XX	**K2**
	CO2	Control DC and Stepper motor with STM32F4XX	**K3**
	CO3	Interface sensor and other peripherals using STM32F4XX	**K3**
	CO4	Comprehend communication features using STM32F4XX	**K3**
	CO5	Implement interrupt features using STM32F4XX	**K3**

List of Experiments

1. Interface LED and keypad with STM32F4XX.
2. Interface LCD with STM32F4XX.
3. Control and interface DC motor using STM32F4XX.
4. Speed control of stepper motor using STM32F4XX.
5. Interface IR, LDR and temperature sensor with STM32F4XX.
6. Implementation of timer features with STM32F4XX.
7. PWM based LED brightness control using STM32F4XX.
8. Implementation of UART using STM32F4XX.
9. Implementation of I2C using STM32F4XX.
10. Implementation of ADC features with STM32F4XX.
11. Implementation of DAC features with STM32F4XX.
12. Implementation of interrupt features in STM32F4XX.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Text Books

1. Alexander G. Dean, Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach, ARM Education media, 2017.
2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian, "Computer Organization and Embedded Systems, Sixth Edition, McGraw Hill, 2012.

Reference Books

1. Steve Furber, "ARM System-on-Chip Architecture, Second Edition, Pearson, 2013.
2. Andrew N. Sloss, Dominic Symes, Chris Wright "ARM System Developers Guide, Designing and Optimizing System Software", Elsevier Publication.

Web References

1. https://developer.arm.com/Processors/Cortex-M4
2. file://datacenter/COMMON%20SHARING%203/ice/odd%2024/8%20BOS/esd/Scheme%202022.pdf
3. https://developer.arm.com/documentation/100166/0001/Programmers-Model

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B.Tech – Instrumentation and Control Engineering

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	2	-	-	-	-	-	-	-	2	3	2
2	3	2	3	-	3	-	-	-	-	-	-	-	3	3	2
3	3	3	3	-	3	-	-	-	-	-	-	-	3	3	3
4	2	2	2	-	2	-	-	-	-	-	-	-	2	3	3
5	3	2	3	-	2	-	-	-	-	-	-	-	2	3	3

Correlation Level: 1 - Low, 2 – Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

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B.Tech – Instrumentation and Control Engineering

2.A.5.87

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Department	**Instrumentation and Control Engineering**	Programme: **B. Tech.**						
Semester	**V**	Course Category: **PC**			*End Semester Exam Type: **LE**			
Course Code	**U23ICP507**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Industrial Instrumentation Laboratory**	**0**	**0**	**2**	**1**	**50**	**50**	**100**
		ICE						
Prerequisite	**Transducer Engineering**							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Determine the viscosity and pressure in the industrial process.	**K2**
	CO2	Comprehend the flow of the industrial process.	**K2**
	CO3	Measure the level parameter of the industrial process.	**K2**
	CO4	Measure the temperature of industrial process.	**K2**
	CO5	Measure and analyze pH and conductivity value of different solutions.	**K2**

List of Experiments

1. Measurement of Viscosity using saybolt viscometer.
2. Calibration of pressure gauge using dead weight tester.
3. Measurement of level using d/p transmitter.
4. Measurement of flow using Discharge coefficient of orifice plate
5. Calibration of manometer.
6. Calibration of I to P and P to I converters.
7. Calibration of RTD and Thermocouple.
8. Standardization and measurement of pH values of different solutions
9. Standardization and measurement of conductivity of different solutions
10. Calibration of Torque meter.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Text Books

1. O. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill publishing company, 2012.
2. R.K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 2019. 3. D. Patranabis, "Principles of Industrial
3. Instrumentation", Tata McGraw Hill Publishing Company Ltd, 2013.

Reference Books

1. A.K. Sawhney and P. Sawhney, "A Course on Mechanical Measurements, Instrumentation and Control", Dhanpath Rai and Co, 2013.
2. S.K. Singh, "Industrial Instrumentation and Control", Tata McGraw Hill, 2014.
3. D.P. Eckman, "Industrial Instrumentation", Wiley Eastern Ltd., 2012.

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	2	-	-	-	-	-	-	-	2	3	2
2	3	3	2	-	3	-	-	-	-	-	-	-	3	3	2
3	3	2	2	-	3	-	-	-	-	-	-	-	3	3	3
4	2	3	2	-	2	-	-	-	-	-	-	-	2	3	3
5	3	3	2	-	2	-	-	-	-	-	-	-	2	3	3

Correlation Level: 1 - Low, 2 – Medium, 3 – High

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2:A5.90

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

2.A.5.92

Department	**Instrumentation and Control Engineering**	Programme: **B. Tech.**						
Semester	**V**	Course Category Code: **PA**				*End Semester Exam Type: **-**		
Course Code	**U23ICW501**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Micro Project**	**0**	**0**	**2**	**1**	**100**	**-**	**100**
ICE								
Prerequisite	Electron Devices and Circuits, Transducer Engineering							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Identify the problem statement for the micro project work through the literature survey	**K2**
	CO2	Choose the proper components as per the requirements of the design/ system.	**K2**
	CO3	Apply the acquainted skills to develop final model/system	**K3**

There shall be a Micro Project, which the student shall pursue as a team consists of maximum 4 students during the third year, fifth semester. The aim of the micro project is that the student has to understand the real time hardware / software applications. The student should gain a thorough knowledge in the problem he/she has selected and in the hardware / software he/she using in the Project. The Micro-project is an application that should be formally initiated and should be developed and also to be implemented by the respective team.

The Micro Project shall be submitted in a report form along with the hardware model / software developed, duly approved by the department internal evaluation committee. It shall be evaluated for 100 marks as Continuous Assessment. The department internal evaluation committee shall consist of faculty coordinator, supervisor of the project and a senior faculty member of the department. There shall be two reviews that will be considered for assessing a Micro Project work with weightage as indicated evaluation Methods.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	3	3	-	1	1	1	1
2	3	3	3	2	2	2	2	2	3	3	3	1	2	2	2
3	3	2	2	1	-	2	-	-	3	3	3	1	3	3	3

Correlation Level: 1 – Low, 2 – Medium, 3 -High

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2.4.5.94

Evaluation Method

Assessment	Review 1			Review 2				Total Marks
	Novelty	Presentation	Viva	Presentation	Demonstration	Viva	Report	
Marks	10	20	10	20	20	10	10	100

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Department	**Instrumentation and Control Engineering**	Programme: **B. Tech.**						
Semester	**V**	Course Category: **AEC**			End Semester Exam Type: **-**			
Course Code	**U23ICC5XX**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Certification Course - V**	**0**	**0**	**4**	**-**	**100**	**-**	**100**
ICE								
Prerequisite	**-**							

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

(i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.

(ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as "pass" on satisfactory completion. A letter grade "P" is awarded to declare pass.

(iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)		Total Marks
	Attendance	MCQ Test	
Marks	**10**	**90**	**100**

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Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V**	Course Category Code: **MC**			*End Semester Exam Type: **-**			
Course Code	**U23ICM505**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Essence of Indian Traditional Knowledge**	**2**	**0**	**0**	**-**	**100**	**-**	**100**
Common to ALL Branches								
Prerequisite	**-**							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Familiarize with the philosophy of Indian culture	**K2**
	CO2	Distinguish the Indian languages and literature	**K2**
	CO3	Describe the philosophy of ancient, medieval and modern India	**K2**
	CO4	Illustrate the information about the fine arts in India	**K2**
	CO5	Describe the contribution of scientists of different eras	**K2**

UNIT- I	**Introduction To Culture**	**Periods:06**	
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India			**CO1**
UNIT- II	**Indian Languages, Culture and Literature**	**Periods:06**	
Indian Languages and Literature - I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature			**CO2**
UNIT- III	**Religion and Philosophy**	**Periods:06**	
Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)			**CO3**
UNIT- IV	**Fine Arts in India (Art, Technology and Engineering)**	**Periods:06**	
Indian Painting, Indian handicrafts, Music, divisions of Indian classical music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India			**CO4**
UNIT-V	**Education System in India**	**Periods:06**	
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India			**CO5**

Lecture Periods:30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods:30**

Reference Books

1. Kapil Kapoor, "Text and Interpretation: The India Tradition", ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. S. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978 - 8120810990, 2014

Web References

1. https://nptel.ac.in/courses/109/104/109104102/
2. https://nptel.ac.in/courses/101/104/101104065/
3. https://nptel.ac.in/courses/109/108/109108158/
4. https://nptel.ac.in/courses/109/106/109106059/
5. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ae01/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	3	-	1	1	-	1
2	1	-	-	-	-	-	-	-	-	3	-	1	1	-	1
3	1	-	-	-	-	-	-	-	-	3	-	1	1	-	1
4	1	-	-	-	-	-	-	-	-	3	-	1	1	-	1
5	1	-	-	-	-	-	-	-	-	3	-	1	1	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100

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Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PC**			*End Semester Exam Type: **TE**			
Course Code	**U23ICT607**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Analytical Instrumentation**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite	Physics							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand the fundamental principle and application of spectrophotometry.	**K3**
	CO2	Gain knowledge on the chromatographic behaviour of solutes in gas and liquid state.	**K3**
	CO3	Critically evaluate the strengths and limitations of the various pollution monitoring instrumental methods.	**K3**
	CO4	Acquaint on PH meters and dissolved component analyzers.	**K3**
	CO5	Understand the working principle, types and applications of NMR and Mass spectroscopy.	**K3**

UNIT –I	**Spectrophotometry**	**Periods:09**	
Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – Single beam and double beam Instruments- IR Spectrophotometer - FTIR spectrophotometer – Atomic absorption spectrophotometer - Flame emission and atomic emission photometry – Construction, working principle, sources, detectors and applications.			**CO1**
UNIT –II	**Chromatography**	**Periods:09**	
General principles – classification – chromatographic behaviour of solutes – quantitative determination – Gas chromatography – Liquid chromatography –High Pressure liquid Chromatography (HPLC), application.			**CO2**
UNIT –III	**Industrial Gas Analyzers and Pollution Monitoring instruments**	**Periods:09**	
Gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity detectors, Thermal Analyzer, analysis based on ionization of gases. Air Pollution due to Carbon monoxide, Hydrocarbons, Nitrogen oxides, Sulphur dioxide estimation - Dust and smoke measurements.			**CO3**
UNIT –IV	**PH Meters and Dissolved Component Analyzers**	**Periods: 09**	
Selective ion electrodes - Principle of pH and conductivity measurements – dissolved oxygen analyzer- Sodium analyzer – Silicon analyzer – Water quality Analyzer- ORP analyzer.			**CO4**
UNIT –V	**Nuclear Magnetic Resonance and Mass Spectrometry**	**Periods: 09**	
NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.			**CO5**
LecturePeriods:45	**Tutorial Periods:-**	**Practical Periods:-**	**TotalPeriods:45**

Text Books

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental methods of analysis", CBS publishing & distribution, 7th Edition, 2012.
2. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2nd edition, 2012
3. Robert E. Sherman., "Analytical Instrumentation", Instruments Society of America, 1996.

Reference Books

1. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw-Hill publishing Co. Ltd., 2nd Edition 2007.
2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", McGraw-Hill, 5th Edition reprint 1985.
3. Liptak, B.G., "Process Measurement and Analysis", CRC Press, 5th Edition, 2015.
4. Dr.J.R. Mudakavi, "Modern Instrumental methods of Analysis", NPTEL lecture notes, IISC, Bangalore, 2019.

Web References

1. https://www.slideshare.net/ErFarukBinPoyen/analytical-instrumentation-introduction.
2. https://www.youtube.com/watch?v=AkXRYGwlbL4
3. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/IC0309%20Analytical%20Instumentation.pdf

*TE – Theory Exam, LE –Lab Exam

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	1	-	-	-	-	-	-	-	3	3	3
2	3	2	1	-	1	-	-	-	-	-	-	-	3	2	2
3	2	2	1	-	1	-	-	-	-	-	-	-	3	2	2
4	3	2	1	-	1	-	-	-	-	-	-	-	3	3	3
5	3	2	1	-	1	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks(CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PC** *End Semester Exam Type: **TE**						
Course Code	**U23ICT608**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Power Plant Instrumentation**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
Prerequisite	Industrial Instrumentation							

Course Outcomes	**On completion of the course the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand and analyze about the various Power Generation Methods.	**K2**
	CO2	Comprehend basic measurement in power plants.	**K2**
	CO3	Recognize various analyzers for monitoring feed water impurity, flue gas etc.	**K2**
	CO4	Acquaint knowledge on various Instruments used in nuclear power plants.	**K2**
	CO5	Gain knowledge to control and monitor the turbines.	**K2**

UNIT –I	**OVERVIEW OF POWERGENERATION**	**Periods:9**	
Brief Survey methods of power generation:– hydro, thermal, nuclear, solar and wind power– Importance of instrumentation in power generation – Thermal power plant – Building blocks - Combined Cycle System – Combined Heat and Power System – sub critical and supercritical boilers.			**CO1**
UNIT –II	**MEASUREMENTS IN POWER PLANTS**	**Periods:9**	
Measurement of feed water flow, air flow, steam flow and coal flow – Drum level measurement – Steam pressure and temperature measurement – radiation detector – smoke density measurement– Flue gas analyzer – Fuel composition analyzer.			**CO2**
UNIT –III	**BOILER CONTROL**	**Periods:9**	
Combustion of fuel and excess air – Firing rate demand – Steam temperature control – Steam & Water Analysis system -Control of deaerator – Drum level control – Single, two and three element control – Furnace draft control –implosion - flue gas dew point control – Trimming of combustion air – Soot blowing.			**CO3**
UNIT –IV	**NUCLEAR POWER PLANT INSTRUMENTATION**	**Periods:9**	
Piping and instrumentation diagram of different types of nuclear power plants-radiation detection instruments-process sensors for nuclear power plants-spectrum analyzers-nuclear reactor control systems and allied instrumentation.			**CO4**
UNIT –V	**TURBINE MONITORING AND CONTROL**	**Periods:9**	
Speed, vibration, shell temperature monitoring and control – Steam pressure control – Lubricant oil temperature control – Cooling system.			**CO5**

Lecture Periods:45	**Tutorial Periods:-**	**Practical Periods:-**	**TotalPeriods:45**

Text Books

1. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2013.
2. P.K.Nag, Powerplant Engineering, Tata McGraw-Hill Education, 3rd edition,2011
3. David Lindsley, Power-plant Control and Instrumentation, The Control of Boilers and HRSG Systems, 2000.

Reference Books

1. Sam Dukelow, "Control of Boilers", Instrument Society of America, 2012.
2. Jain R.K., "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 2012.
3. Singh, S. K., "Industrial Instrumentation and Control", Tata- McGraw-Hill Publishing Company, ISBN-13: 978-0-07-026222-5, 2009.
4. K. Krishnaswamy, M. Ponnibala, "Power plant instrumentation", 2013

Web References

1. www.ignou.ac.in/upload/Unit-2-58.pdf
2. http://www.powerplantinstrumentationcontrol.yolasite.com/
3. https://electrical-engineering-portal.com/download-center/books-and-guides/power-

TE – Theory Exam, LE – Lab Exam

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D

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2.A.5.108

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	-	1	-	-	-	-	-	-	-	2	2	2
2	3	2	3	-	2	-	-	-	-	-	-	-	3	2	2
3	3	3	2	-	1	-	-	-	-	-	-	-	2	1	2
4	3	2	3	-	2	-	-	-	-	-	-	-	2	2	2
5	3	1	2	-	1	-	-	-	-	-	-	-	2	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

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Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PC**			*End Semester Exam Type: **TE**			
Course Code	**U23ICT609**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Process Control**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite	Industrial Instrumentation							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Acquaint the dynamics of various processes.	**K2**
	CO2	Acquire knowledge on the characteristics, Selection and Sizing of final control elements.	**K2**
	CO3	Describe the effect of various control actions.	**K2**
	CO4	Interpret the evaluation criteria and tuning techniques of controllers.	**K2**
	CO5	Comprehend the concept of multi loop control techniques.	**K2**

UNIT –I	**Process Modelling and Dynamics**	**Periods:9**	
Need for process control – Mathematical Modelling of Processes: Level, Flow, Pressure and Thermal processes – Interacting and non-interacting system - Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR.			**CO1**
UNIT –II	**Final Control Elements**	**Periods:9**	
Signal Conversions: I to P and P to I Converters - Actuators: Pneumatic and electric actuators — Control Valves-Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner– Valve body:-Commercial valve bodies-Control Valve Sizing – Cavitation and flashing.			**CO2**
UNIT –III	**Control Actions**	**Periods:9**	
Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues: Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action			**CO3**
UNIT –IV	**PID Controller Tuning**	**Periods:9**	
PID Controller Design Specifications: Criteria based on Time Response and Criteria based Frequency Response - PID Controller Tuning: Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, optimization methods, Auto tuning- Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio.			**CO4**
UNIT –V	**Control Techniques and Applications**	**Periods:9**	
Feed-forward control – Ratio control – Cascade control – Inferential control – Split-range - Override Control and introduction to multivariable control— IMC– Adaptive control – P&ID diagram. Case Studies: Control Schemes for Distillation Column-Three-element Boiler drum level control.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., "Process Dynamics and Control", Wiley John and Sons,4th Edition, 2016.
2. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2nd Edition, 2023.
3. Stephanopoulos, G., "Chemical Process Control", Prentice Hall of India, 2006.

Reference Books

1. Coughanowr, D.R., "Process Systems Analysis and Control", McGraw - Hill International Education,3rd Edition,2013
2. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson, 2013.
3. Considine, D.M., "Process Instruments and Controls Handbook", Second Edition, McGraw, 5th Edition 2022.
4. Bela.G.Liptak., "Process Control and Optimization", Instrument Engineers' Handbook, Volume 2,CRC,2018.
5. D. P. Eckman, "Automatic Process control", 7th Edition, John Wiley, New York, 1990.

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1. http://www.pc-education.mcmaster.ca/
2. https://controlguru.com/

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3. https://www.youtube.com/watch?v=eYrZcxOPVPE
4. http://www.instrumentationworld.com/instrumentation_tutorial.htm
5. http://www.pc-education.mcmaster.ca/Instrumentation/go_inst.htm

*TE – Theory Exam, LE –Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	-	3	-	-	-	-	-	-	-	3	2	2
2	3	2	2	-	2	-	-	-	-	-	-	-	3	1	2
3	3	2	2	1	2	-	-	-	-	-	-	-	3	2	3
4	3	3	3	2	3	-	-	-	-	-	-	-	3	1	3
5	3	2	1	2	1	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks(CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

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Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PC** *End Semester Exam Type: **TE**						
Course Code	**U23ICB603**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Internet of Things for Automation**	**2**	**0**	**2**	**3**	**50**	**50**	**100**
ICE								
Prerequisite	Microcontroller							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Infer internet of Things and its components.	**K2**
	CO2	Describe about Reference modules and Architecture.	**K2**
	CO3	Explain the concepts of Hardware and Software Elements.	**K2**
	CO4	Build and deploy various Functions with IoT elements.	**K2**
	CO5	Develop real-time IoT based Applications.	**K2**

UNIT –I	**INTRODUCTION TO INTERNET OF THINGS**	**Periods:10**	
The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.			**CO1**
UNIT –II	**ARCHITECTURE OF IoT**	**Periods:10**	
State of the Art – Introduction, Architecture Reference Model- IoT reference Model, IoT Reference Architecture, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.			**CO2**
UNIT –III	**ELEMENTS OF IoT**	**Periods:10**	
Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming APIs (using Python/Embedded C,C++) for Communication.			**CO3**
UNIT-IV		**Periods:15**	

List of Experiments:

1. Interfacing sensor with IoT device
2. Temperature and Humidity Logger using Thing Speak cloud
3. Smart Plant Monitoring System
4. DC motor monitoring and control using blynk app.
5. Home Automation using IoT cloud platform.
6. IoT Enabled parking management.

UNIT- V		**Periods:15**	

List of Experiments:

1. Smart Energy Meter System
2. Water Quality Monitoring System
3. Integrate SMTP Protocol in real time application.
4. Automatic Door Lock System
5. Smart waste bin monitoring with IoT
6. IoT based health monitoring system.

Lecture Periods: 30	**Tutorial Periods:**	**Practical Periods: 30**	**Total Periods: 60**

Text Books

1. Vijay Madisetti, ArshdeepBahga, "Internet of Things, A Hands-on Approach", University Press,3rd edition, Aug 2018.
2. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill ISBN: 9789352605224, 9789352605224,2nd edition, May 2017.
3. Dr. SRN Reddy, RachitThukral and Manasi Mishra, "Introduction to Internet of Things: A Practical Approach", ETI Labs 2014.

Reference Books

1. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi, 2012.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2007

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3. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill, 2002
4. CunoPfister, "Getting Started with the Internet of Things", O Reilly Media, 2015
5. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

Web References

1. https://www.i-scoop.eu/internet-of-things-guide/
2. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/
3. https://www.youtube.com/watch?v=eYrZcxOPVPE
4. https://www.coursera.org/learn/iot
5. https://onlinecourses.nptel.ac.in/noc21_ee85/preview

*TE – Theory Exam, LE –Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	-	-	1	1	-	-	-	-	-	3	2	2
2	3	2	2	-	-	1	1	-	-	-	-	-	3	1	2
3	3	2	2	-	-	1	1	-	-	-	-	-	3	2	3
4	3	3	3	-	-	1	1	-	-	-	-	-	3	1	3
5	3	2	1	1	-	1	1	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment method for theory cum practical course

Assessment	Continuous Assessment Marks(CAM)–Maximum 50 Marks										End Semester Examination (ESE) Marks (Theory)	Total Marks
	Continuous Assessment (Theory)					Continuous Assessment(Practical)						
	CAT1	CAT2	Model	Attendance	Total	Conduction of Practical	Report	Viva	Total	#End Semester Examination (ESE) Marks (Practical – Internal Evaluation)		
Marks	5	5	5	5	20*	15	10	5	30*	30	75**	-
	*Tobe weighted for 10 Marks				10	*Tobe weighted for 10 Marks			10		**To be weighted for 50 Marks	100

Final End Semester practical exam to be conducted with internal and external examiner by Head of the institution and HoD.

*Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

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Department	**Instrumentation and Control Engineering**	Programme: **B. Tech.**						
Semester	**VI**	Course Category: **PC**			*End Semester Exam Type: **LE**			
Course Code	**U23ICP608**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Instrumentation System Design Laboratory**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Design, test and calibrate the industrial instruments.	**K1**
	CO2	Understand design of signal conditioning circuits and instrumentation systems	**K2**
	CO3	Calibrate different instruments used in industries.	**K3**
	CO4	Design the multi-channel data acquisition system and transmitter	**K3**
	CO5	Design the advanced measuring circuits.	**K2**

List of Experiments

1. Design and Testing of Monolithic Function Generator using XR 2206
2. Design and Testing of Batch counter using TTL ICs.
3. Design and Testing of Regulated Power supplies.
4. Design and Testing of Electronic P, PI, PID & ON/OFF controllers.
5. Design and Testing of Programmable Timers.
6. Design and Testing of DAC and ADC
7. Design and Testing of Frequency to Voltage converters.
8. Design and Testing of Cold Junction compensation of a Thermocouple.
9. Design and Testing of Signal Conditioning Circuit of RTD.
10. Design and Testing of Voltage to Current converters.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Text Books

1. Jacob Fraden, "Handbook of Modern Sensors Physics, design and Applications", springer publication, 4th edition 2010.
2. GanjiVasu, "Design of Controller for Higher Order Discrete Systems", LAP Lambert Academic Publishing, 26 November 2012.
3. D.Patranabis, "Principles of Industrial Instrumentation", Tata McGraw Hill Publishing Ltd., New Delhi, 1999.

Reference Books

1. A.K.Sawhney, "A course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai and Sons, New Delhi, 1999

Web References

1. https://dl.acm.org/doi/book/10.5555/269184.
2. https://nptel.ac.in/courses/108/105/108105064/
3. https://lecturenotes.in/subject/42/industrial-instrumentation-ii

* TE – Theory Exam, LE – Lab Exam

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	3	-	-	2	-	-	-	-	-	-	3	2	3
2	2	1	3	-	-	1	-	-	-	-	-	-	3	2	3
3	2	1	3	-	-	2	-	-	-	-	-	-	3	3	3
4	3	1	3	-	-	2	-	-	-	-	-	-	3	3	3
5	3	1	3	-	-	2	-	-	-	-	-	-	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

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Department	**Instrumentation and Control Engineering**	Programme: **B. Tech.**						
Semester	**VI**	Course Category: **PC**			*End Semester Exam Type: **LE**			
Course Code	**U23ICP609**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Process Control Laboratory**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

Prerequisite

			BT Mapping (Highest Level)
Course Outcomes	**On completion of the course, the students will be able to**		
	CO1	Understand the practical issues of closed loop control of processes.	**K2**
	CO2	Comprehend process control system components to meet desired needs within realistic constraints.	**K2**
	CO3	Understand tuning of level, flow, temperature and pressure process.	**K2**
	CO4	Evaluate the dynamic behaviour of Interacting and Non-interacting System.	**K2**
	CO5	Acquire knowledge on PID enhancements.	**K2**

List of Experiments

1. Study of Process Control Training System and Piping and Instrumentation diagram of a plant.
2. Study of Inherent and Installed Characteristics of Control Valves.
3. Tuning and closed loop control of soft process by Reaction Curve Method/Continuous Cycling Method.
4. Closed loop control of Level Process.
5. Closed loop control of Flow Process.
6. Closed loop control of Temperature Process.
7. Closed loop control of Pressure Process.
8. Determine the characteristics of ON/OFF Controller for the Temperature Process.
9. Obtain the characteristics of Interacting system.
10. Obtain the characteristics of Non-interacting system.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

Text Books

1. N.A.Anderson, Instrumentation for Process Measurement and Control, Chilton Company, 2012.
2. D.M.Considine, Process Instruments and Controls Handbook, McGraw-Hill. 5th Edition 2022.
3. Coughanowr, D.R., "Process Systems Analysis and Control", McGraw - Hill InternationalEducation3rd edition, 2013.

Reference Books

1. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson, 2013.
2. D. P. Eckman, "Automatic Process control", 7th Edition, John Wiley, New York, 1990.

Web References

1. https://nptel.ac.in/courses/103/103/103103037/
2. http://www.nptelvideos.in/2012/11/process-control-and-instrumentation.html
3. https://www.youtube.com/watch?v=J1-tzQtqifU

* TE – Theory Exam, LE – Lab Exam

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	-	1	-	-	-	-	-	-	-	3	2	2
2	3	2	1	-	1	-	-	-	-	-	-	-	3	1	2
3	3	2	1	-	1	-	-	-	-	-	-	-	3	2	3
4	3	3	3	-	1	-	-	-	-	-	-	-	3	1	3
5	3	2	1	-	1	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category:**PC**			*End Semester Exam Type:**LE**			
Course Code	**U23ICP610**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Virtual Instrumentation Laboratory**	**0**	**0**	**2**	**1**	**50**	**50**	**100**

Prerequisite	Basic Electronics Laboratory		
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Get adequate knowledge on VI tool sets	**K2**
	CO2	Describe the data acquisition.	**K2**
	CO3	Attain knowledge on VI programming techniques.	**K3**
	CO4	Understand VI programming techniques.	**K3**
	CO5	Get an adequate knowledge on application of virtual instrumentation	**K2**

1. Creating Virtual Instrumentation for simple applications.
2. Programming exercises for loops and charts
3. Programming exercises for clusters and graphs.
4. Programming exercises on case and sequence structures, file Input / Output.
5. Data acquisition through Virtual Instrumentation.
6. Developing voltmeter using DAQ cards.
7. Developing signal generator using DAQ cards.
8. Simulating reactor control using Virtual Instrumentation.
9. Real time temperature control using Virtual Instrumentation.
10. Real time sequential control of any batch process.

Lecture Periods:	**Tutorial Periods:-**	**Practical Periods:30**	**Total Periods:30**

Reference Books

1. Sanjay Gupta, "Virtual Instrumentation using LABVIEW" Prentice Hall India Learning Private Limited 2010
2. Jeffrey Y Beyon,"Hands-On Exercise Manual for LabVIEW Programming, Data Acquisition and Analysis", Prentice Hall 2000.
3. Saanjay Gupta and Joseph John, "Virtual Instrumentation using LAbVIEW",Tata Mc Graw Hill 2006.
4. S.Sumathi,P.Surekha,"LabVIEW Based Advanced Instrumentation Systems",Springer,2007.
5. Jovitha Jerome,"Virtual Instrumentation using LAbVIEW",Prentice Hall India Learning Private Limited 2010

Web References

1. https://www.ni.com
2. https://www.sciencedirect.com/topics/engineering/virtual-instrument
3. http://jjackson.eng.ua.edu/courses/ece380/assignments/373363c.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	2	-	-	-	-	-	-	-	3	2	3
2	3	1	2	1	2	-	-	-	-	-	-	-	3	2	2
3	3	1	2	1	2	-	-	-	-	-	-	-	3	3	2
4	3	2	1	2	2	-	-	-	-	-	-	-	3	2	2
5	3	2	1	2	2	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

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Evaluation Method

Assessment	Continuous Assessment Marks(CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**Instrumentation and Control Engineering**	Programme: **B. Tech.**						
Semester	**VI**	Course Category Code: **PA**				*End Semester Exam Type: **-**		
Course Code	**U23ICW602**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Mini Project**	**0**	**0**	**2**	**1**	**100**	**-**	**100**
ICE								
Prerequisite	Electron Devices and Circuits, Transducer Engineering, C Programming							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Identify the problem statement for the mini project work through the literature survey	**K2**
	CO2	Choose the proper components as per the requirements of the design/ system.	**K2**
	CO3	Apply the acquainted skills to develop final model/system	**K3**

There shall be a Mini Project, which the student shall pursue as a team consists of maximum 4 students during the third year, fifth semester. The aim of the mini project is that the student has to understand the real time hardware / software applications. The student should gain a thorough knowledge in the problem he/she has selected and in the hardware / software he/she using in the Project. The Mini-project is an application that should be formally initiated and should be developed and also to be implemented by the respective team.

The Mini Project shall be submitted in a report form along with the hardware model / software developed, duly approved by the department internal evaluation committee. It shall be evaluated for 100 marks as Continuous Assessment. The department internal evaluation committee shall consist of faculty coordinator, supervisor of the project and a senior faculty member of the department. There shall be two reviews that will be considered for assessing a Mini Project work with weightage as indicated evaluation Methods.

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 30**	**Total Periods: 30**

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	3	3	-	1	1	1	1
2	3	3	3	2	2	2	2	2	3	3	3	1	2	2	2
3	3	2	2	1	-	2	-	-	3	3	3	1	2	2	2

Correlation Level: 1 – Low, 2 – Medium, 3 – High

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Evaluation Method

Assessment	Review 1			Review 2				Total Marks
	Novelty	Presentation	Viva	Presentation	Demonstration	Viva	Report	
Marks	10	20	10	20	20	10	10	100

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Department	**Instrumentation and Control Engineering**	Programme: **B. Tech.**						
Semester	**VI**	Course Category: **AEC**			End Semester Exam Type: **-**			
Course Code	**U23ICC6XX**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Certification Course - VI**	**0**	**0**	**4**	**-**	**100**	**-**	**100**
ICE								
Prerequisite	**-**							

Students shall choose an International / Reputed organization certification course of 40-50 hours duration specified in the curriculum (It is mandatory to do a minimum of six courses) which will be offered through the Centre of Excellence. These courses have no credit and will not be considered for CGPA calculation.

(i) Certification Courses are required to be completed to fulfil the degree requirements. All Certification courses are assessed internally for 100 marks.

(ii) The Course coordinator handling the course will assess the student through attendance and MCQ test, and declare the student as "pass" on satisfactory completion. A letter grade "P" is awarded to declare pass.

(iii) The marks scored in these courses will not be taken into consideration for the SGPA / CGPA calculations in the grade sheet.

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**		**Total Marks**
	Attendance	**MCQ Test**	
Marks	**10**	**90**	**100**

Department	**Instrumentation and Control Engineering**	Programme: **B. Tech.**						
Semester	**VI**	Course Category: **MC**			End Semester Exam Type :			
Course Code	**U23ICM606**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Gender Equality**	**2**	**0**	**0**	**-**	**100**	**-**	**100**

Prerequisite	**-**		
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Describe the general identity, social construction of gender roles.	**K2**
	CO2	Illustrate the causes and issues of gender discrimination in Indian society.	**K2**
	CO3	Describe the workplace discrimination, media influences on gender and culture.	**K2**
	CO4	Familiarize with international and Indian frameworks on gender equality.	**K2**
	CO5	Illustrate the current challenges in gender equality, including the glass ceiling and the role of technology.	**K2**

UNIT -I	**Introduction to Gender Equality**	**Periods:06**	
Gender equality - exploring gender identity and expression, Understanding the social construction of general roles and norms, historical perspectives on gender roles, Analyzing key milestones in the fight for gender equality.			**CO1**
UNIT - II	**Gender Inequality and Its Manifestations**	**Periods:06**	
Gender discrimination in Indian society - causes of gender inequality - Illiteracy, patriarchal set up, lack of awareness, social beliefs, practice and custom - Issues of gender discrimination - Child marriage, child domestic work, poor education and health, violence and exploitation in workplace.			**CO2**
UNIT - III	**Gender and Culture**	**Periods:06**	
Workplace discrimination, Media influences on gender and culture, Gender and power dynamics in society. Strategies for promoting gender equality and cultural understanding.			**CO3**
UNIT - IV	**Promoting Gender Equality**	**Periods:06**	
Gender Equality and Human Rights - International frameworks and Conventions on Gender Equality - Equality under the Indian Constitution - Policies and initiatives for gender mainstreaming - Strategies for promoting Gender Equality in various contexts.			**CO4**
UNIT - V	**Contemporary Challenges and Future Directions**	**Periods:06**	
Current challenges and emerging issues in gender equality- Glass ceiling - role of technology in continuing or challenging gender inequality - Exploring possibilities for transformative change and envisioning a gender-equal future.			**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Text Books

1. "Gender and Society" by Raewyn Connell - This book provides a comprehensive overview of gender roles, power dynamics, and the social construction of gender.
2. "The Second Sex" by Simone de Beauvoir - A historical and philosophical examination of women's oppression and gender inequality.
3. "Women and Gender in the Indian Society" by Neera Desai and Usha Thakkar – Focuses on the context of gender roles, inequality, and feminist movements in India.

Reference Books

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1. Woman in early Indian societies, New Delhi: Manohar Publications. Sita A. Raman (2009).
2. A social and Cultural history, Volume1. Connecticut: Oxford: Praeger. Sita Raman (2009).
3. A social and Cultural history, Volume2. Connecticut: Oxford: Praeger.
4. Iftikhar R. (2016). Indian Feminism: Class, Gender and Identity in Medieval Ages. Chennai: Notion Press. Iftikhar, R. (2012).

Web References

1. https://www.unwomen.org
2. https://ncw.nic.in
3. https://en.unesco.org/themes/gender-equality
4. https://www.weforum.org/reports
5. https://wcd.nic.in

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	3	-	1	1	-	1
2	1	-	-	-	-	-	-	-	-	3	-	1	1	-	1
3	1	-	-	-	-	-	-	-	-	3	-	1	1	-	1
4	1	-	-	-	-	-	-	-	-	3	-	1	1	-	1
5	1	-	-	-	-	-	-	-	-	3	-	1	1	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)			Total Marks
	Attendance	MCQ Test	Presentation / Activity / Assignment	
Marks	10	30	60	100

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Annexure - II

PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U23BMEC01	Communication Systems
2	U23ICE401	Energy Harvesting Techniques
3	U23ICE402	Fundamentals of Computer Networks
4	U23ICE403	Fundamentals of Pneumatics and Hydraulics
5	U23ICE404	Signal Processing for Instrumentation
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U23ICE505	Calibration Systems
2	U23ICE506	Industrial Unit Operations
3	U23ICE507	Instrumentation Buses and Data Networks
4	U23ICE508	Instrumentation Symbols and Standards
5	U23ICE509	Software Design Tools for Sensing and Control
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U23ICEC01	Virtual Instrumentation
2	U23ICEC02	Soft Computing Techniques
3	U23ICE610	MEMS and NEMS
4	U23ICE611	Non-Linear Control Systems
5	U23ICE612	Piping and Instrumentation Diagram
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U23ICEC03	Intelligent Robotic Systems
2	U23ICE713	Computer Control of Processes
3	U23ICE714	Fiber Optics and Laser Instrumentation
4	U23ICE715	Field Instruments for Process Control
5	U23ICE716	Instrumentation in Process Industries
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U23BMEC02	Wearable Technology
2	U23ICE817	Artificial Intelligence for Process Control
3	U23ICE818	Design of Process Control System Components
4	U23ICE819	Green Electronics

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5	U23ICE820	Instrumentation in Petrochemical Industries
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U23ICE821	Automotive Instrumentation and Control
2	U23ICE822	Condition Monitoring
3	U23ICE823	Cybersecurity in Industrial Automation
4	U23ICE824	Instrumentation in Agriculture and Food Processing Industries
5	U23ICE825	System Identification and Adaptive Control

Professional Elective Courses
Semester – IV, V, VI

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Department	**Biomedical Engineering**	Programme: **B.Tech.**						
Semester	**IV**	Course Category: **PE**				End Semester Exam Type: **TE**		
Course Code	**U23BMECO1**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Communication Systems**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
	(Common to BME and ICE)							
Prerequisite	Basic Electronics							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand the various Analog modulation techniques	**K2**
	CO2	Gain knowledge in Digital modulation techniques	**K3**
	CO3	Knowledge about fiber optic and satellite communication systems	**K2**
	CO4	Analyse spread spectrum and multiple access techniques	**K3**
	CO5	Realize the concepts of wireless communication	**K3**

UNIT – I	**Analog modulation**	**Periods:9**	
Need for modulation - Amplitude modulation – Frequency spectrum of AM wave – Representation of AM –Power relation – Frequency modulation – Frequency spectrum of FM wave –AM transmitter – FM transmitter – Super heterodyne AM receiver –FM receivers.			**CO1**
UNIT – II	**Digital modulation**	**Periods:9**	
Principles of pulse modulation – sampling theorem, PAM, PWM, PPM, Conversion of PWM wave to PPM wave – Generation of PAM, PPM and PWM waves – Demodulation of PAM, PWM, PPM – An introduction todigital modulation systems – PCM, DPCM, Delta Modulation, ADM, ASK, FSK and PSK.			**CO2**
UNIT – III	**Fiber optic and satellite communication**	**Periods:9**	
Need for fiber optics- principle of light transmission through a fiber- fiber classification-fiber losses- Light sources and photo detectors- Block diagram of a fiber optic system - Power budget analysis for an optical link- Recent medical application of fiber optics. Block diagram of a satellite communcation system, Satellite Orbits, satellite parameters, satellite link model, GPS services.			**CO3**
UNIT – IV	**Spread spectrum and multiple access techniques**	**Periods:9**	
Pseudo-noise sequence, DS spread spectrum, FH spread spectrum, multiple access techniques –TDMA andFDMA, source coding of speech for wireless communication.			**CO4**
UNIT – V	**Wireless communication**	**Periods:9**	
Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand off- Introduction to 4G & 5G technologies			**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Wayne Tomasi, "Advanced Electronic Communication Systems", Sixth Edition, Pearson Education, 2010.
2. Kennedy Davis, "Electronic Communication Systems", Fifth Edition, Tata McGraw Hill Publishing CompanyLimited, New Delhi, 2011.
3. Rappaport T.S, "Wireless Communications: Principles and Practice", Second Edition, PearsonEducation, 2010.

Reference Books

1. Simon Haykin, "Communication Systems", Fourth Edition, John Wiley and Sons, 2009.
2. William C.Y. Lee, "Mobile Cellular Telecommunication Systems", McGraw Hill International Edition, Third edition, 2008.
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", Third Edition, Pearson Education,2010
4. B. P.Lathi, "Modern Analog and Digital Communication Systems", Third Edition, Oxford University Press,2009
5. Martin S.Roden, "Analog and Digital Communication System", Fifth Edition, Prentice Hall of India, 2012.

Web References

1. https://nptel.ac.in/courses/108104091/
2. https://www.docsity.com/en/lecture-notes-of-intro-to-communication-systems/4580827/
3. https://nptel.ac.in/courses/117/105/117105143/
4. https://nptel.ac.in/courses/108104091/
5. https://www.docsity.com/en/lecture-notes-of-intro-to-communication-systems/4580827/

* TE – Theory Exam, LE – Lab Exam

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	3	3	2	1	2	-	-	-	-	3	1	1	2	2	-
2	3	2	2	1	2	-	-	-	-	3	1	1	2	2	-
3	3	3	-	1	1	-	-	-	-	3	1	1	2	2	-
4	3	2	-	1	1	-	-	-	-	3	1	1	2	2	-
5	3	3	2	1	2	-	-	-	-	3	1	1	2	2	-

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

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2. 4. 5. 187

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**IV**	Course Category Code: **PE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICE401**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Energy Harvesting Techniques**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite	-							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Impart knowledge on the fossil fuels and alternate sources of energy.	**K2**
	CO2	Comprehend the importance and applications of solar energy.	**K2**
	CO3	Acquaint knowledge on the wind and geothermal energy harvesting technologies.	**K2**
	CO4	Acquaint the concepts of ocean energy and hydro energy	**K2**
	CO5	Interpret the characteristics of piezoelectric effect.	**K2**

UNIT – I	**Fossil Fuels and Alternate Sources of Energy**	**Periods:09**	
Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean, Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy, tidal energy, Hydroelectricity.			**CO1**
UNIT – II	**Solar Energy**	**Periods:09**	
Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking system.			**CO2**
UNIT – III	**Wind and Geothermal Energy Harvesting**	**Periods: 09**	
Wind Energy: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. **Geothermal Energy**: Geothermal Resources, Geothermal Technologies.			**CO3**
UNIT – IV	**Ocean Energy and Hydro Energy**	**Periods: 09**	
Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. **Hydro Energy:** Hydropower resources, hydropower technologies, environmental impact of hydro power sources.			**CO4**
UNIT – V	**Piezoelectric Energy Harvesting**	**Periods: 09**	
Piezoelectric Energy harvesting: Introduction and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, piezoelectric parameters and modeling piezoelectric generators, piezoelectric energy harvesting applications.			**CO5**

Lecture Periods:45	**Tutorial Periods:-**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. G.D Rai, "Non-conventional energy sources", Khanna Publishers, New Delhi, 2004.
2. Joseph Paradiso, "Energy Harvesting: Principles and Applications", MIT Press, 2008.
3. Brian C. Cullity, "Energy Harvesting: A Tutorial", IEEE Power Electronics Magazine, 2010.

Reference Books

1. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", Oxford University Press, in association with The Open University, 2004.
2. Dr. P Jayakumar, "Solar Energy: Resource Assessment Handbook", Renewable Energy Corporation Network for the Asia Pacific, 2009.
3. J.Balfour, M.Shaw and S. Jarosek, "Photovoltaics", Lawrence J Goodrich USA, 2011.
4. M P Agarwal, "Solar energy", S Chand and Co. Ltd, 1985.
5. Suhas P Sukhative, "Solar energy", Tata McGraw Hill Publishing Company Ltd., 1997.

Web References

1. https://www.electronicsforu.com/electronics-projects/electronics-design-guides/emerging-energy-harvesting-techniques-low-power-no-battery-solutions
2. https://onlinecourses.nptel.ac.in/noc19_me73/preview
3. https://www.youtube.com/watch?v=5kpqhLzRIns
4. https://www.mouser.in/applications/energy_harvesting/?srsltid=AfmBOoqDiqZhoaox2OfOjWGi0MMbwC3Hh9ZzuurBTrwe2iLSyvsn_kN_
5. https://proesolar.com/tips/solar-energy-harvesting/

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* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
2	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
3	2	2	-	-	-	1	-	-	-	-	-	-	1	1	1
4	3	2	1	1	-	1	-	-	-	-	-	-	1	1	1
5	3	2	1	1	-	1	-	-	-	-	-	-	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content

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Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V**	Course Category Code: **PE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICE402**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Fundamentals of Computer Networks**	3	0	0	3	25	75	100
ICE								
Prerequisite	Basics of computer hardware							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Comprehend the role of network hardware and software, and different network models like OSI and TCP/IP.	**K2**
	CO2	Implement protocols like HDLC, PPP, Ethernet, and wireless LAN, and utilize techniques such as CSMA/CD and VLAN.	**K2**
	CO3	Utilize and differentiate between transport layer protocols, including TCP and UDP, for reliable data transmission.	**K2**
	CO4	Gain knowledge of email protocols like SMTP, POP3, IMAP, and MIME for various network communication services.	**K2**
	CO5	Understand and apply different network topologies such as bus, ring, star, mesh, and tree.	**K2**

UNIT – I	**Physical Layer**	**Periods:09**	
INTRODUCTION: Network applications, network hardware, network software, reference models: OSI, TCP/IP, Internet THE PHYSICAL LAYER: Guided transmission media- twisted pair, co axial, fiber optics, wireless transmission.			**CO1**
UNIT – II	**Data Link Layer**	**Periods:09**	
Data Link Layer – Framing – Flow control – Error control – Data link layer Switching Data Link Layer Protocols: HDLC – PPP - Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN.			**CO2**
UNIT – III	**Network Layer and Transport Layer**	**Periods:09**	
Routing :RIP- LSRP-OSPF-BGP- internet protocol: IPv4 and IPv6 NETWORK LAYER protocols ARP,RARP, ICMP, DHCP Transport layer protocols: UDP and TCP.			**CO3**
UNIT – IV	**Application Layer**	**Periods:09**	
Domain name system, Electronic mail, World Wide Web Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP			**CO4**
UNIT – V	**Network Topology and Networking Devices**	**Periods:09**	
Network Topology point-to-point- Bus- Ring -Star -Mesh –Tree Networking devices Hub. Switch Repeaters, Router. Bridge. Gateway, Modem, NIC			**CO5**
Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. A. S. Tanenbaum, Computer Networks, 4th edition, Pearson Education/PHI, New Delhi, India, 2003.
2. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 8th edition, Pearson Education, 2021.
3. Behrouz A. Forouzan, Data Communication and Networking, 4th edition, McGraw-Hill, India, 2006.

Reference Books

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", 5th edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, "Data and Computer Communications", 10th edition, Pearson Education, 2013.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw-Hill, 2012.

Web References

1. https://osi-model.com/physical-layer/
2. https://ipcisco.com/lesson/network-devices-2/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
2	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
3	2	2	-	-	-	1	-	-	-	-	-	-	1	1	1
4	3	2	1	1	-	1	-	-	-	-	-	-	1	1	1
5	3	2	1	1	-	1	-	-	-	-	-	-	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content

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Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**IV**	Course Category: **PE**				End Semester Exam Type: **TE**		
Course Code	**U23ICE403**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Fundamentals of Pneumatics and Hydraulics**	**3**	**0**	**0**	**3**	**25**	**75**	**100**

Prerequisite	Basics in fluid mechanics		
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Acquire knowledge about the working of Pneumatic systems.	**K2**
	CO2	Identify the controlling components of Pneumatic systems	**K3**
	CO3	Comprehend the working of hydraulic systems	**K2**
	CO4	Identify the controlling components of hydraulic systems	**K3**
	CO5	Trouble shoot malfunctioning of the hydraulic and pneumatic systems and identifies the various application of the system.	**K3**

UNIT – I	**Introduction to Pneumatic Control**	**Periods:09**	
Structure of pneumatic control system.- Choice of working medium - characteristics of compressed air - Production of compressed air - Driers, filters, regulators, lubricators, distribution of compressed air. - Pneumatic Actuators: Linear cylinders – types, conventional type of cylinder working, mounting arrangements applications.			**CO1**
UNIT – II	**Directional Control Valves**	**Periods:09**	
Simple Pneumatic Control - Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves - speed control of cylinders supply air throttling - Exhaust air throttling and use of quick exhaust valve. Use of Logic gates – OR and AND gates pneumatic applications - Practical examples involving the use of logic gates.			**CO2**
UNIT – III	**Introduction to Hydraulic Systems**	**Periods:09**	
Structure of Hydraulic Control System - The Source of Hydraulic Power - Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps, Hydraulic Actuators - Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading.			**CO3**
UNIT – IV	**Hydraulic Motors**	**Periods:09**	
Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance, Control Components in Hydraulic Systems - Constructional features, pressure control valves – direct and pilot operated types, flow control valves.			**CO4**
UNIT – V	**Trouble Shooting and Applications**	**Periods:09**	
Trouble shooting and Remedies in Hydraulic and Pneumatic systems - Electrical and electronic components in fluid power systems (sensors, controllers). **Applications of Hydraulic and Pneumatic Systems** - Press and Forklift –**Low Cost Automation** - Hydraulic and pneumatic power packs.			**CO5**
Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Anthony Esposito, Fluid Power with applications, Pearson education, Inc., 5th Edition, 2000.
2. Andrew Parr, Pneumatics and Hydraulics, Jaico Publishing Co. 2000.
3. Dr. Niranjan Murthy and Dr.R.K. Hegde, Hydraulics and Pneumatics, Sa8\pna Publications, 2013.

Reference Books

1. Srinivasan. R, Hydraulic and Pneumatic Control, Tata McGraw - Hill Education, 2nd Edition, 2012.
2. Shanmugasundaram.K, Hydraulic and Pneumatic controls, Chand & Co, 2006.
3. Jagadeesha. T., "Pneumatics Concepts, Design and Applications ", Universities Press, 2011
4. Majumdar S.R., Oil Hydraulics Systems - Principles and Maintenance, Tata McGraw-Hill, 2001.
5. Majumdar, S.R., Pneumatic Systems – Principles and Maintenance, Tata McGraw Hill, 2007.

Web References

1. https://archive.nptel.ac.in/courses/112/106/112106300/#
2. https://www.youtube.com/watch?v=Dim0fLFIFOg
3. https://www.youtube.com/watch?v=IqgDDS7x1Gc

* TE – Theory Exam, LE – Lab Exam

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	2	-	-	-	-	-	-	-	-	-	3	-	1
2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	1
3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	1
4	3	2	2	-	-	-	-	-	-	-	-	-	3	-	1
5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

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Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**IV**	Course Category: **PE**				End Semester Exam Type: **TE**		*
Course Code	**U23ICE404**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Signal Processing for Instrumentation**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
		ICE						
Prerequisite	Basic Mathematics							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Comprehend the continuous and discrete time signals and systems.	**K3**
	CO2	Acquire knowledge on continuous time signal using fourier transform and laplace transform	**K3**
	CO3	Analyze the frequency spectrum of discrete-time signals.	**K3**
	CO4	Familiarize the concept of DFT and FFT.	**K3**
	CO5	Acquaint knowledge on digital signal processor for various applications.	**K3**

UNIT – I	**Classification of Signals and Systems**	**Periods:09**	
Continuous time signals, Discrete time signals, Representation of signals: Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential signals, Classification of continuous time and discrete time signals: Periodic, aperiodic and Random signals, Energy and power signals, Continuous time and discrete time systems: Classification of systems, Properties of systems.			**CO1**
UNIT – II	**Analysis of Continuous Time Signals**	**Periods:09**	
Fourier Series: Properties - Trigonometric and Exponential Fourier Series -Parsavel's relation for periodic signals - Fourier Transform: Properties - Laplace Transformation: Properties, R.O.C - Inverse Laplace transform.			**CO2**
UNIT – III	**Analysis of Discrete Time Signals**	**Periods:09**	
Discrete Time Fourier Series: Properties, Discrete Time Fourier Transform: Properties, Z Transformation: Properties, Inverse Z-Transformation.			**CO3**
UNIT – IV	**Computation of DFT and FFT**	**Periods:09**	
Discrete Fourier Transform (DFT), Relationship of the DFT to other transforms, Properties of DFT, circular convolution, filtering long duration sequences, parameter selection to calculate DFT. Computation of DFT using Fast Fourier Transforms (FFT) algorithm, DIT & DIF - FFT using radix 2 – Butterfly structure- FFT applications			**CO4**
UNIT – V	**Digital Signal Processors**	**Periods:09**	
Introduction – Architecture of one DSP processor for motor control – Features – Addressing Formats – Functional modes - Introduction to Commercial Processors.			**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Allan V.Oppenheim, Allan S.Willsky and S.Hamid Nawab, "Signals and Systems", Pearson, Second Edition, New Delhi, 2015.
2. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
3. Proakis, J.G. and Manolakis, D.G., "Digital Signal Processing: Principles", Algorithms and Applications, Prentice Hall, 2007.
4. Rabiner, C.R. and Gold, B., "Theory and Applications of Digital Signal Processing", Prentice Hall of India Private Limited, 2000.

Reference Books

1. J Simon Haykins and Barry Van Veen, "Signals and Systems", Second Edition, Wiley, 2021.
2. H.P.Hsu and R.Ranjan, "Signals and Systems", Schaum's Outlines, Tata McGraw Hill, third Edition, 2013
3. Johny R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 2015.
4. J.GProakis and D.G.Manolakis, "Digital Signal Processing Principles", Algorithms and Applications, Pearson Education/ PHI, New Delhi, 2014.
5. Anil Jain K, "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2015.

Web References

1. http://eeweb.poly.edu/~onur/lectures/lectures.html.
2. http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html
3. https://nptel.ac.in/courses/117/105/117105079/
4. https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/
5. https://nptel.ac.in/courses/117101055

Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

* TE – Theory Exam, LE – Lab Exam

2.A.5.200

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B.Tech – Instrumentation and Control Engineering

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	-	-	-	-	-	-	-	3	3	3
2	3	2	3	2	1	-	-	-	-	-	-	-	3	3	3
3	3	2	2	3	1	-	-	-	-	-	-	-	3	3	3
4	3	2	2	2	1	-	-	-	-	-	-	-	3	3	3
5	3	2	1	2	1	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

24.5.2021

Dr. L. M. Varalakshmi

B.Tech – Instrumentation and Control Engineering

2.A.5.202

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V**	Course Category Code: **PE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICE505**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Calibration Systems**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite	Basic Probability							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Comprehend the key terms related to testing and calibration	**K2**
	CO2	Illustrate the test measurement instrumentation system.	**K2**
	CO3	Determine the testing procedures for industrial instruments	**K2**
	CO4	Summarize the procedures related to calibration requirements	**K2**
	CO5	Interpret the calibration services of different laboratories	**K2**

UNIT – I	**INTRODUCTION TO TESTING AND CALIBRATION**	**Periods:09**	
The Signal Flow of Electronic Instruments, The Instrument Block Diagram, Measurement Systems, Types of instruments, Traceability, Calibration Types, Calibration Requirements, Calibration Methodology, Instrument Specifications and Calibration Tests, Calibration Standard Requirements..			**CO1**
UNIT – II	**CALIBRATION STANDARDS**	**Periods:09**	
National Measurement Standard Laboratories, Commercial Calibration Services, Standards in different National Laboratories and Bureaus, calibration management and maintenance.			**CO2**
UNIT – III	**TESTING OF INSTRUMENTS**	**Periods:09**	
Voltage-Voltmeter, Current - Ammeter and Resistance - Ohmmeter, Temperature - Thermocouple, Pressure - Primary pressure sensing elements-Diaphragm, Bourdon tube. Flow – Pitot tube, Electromagnetic Flowmeter- Anemometer.			**CO3**
UNIT – IV	**CALIBRATION REQUIREMENTS**	**Periods:09**	
Calibration procedure, calibration procedure content, calibration datasheet, Instrument Specification Forms, Project Specifications, Manufacturers Specifications, Calibration Intervals, Safety Considerations, Calibration Status Labels.			**CO4**
UNIT – V	**INSTRUMENTATION AND DATA ANALYSIS**	**Periods:09**	
Test Measurement Instrumentation, Process Instrumentation, Test Objective – Requirements and limitations - Format and Analysis.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Henry Zumbrun" Force Calibration for Technicians and Quality Managers", 2024.
2. Vaisala Oyj, "Calibration Book", Calibration book project team, 2006.

Reference Books

1. Clyde F.Coombs Jr, "Electronic Instrument Handbook", Tata McH, 3rd Edition, 2008.
2. M/s. Beamex OYED, Fram in Vaasa, Finland, 2nd Edition, 2012.
3. Tony R. Kuphaldt, "Lesson in Industrial Instrumentation", 2017.

Web References

1. https://www.youtube.com/watch?v=SamV6zpRNgg
2. https://www.youtube.com/watch?v=RHt0sYsPUbw

* TE – Theory Exam, LE – Lab Exam

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	2	1	1	-	-	-	-	-	3	-	2
2	3	2	-	2	2	1	1	-	-	-	-	-	3	-	3
3	3	2	2	2	2	1	1	-	-	-	-	-	3	-	3
4	3	2	2	-	2	1	1	-	-	-	-	-	3	-	3
5	3	2	2	2	2	1	1	-	-	-	-	-	3	-	3

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

2.A.5.2025

Dr. L. M. Varalakshmi

B.Tech – Instrumentation and Control Engineering

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V**	Course Category Code: **PE**			*End Semester Exam Type:**TE**			
Course Code	**U23ICE506**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Industrial Unit Operations**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite								

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Determine unit operations, unit process and types of reactions involved in different industries	**K2**
	CO2	Comprehend the unit operations in transportation of solids, liquids and gases	**K2**
	CO3	Develop knowledge on the unit operations in different processes of distillation	**K2**
	CO4	Outline the working principle and operation of different processes of Dryers, Crystallizers and Evaporators	**K2**
	CO5	Analyze the unit operation in pumps compressors with case studies	**K3**

UNIT – I	**Overview of Unit Operations**	**Periods:09**	
Introduction to industrial processes - Concepts of unit operations and unit processes - Material balance and energy balance -Types of reactions - General idea of controlling operations.			**CO1**
UNIT – II	**Transport of Solids, Liquids and Gases**	**Periods:09**	
Study of Unit operation in Transport of Solids, liquids and gases - Different crushers and grinders - Adjusting of particle size, Mixing-Separation- Leaching and extraction.			**CO2**
UNIT – III	**Distillation, Chemical Reactors, Steam Boilers, Furnaces**	**Periods:09**	
Study of Unit operation in Distillation: Binary fractional distillation - Flash distillation - Batch distillation- Continuous distillation-Operational features- construction and working principle of Chemical reactors- Steam boilers- Furnaces			**CO3**
UNIT – IV	**Dryers, Crystallizers, Evaporator**	**Periods:09**	
Study of Unit operation in Dryers, Crystallization, Evaporators, Heat exchangers, Humidification, De-humidification - Different types - operational features, construction and working principle			**CO4**
UNIT – V	**Pumps, Compressors, Extruders, Blowers, Centrifuges**	**Periods:09**	
Study of Unit operation in Pumps, Compressors, Extruders, Blowers, Centrifuges - operational features, construction and working principle. **Case studies:** Unit Operations and Control schemes applied to Food processing Industry.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Balchen ,J.G., and Mumme, K.J., " Process Control structures and applications", Van Nostrand Reinhold Co., New York,1988
2. Warren L. McCabe, Julian C. Smith and Peter Harriot, "Unit Operations of Chemical Engineering", McGraw-Hill International Edition, New York, 6th edition,2001.
3. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, "Chemical Process Equipment Selection and Design", Gulf Professional Publishing, 2010.

Reference Books

1. Waddams, A.L., "Chemicals from petroleum", Butler and Taner Ltd., UK,1969.
2. Liptak, B.G., "Process measurement and analysis", Chilton Book Company, USA,1995.
3. Luyben W.C., "Process Modeling, Simulation and Control for Chemical Engineers", McGraw- Hill, 5th edition, 2023.
4. McCabe, W.L., J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering". McGraw Hill. Inc. Kosaido Printing Ltd. Tokyo, Japan, 2001
5. Geankoplis C.J., Transport Process and Unit Operations. Prentice-Hall of India Private Limited, New Delhi, 1999

Web References

1. https://www.youtube.com/watch?v=9M0HqQEFL6k
2. https://nptel.ac.in/courses/103107127/
3. https://www.docsity.com/en/ontroductions-unit-operations-lecture-slides/394376/

* TE – Theory Exam, LE – Lab Exam

2.A.5.207

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	1	-	-	-	-	-	-	3	-	2
2	3	3	2	3	1	1	-	-	-	-	-	-	3	-	3
3	3	3	2	3	1	1	-	-	-	-	-	-	3	-	3
4	3	3	3	3	1	1	-	-	-	-	-	-	3	-	3
5	3	3	3	3	1	1	-	-	-	-	-	-	3	-	3

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Dr. L. M. Varalakshmi

2.A.5.209

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V**	Course Category Code: **PE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICE507**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Instrumentation Buses and Data Networks**	3	0	0	3	25	75	100
ICE								
Prerequisite	NIL							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Acquaint knowledge and analyze Instrumentation systems and their applications to various industries	**K2**
	CO2	Determine basic concepts of data communication and its importance.	**K2**
	CO3	Gain knowledge on the various internetworking devices involved in industrial networks.	**K2**
	CO4	Explore the various serial communication used in process industries	**K2**
	CO5	Illustrate and compare the working of HART and Field bus used in process digital communication.	**K2**

UNIT – I	**NETWORK FUNDAMENTALS**	**Periods:09**	
Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD, TCP/IP			**CO1**
UNIT – II	**INTERNET WORKING and RS 232, RS485**	**Periods:09**	
Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Device net.			**CO2**
UNIT – III	**HART AND FIELD BUS**	**Periods:09**	
Introduction - Evolution of signal standard - HART communication protocol - HART networks HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability Interchangeability - Introduction to OLE for process control (OPC).			**CO3**
UNIT – IV	**MODBUS AND PROFIBUS PA/DP/FMS AND FF**	**Periods:09**	
MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation troubleshooting - review of foundation fieldbus - Data Highway.			**CO4**
UNIT – V	**INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION**	**Periods:09**	
Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, "Practical Industrial Data Networks: Design, Installation and Troubleshooting," Newnes Publication, Elsevier First Edition, 2004
2. Andrew Butterfield, "Industrial Automation Systems", Elsevier, 2017.
3. Michael J. Walsh, "Industrial Control Systems: A Practical Guide", CRC Press, 2016.

Reference Books

1. B.Govindarajulu, "IBM PC and CLONES", Tata McGraw – Hill Publishing Company, 2004.
2. A. Behrouz Forouzan, "Data Communications & Networking", 3rd Edition, Tata Mc Graw Hill, 2006.

Web References

1. https://nptel.ac.in/courses/106/105/106105082/.
2. https://lecturenotes.in/subject/903/industrial-data-networks-idn.

COs/POs/PSOs Mapping

2.4.5.2011

Dr. L. M. Varalakshmi

B.Tech – Instrumentation and Control Engineering

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	1	-	-	-	-	-	-	2	1	1	2
2	3	2	3	2	1	-	-	-	-	-	-	2	2	1	2
3	3	2	2	2	1	-	-	-	-	-	-	2	2	1	2
4	2	2	2	3	1	-	-	-	-	-	-	2	2	1	2
5	3	2	2	3	1	-	-	-	-	-	-	2	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

2.A.5-213

Dr. L. M. Varalakshmi

B.Tech – Instrumentation and Control Engineering

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V**	Course Category Code: **PE**			*End Semester Exam Type:**TE**			
Course Code	**U23ICE508**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Instrumentation Symbols and Standards**	3	0	0	3	25	75	100
ICE								
Prerequisite	NIL							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Comprehend the role of standards organization	**K2**
	CO2	Implement different standards related to installation and control system, programming, documentation, equipment in hazardous area and instrument specification forms.	**K2**
	CO3	Utilize standards related to control valve, actuators. orifice sizing, RTD and thermocouple	**K2**
	CO4	Implement standards related to power plant and nuclear power plant.	**K2**
	CO5	Build environment friendly electronic manufacturing systems.	**K2**

UNIT – I	**Standards Organization**	**Periods:09**	
Standards: Introduction International and National Standards organization: IEC, ISO, NIST, IEEE, ISA, API, BIS, DIN, JISC and ANSI. API: Process Measurement and Instrumentation (APIRP551): recommended practice for installation of the instruments – flow, level, temperature, pressure - Process Instrument and Control (API RP554): performance requirements and considerations for the selection, specification, installation and testing of process instrumentation and control systems.			**CO1**
UNIT – II	**ISA Standards**	**Periods:09**	
Documentation of Measurement and Control, Instruments and System (ISA 5): 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 - General Requirements for Electrical Equipment in Hazardous Location (ISA 12): 12.2, 12.4, 12.24, 12.29 – Instrument Specification Forms (ISA20): – Measurement Transducers (ISA37)			**CO2**
UNIT – III	**ISA Standards - Control Valve and Actuator**	**Periods:09**	
Control Valve Standards (ISA75): 75.01, 75.04, 75.05, 75.7, 75.11, 75.13, 75.14, 75.23, 75.24,75.26. Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04.			**CO3**
UNIT – IV	**Cybersecurity AD SIL Standards**	**Periods:09**	
Fossil Power Plant Standards - ISA62443, ISA84, IEC61508/61511			**CO4**
UNIT – V	**BS , ISO, IEC, & ANSI**	**Periods:09**	
Measurement of Fluid Flow by means of Orifice Plates (ISO 5167/ BSI042) IEC 61131-3 – Programmable Controller – Programming Languages – Specification for Industrial Platinum Resistance Thermometer Sensors (BSI904) – International Thermocouple Reference Tables (BS4937) – Temperature Measurement Thermocouple (ANSIC96.1).			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. W. Bolton, "Instrumentation and Control Systems", Elsevier, 1st Edition, 2004.
2. Thomas A. Hughes, "Measurement and Control Basics", ISA, 5th Edition, 2019.
3. William C. Dunn, "Industrial Instrumentation and Control Systems", Artech House, 2nd Edition, 2005.

Reference Books

1. Roy D. Moffat, "Process Measurement and Control", ISA, 2nd Edition, 2009.
2. Paul Gruhn and Harry L. Cheddie, "Safety Instrumented Systems: A Life-Cycle Approach", ISA, 2nd Edition, 2006.
3. David W. Spitzer, "Fluid Flow Measurement: A Practical Guide to Accurate Flow Measurement", ISA, 2nd Edition, 2005.

Web References

1. https://www.isa.org/standards-and-publications/isa-standards/isa-standards-committees/isa5-1
2. https://blog.ansi.org/ansi-isa-5-1-2024-instrumentation-symbols/

2.4.5.215

Dr. L. M. Varalakshmi

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	1	-	-	-	-	-	-	-	1	1	2
2	3	3	3	2	1	-	-	-	-	-	-	-	2	1	2
3	3	3	3	2	1	-	-	-	-	-	-	-	2	1	2
4	2	3	3	2	1	-	-	-	-	-	-	-	2	1	2
5	3	3	3	2	1	-	-	-	-	-	-	-	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

2.A.5.2017

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V**	Course Category Code: **PE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICE509**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Software Design Tools for Sensing and Control**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite	Mathematics							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Select an appropriate software tool for sensor and actuator design.	**K2**
	CO2	Design, model and simulate various sensing and actuating mechanisms.	**K3**
	CO3	Design a controller and evaluate its performance through simulation.	**K3**
	CO4	Design a controller using state space method and evaluate its performance through simulation.	**K3**
	CO5	Acquire knowledge in the selection and usage of hardware for real time implementation of controllers.	**K2**

UNIT – I	**Introduction to Sensor Design Software Tools**	**Periods:09**	
Introduction to history of sensor design software tools, importance and need of software tools. Recent developments in sensor design and analysis software tools. Introduction to COMSOL Multiphysics. Structural Mechanics: Analysis of mechanical structures to static or dynamic loads.			**CO1**
UNIT – II	**Software Tools for Sensor Design**	**Periods:09**	
Stationary, transient, eigenmode/modal, parametric, quasi-static and frequency-response analysis. Electrical: AC/DC Module for simulating electric, magnetic, and electromagnetic fields in static and low frequency applications. Design and simulation of sensors and actuators using COMSOL.			**CO2**
UNIT – III	**Software Tools for Micro Sensor Design**	**Periods:09**	
Introduction to IntelliSuite, mechanism design, development of sensors and actuators. Introduction to Coventorware, Description of main modules, Architect, Designer, Analyzer and Integrator. System-level and physical-level design approaches. Introduction to meshing and result visualization. Design and simulation of sensors using Coventorware.			**CO3**
UNIT – IV	**Software Tools for Control Design**	**Periods:09**	
Introduction to MATLAB, Simulink and Scilab. Introduction to toolboxes. Control design problems using classical control. Control design problems using state space approach.			**CO4**
UNIT – V	**Implementation of Controllers in Real Time**	**Periods:09**	
Introduction to various hardware platforms, control design and implementation for electrical/mechanical/electromechanical/chemical processes using dSPACE, LabVIEW and OPAL-RT.			**CO5**
Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Holly Moore, "MATLAB for Engineers", Pearson Education, 5th edition, 2017.
2. Brian Hahn and Daniel Valentine, "Essential MATLAB for Engineers and Scientists", Elsevier, Academic press, 6th edition, 2016.
3. Tamara Bechtold, Gabriela Schrag and Lihong Feng, "System-level Modeling of MEMS", Wiley VCH verlag GmbH & Co, 1st edition, 2013.

Reference Books

1. Roger W. Pryor, "Multiphysics Modeling Using COMSOL: A First Principles Approach", Jones and Bartlett Publishers, 1st edition, 2011.
2. Mehrzad Tabatabaian, "COMSOL 5 for Engineers", Mercury Learning & Information, 1st edition, 2015.
3. S R Otto and J P Denier, "An Introduction to Programming and Numerical Methods in MATLAB", Springer-verlag, 1st edition, 2005.
4. Stephen J Chapman, "MATLAB Programming for Engineers", Bookware Companion Series, 5th Edition, 2015.
5. Amos Gilat, MATLAB, "An Introduction with Applications", John Wiley & Sons, Inc., 5th edition, 2014.

Web References

1. https://www.comsol.com/
2. https://www.youtube.com/comsol
3. https://www.youtube.com/watch?v=h50L6UlW3a4&list=PLLii_xB37L998Ytf3hOGHFGbeTibm3U_c

* TE – Theory Exam, LE – Lab Exam

2.A.5.219

Dr. L. M. Varalakshmi

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	-	-	-	-	-	-	-	-	-	3	2	3
2	3	1	2	-	-	-	-	-	-	-	-	-	3	2	3
3	3	1	3	-	-	-	-	-	-	-	-	-	3	2	3
4	3	1	3	-	-	-	-	-	-	-	-	-	3	2	3
5	3	1	2	-	-	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

2. A. 5. 2021

Dr. L. M. Varalakshmi

B.Tech – Instrumentation and Control Engineering

2.4.5.222

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICEC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Virtual Instrumentation**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
(Common to ICE and Mechatronics)								
Prerequisite	-							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Comprehend the concepts of virtual instruments	**K2**
	CO2	Apply the Programming concepts in VI	**K3**
	CO3	Interpret the concepts of instrument interfacing by VI tools.	**K2**
	CO4	Acquaint the various instrument control interfaces.	**K2**
	CO5	Elucidate the concepts of VI in real time applications.	**K2**

UNIT – I	**INTRODUCTION**	**Periods:09**	
Evolution of LabVIEW - Block diagram and architecture of a virtual instrument – Graphical programming and comparison with conventional programming - Controls and indicators- Labels and Text –Shape, size and color – Data type, Format, Precision and representation – Data types – Data flow programming-Editing – Debugging and Running a Virtual Instrument.			**CO1**
UNIT – II	**PROGRAMMING STRUCTURE**	**Periods: 09**	
Front panel - Block diagram - VIS and sub-VIS, Display types – Digital – Analog – Chart – Oscilloscopic types, Loops: For Loops, While Loops, arrays, clusters, Charts and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.			**CO2**
UNIT – III	**DATA ACQUISITION**	**Periods: 09**	
Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.			**CO3**
UNIT – IV	**INSTRUMENT CONTROL**	**Periods: 09**	
Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office and Industrial applications, VISA and IVI.			**CO4**
UNIT – V	**APPLICATIONS**	**Periods: 09**	
Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Gupta , "Virtual Instrumentation Using Lab view", 2nd edition, Tata McGraw-Hill Education, 2010
2. Jovitha Jerome, "Virtual Instrumentation using LabVIEW", PHI Learning Pvt. Ltd., 2010.
3. T. S. Kang and D. M. Han, "Virtual Instrumentation: A Practical Approach", CRC Press, 2007.

Reference Books

1. Gary Jonson, "Labview Graphical Programming", 4th edition, McGraw Hill, New York, 2012.
2. Gupta.S., Gupta.J.P., "PC interfacing for Data Acquisition and Process Control", 2nd edition, Instrument Society of America, 2012.
3. Sokoloff; "Basic concepts of Labview 4", Prentice Hall Inc., New Jersey 2013.
4. N. Mathivanan, "Virtual Instrumentation: Concepts and Applications", PHI Learning Private Limited, 2008.
5. Stephen T. Morse, "Virtual Instrumentation with LabVIEW: A Hands-On Guide", Prentice Hall, 2005.

Web References

1. https://www.ni.com/
2. https://www.youtube.com/user/Labview/playlists

* TE – Theory Exam, LE – Lab Exam

2.4.5.23

2.A.5.2024

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
2	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
3	2	2	-	-	-	1	-	-	-	-	-	-	1	1	1
4	3	2	1	1	-	1	-	-	-	-	-	-	1	1	1
5	3	2	1	1	-	1	-	-	-	-	-	-	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

2.9.5.225

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PE**			*End Semester Exam Type: **TE**			
Course Code	**U23ICEC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Soft Computing Techniques**	**3**	**0**	**0**	**3**	25	75	100
(Common to ICE and BME)								
Prerequisite	Basic Mathematics, Digital Circuits							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Illustrate the fuzzy sets and the properties of fuzzy logic	**K2**
	CO2	Comprehend fuzzy logic controllers and its applications.	**K2**
	CO3	Familiarize in the neural network architecture.	**K2**
	CO4	Impart knowledge on various training algorithm of neural network and its application	**K2**
	CO5	Interpret the concepts of optimization algorithms.	**K2**

UNIT – I	**Introduction to Fuzzy Logic**	**Periods:09**	
Classical sets - Fuzzy sets – properties of fuzzy sets – operations on fuzzy sets, Cartesian Product, Fuzzy relations, linguistic variables, Linguistic approximation. Fuzzy statements: Assignments, Conditional and Unconditional statements.			**CO1**
UNIT – II	**Fuzzy Logic Control System**	**Periods:09**	
Introduction to Fuzzy logic controller: Architecture, Fuzzification, Membership functions: Triangular, Trapezoidal, Gaussian. Inference Mechanism, knowledge base, fuzzy rule base, Inference method: Mamdani, Sugeno and TSK models, Defuzzification, Applications of Fuzzy logic controller.			**CO2**
UNIT – III	**Introduction to Neural Network**	**Periods:09**	
Introduction to neural networks, Biological neural networks, Artificial Neural network, Review of genetic algorithm- Single and Multi-layer feed forward network- Activation function, types (step and sigmoid function), threshold function, Classification of learning: Supervised, Unsupervised and Reinforced. McCulloh Pitts neuron: architecture, algorithm and applications.			**CO3**
UNIT – IV	**Neural Networks Control**	**Periods:09**	
Back propagation neural net: standard architecture and algorithm, Hopfield net: architecture and algorithm, Kohonnen's Self Organizing map, Adaptive Resonance Theory ART 1: Architecture and operation- Neural networks for control: Schemes of neuro control, Applications of neuro controller. Case studies: Neuro controller for DC motor speed control, Neuro controller for a Temperature Process.			**CO4**
UNIT – V	**Optimization**	**Periods:09**	
Optimization - Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Simulated Annealing – Random Search – Downhill Simplex Search.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International, 4th editions, 2010.
2. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2008.
3. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic", Prentice Hall, USA, 2015.

Reference Books

1. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 2019.
2. Rajasekaran. S, Pai. G.A.V., "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice-Hall, 2004.
3. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education, 2007.
4. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 2001.
5. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks using MATLAB 6.0", Tata McGraw Hill Education, 1st edition, 2017.

Web References

1. https://lecturenotes.in/subject/922.
2. https://www.ifi.uzh.ch/dam/jcr:00000000-2826-155d-0000-00005e4763e3/fuzzylogicscript.pdf.
3. https://nptel.ac.in/courses/106/105/106105173/.

2.A.5.227

Dr. L. M. Varalakshmi

B.Tech – Instrumentation and Control Engineering

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	2	-	-	-	-	-	-	3	2	1
2	3	3	-	3	3	2	-	-	-	-	-	-	2	2	1
3	3	3	2	3	3	2	-	-	-	-	-	-	2	2	1
4	3	2	3	3	3	2	-	-	-	-	-	-	2	2	1
5	3	3	3	2	2	2	-	-	-	-	-	-	2	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Q.A.5.229

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICE610**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MEMS and NEMS**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite	Linear Integrated Circuits							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Interpret the basics of micro / nano electromechanical systems.	**K2**
	CO2	Recognize the use of materials in micro fabrication and describe the fabrication.	**K2**
	CO3	Analyze the key performance aspects of electromechanical transducers.	**K3**
	CO4	Comprehend the theoretical foundations of micro actuators.	**K2**
	CO5	Analyze the efforts of Nano Devices.	**K3**

UNIT – I	**Introduction to MEMS and NEMS**	**Periods:09**	
Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.			**CO1**
UNIT – II	**MEMS Fabrication Technologies**	**Periods:09**	
Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.			**CO2**
UNIT – III	**Micro Sensors**	**Periods:09**	
MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester			**CO3**
UNIT – IV	**Micro Actuators**	**Periods:09**	
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch.			**CO4**
UNIT – V	**Nano Devices**	**Periods:09**	
Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Marc Madou, "Fundamentals of Micro fabrication", CRC press, 2009.
2. Stephen D. Senturia, "Micro system Design", Kluwer Academic Publishers, 2001.
3. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata Mcraw Hill, 2012.

Reference Books

1. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006
2. Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structuresll", CRC Press, 2002.

Web References

1. https://ieeexplore.ieee.org/document/8352606.
2. https://www.theiet.org/publishing/inspec/researching-hot-topics/mems-to-nems/
3. https://nems.org/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	2	-	-	-	-	-	-	3	2	1
2	3	3	-	3	3	2	-	-	-	-	-	-	2	2	1
3	3	3	2	3	3	2	-	-	-	-	-	-	2	2	1
4	3	2	3	3	3	2	-	-	-	-	-	-	2	2	1
5	3	3	3	2	2	2	-	-	-	-	-	-	2	2	1

2.A.5.231

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICE611**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Non-Linear control systems**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite	Mathematics, Control System							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Apply advanced control theory to practical engineering problems	**K2**
	CO2	Design in state space analysis	**K2**
	CO3	Interpret the stability of linear and nonlinear systems using Lyapunov method.	**K2**
	CO4	Design of digital controller.	**K3**
	CO5	Describe the discrete system design stability concept	**K2**

UNIT – I	**State Space Model**	**Periods:09**	
Introduction to State Space, State Variables, Physical Variables, Phase Variables-Matrices, Eigen Values and Eigen vectors - Diagonalization, Canonical and Jordan forms - State Space Models from Differential Equations - Conversion of State Variable Models to Transfer Function.			**CO1**
UNIT – II	**Mathematical Analysis**	**Periods:09**	
Computation of State Transition Matrix - Laplace Transformation Method, Canonical Transformation - Cayley Hamilton Theorem- Solution of State Equation. Concepts of Controllability and Observability			**CO2**
UNIT – III	**Phase Plane Analysis**	**Periods:09**	
Features of linear and non-linear systems - Common physical non-linearity – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.			**CO3**
UNIT – IV	**Describing Function Analysis**	**Periods:09**	
General Properties of Non-Linear Systems - Describing Function Method - On / Off, Dead Zone, Saturation and Hysteresis Non Linearity - Determination of Limit Cycle by Describing Function. Stability of oscillations			**CO4**
UNIT – V	**Stability Analysis**	**Periods:09**	
Stability concepts - Equilibrium points - BIBO and asymptotic stability, Lyapunov Theory, Definitions (Stability and Functions). Direct method of Lyapunov, Application to non-linear problems.Stability analysis by describing function method –jump resonance. Frequency domain stability criteria.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Benjamin C. Kuo, "Digital Control Systems", Oxford University Press, 10th Edition 2018.
2. George J. Thaler, "Automatic Control Systems", Jaico Publishers, 2013.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 1st Edition, 2006.

Reference Books

1. Nagrath I J and Gopal M, "Control System Engineering", New Age International Pvt Ltd, 6th Edition, 2017.
2. Smarajith Ghosh, "Control Systems Theory and Applications II", Pearson Education, Singapore, 6th Edition, 2015.
4. K. Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., PHI, New Delhi, 2015.
5. William S Levine, "Control System Fundamentals", The Control Handbook, CRC Press, Tayler and Francies Group, 2nd Edition, 2011.
6. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 1st Edition, 2009.

Web References

1. https://lecturenotes.in/subject/111/advanced-control-systems-acs
2. https://nptel.ac.in/courses/108103007/
3. https://freevideolectures.com/course/3488/advanced-control-systems

* TE – Theory Exam, LE – Lab Exam

2.A.5.235

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	-	-	-	-	-	-	-	-	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	-	2	2	3
3	3	3	3	3	-	-	-	-	-	-	-	-	2	2	3
4	3	2	3	2	-	-	-	-	-	-	-	-	2	2	3
5	3	3	2	2	-	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICE612**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Piping and Instrumentation Diagram**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
ICE								
Prerequisite	Industrial Instrumentation, Control System							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Comprehend the basics of piping and instrumentation diagrams	**K2**
	CO2	Impart knowledge on P&I D symbols for pumps, compressors and process vessels.	**K2**
	CO3	Implement the control concepts in basic process systems and develop simple control loops	**K3**
	CO4	Impart knowledge to development the piping on P&IDs	**K2**
	CO5	Develop the safety interlock systems and alarm systems in process plants and P&ID systems.	**K3**

UNIT – I	**Introduction to Piping and Instrumentation Diagrams**	**Periods:09**	
Introduction to P&ID - Importance of P&IDs -Common tools used to develop P&IDs-General guidelines for developing P&IDs -Types of P&IDs - Steps in developing P&IDs - Comparison of BFD, PFD, and P&IDs.			**CO1**
UNIT – II	**Piping and Instrumentation Diagram Evaluation and Preparation**	**Periods:09**	
P & I D Symbols, line numbering, line schedule, P&I D development, various stages of P&I D, P&I D for pumps, compressors process vessels, Heat exchanger, Storage tanks.			**CO2**
UNIT – III	**Control Systems Components for Process Operation**	**Periods:09**	
Introduction and description, Valve types , P&IDs for furnaces or heaters, distillation column, Flow measurement and restriction , Gauges and switches, Cascade process controls,			**CO3**
UNIT – IV	**Development of Piping on P&IDs**	**Periods:09**	
Introduction to piping, Significance of piping, Pipeline tagging and information, Selection of piping specification and guidelines, Selection of piping class, Smart plant 3D.			**CO4**
UNIT – V	**Plant Interlocks, Alarms and P&ID systems**	**Periods:09**	
Safety Instrumented Functions on P&IDs- Process alarms - Safety interlocks -. Control valve stations - Reactor system - Storage tank mixer and heater - P&IDs for boilers - Storage tank with a pump system			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Avinashkumar Vinodkumar Karre, "Piping and Instrumentation Diagram." CPI books Walter de Gruyter GmbH, Berlin/Boston, 2023.
2. Max. S. Peters and K.D.Timmerhaus, "Plant Design and Economics for Chemical Engineers", McGraw Hill Inc., New York, 1991.
3. Considine, John M., "Piping and Instrumentation Diagrams: A Practical Guide", McGraw-Hill, 2009.

Reference Books

1. Anil Kumar, "Chemical Process Synthesis and Engineering Design", Tata McGraw Hill, New Delhi, 1981.
2. A.N.Westerberg et al., "Process Flow sheeting", Cambridge University Press, New Delhi, 1979.
3. Moe Toghraei, "Piping and Instrumentation Diagram Development", 1st Edition, Wiley-Blackwell, USA, 2019.
4. Anderson, James G., "Piping and Instrumentation Diagrams: A Practical Guide to Design, Layout, and Application", Prentice Hall, 2014.
5. Stephanopoulos, George, "Process Control Engineering", Prentice Hall, 1984.

Web References

1. https://www.youtube.com/watch?v=2VLpV1dpUho
2. https://www.youtube.com/watch?v=aWGlXamTRd4

* TE – Theory Exam, LE – Lab Exam

2.A.5.239

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	1	1	-	-	-	-	-	3	-	2
2	3	3	3	3	3	1	1	-	-	-	-	-	3	-	3
3	3	3	3	3	3	1	1	-	-	-	-	-	3	-	3
4	3	3	3	3	3	1	1	-	-	-	-	-	3	-	3
5	3	3	3	3	3	1	1	-	-	-	-	-	3	-	3

Correlation Level: 1-Low, 2-Medium, 3- High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

2.A.5.24.1

OPEN ELECTIVE COURSES

Open Elective- I (Offered in Semester V/ VI)				
S. No	**Course Code**	**Course Title**	**Offering Department**	**Offered Department**
Open Elective – I/ Open Elective – II (Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE, CSE &BS**)				
1	U23ICOC01	Sensors for Engineering Applications	ICE	EEE, ECE, CSE, IT, MECH, CCE, CSE&BS, AI&DS
2	U23ICOC02	Fuzzy Logic and Neural Networks	ICE	CSE, IT, MECH, CSE&BS, AI&DS
Open Elective- II (Offered in Semester VII)				
1	U23ICOC03	Embedded Systems for AI Applications	ICE	CSE, IT, BME, CCE, CSE&BS, AI&DS
2	U23ICOC04	Industrial Automation	ICE	ECE, CSE, IT, MECH, CCE, CSE&BS, AI&DS

2.A.5.243.

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V / VI**	Course Category Code: **OE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICOC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Sensors for Engineering Applications**	3	0	0	3	25	75	100
(Common to EEE, ECE, CSE, IT, MECH, CCE, CSE&BS, AI&DS)								
Prerequisite	Basic electronics							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Comprehend the concepts of classification of Transducers.	**K2**
	CO2	Elucidate the working of resistance Transducer.	**K2**
	CO3	Acquaint with the principle and working of various Inductive and Capacitive transducer	**K2**
	CO4	Interpret the miscellaneous transducers	**K2**
	CO5	Gain knowledge on smart transducers	**K2**

UNIT – I	**Classification of Transducers**	**Periods:09**	
General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data.			**CO1**
UNIT – II	**Resistance Transducers**	**Periods:09**	
Resistive transducers: Potentiometers, Strain gauge: Gauge factor, Types of strain gauge, strain gauge applications: Load and torque measurement, Digital displacement sensors.			**CO2**
UNIT – III	**Inductive and Capacitive Transducers**	**Periods:09**	
LVDT: Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers - Capacitive transducers: variable area type, variable air gap type, variable permittivity, Applications- Capacitor microphone, Proximity sensor: capacitive and inductive type.			**CO3**
UNIT – IV	**Miscellaneous Transducers**	**Periods:09**	
Piezoelectric transducers: Seismic transducer, photoelectric transducers: photo diode and photovoltaic transducer, Hall Effect sensors, Magnetostrictive transducers, Eddy current transducers, Introduction to Fiber optic sensors: Temperature and level measurement, Humidity Sensor, Accelerometer and Gyroscopes.			**CO4**
UNIT – V	**Smart Transducers**	**Periods:09**	
Introduction to semiconductor sensor and smart sensor: materials, scaling issues. MEMS Sensor, Nano-sensors, SQUID Sensors, Environmental Monitoring sensors: Air and Water quality Monitoring systems.			**CO5**
Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Doebelin E.O. and Manik D.N., "Measurement Systems", 7th edition, McGraw-Hill Education Pvt. Ltd., 2019.
2. Neubert H.K.P., "Instrument Transducers – An Introduction to their Performance and Design", Oxford University Press, Cambridge, 2003.
3. Doeblin. E.O. "Measurement System Applications and Design", TMH, 5th edition, 2004.

Reference Books

1. Bela G. Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th edition, Vol.2 ASME PTC ,2018
2. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010.
3. John P. Bentley, Principles of Measurement Systems, 3rd edition, Pearson Education, 2000.

Web References

1. https://nptel.ac.in/courses/108108147/
2. https://www.youtube.com/watch?v=1uPTyjxZzyo

Dr. L. M. Varalakshmi 2.A.5.245 B.Tech – Instrumentation and Control Engineering

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	1	-	-	-	-	-	-	-	1	1
2	2	3	3	3	-	1	-	-	-	-	-	-	-	1	1
3	2	2	2	2	-	1	-	-	-	-	-	-	-	1	1
4	2	3	3	3	-	1	2	-	-	-	-	-	-	1	1
5	2	3	3	3	2	2	3	-	-	-	-	-	-	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Internal Assessment Marks (IAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**V/ VI**	Course Category Code: **OE**				*End Semester Exam Type:**TE**		
Course Code	**U23ICOC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Fuzzy Logic and Neural Networks**	3	0	0	3	25	75	100
(Common to CSE, IT, MECH, CCE, CSE&BS,AI&DS)								
Prerequisite	Basic Mathematics							

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
CO1	Illustrate the fuzzy sets and the properties of fuzzy logic	**K2**
CO2	Comprehend fuzzy logic controllers and its applications	**K2**
CO3	Familiarize in the neural network architecture.	**K2**
CO4	Impart knowledge on various training algorithm of neural network and its application.	**K3**
CO5	Recognize the hybrid Neuro-fuzzy logic controllers.	**K2**

UNIT – I	**Introduction to Fuzzy Logic**	**Periods:09**	
Classical sets - Fuzzy sets – properties of fuzzy sets – operations on fuzzy sets, Cartesian Product, Fuzzy relations linguistic variables – Linguistic approximation. Fuzzy statements: Assignments, Conditional and Unconditional statements.			**CO1**
UNIT – II	**Fuzzy Logic Control System**	**Periods:09**	
Introduction to Fuzzy logic controller: Architecture – Fuzzification, Membership functions: Triangular, Trapezoidal, Gaussian. Inference Mechanism, knowledge base, fuzzy rule base, Inference method: Mamdani, Sugeno and TSK models, Defuzzification - Applications of Fuzzy logic controller.			**CO2**
UNIT – III	**Introduction to Neural Network**	**Periods:09**	
Introduction to neural networks – Biological neural networks, Artificial Neural network: Single and Multi layer feed forward network- Activation function, types (step and sigmoid function), threshold function- Classification of learning: Supervised, Unsupervised and Reinforced. McCulloh Pitts neuron: architecture, algorithm and applications.			**CO3**
UNIT – IV	**Neural Networks Control**	**Periods:09**	
Back propagation neural net: standard architecture, algorithm -Hopfield net: architecture and algorithm- Kohonnen's Self Organizing map- Adaptive Resonance Theory ART 1: Architecture and operation- Neural networks for control: Schemes of neuro control - Applications of neuro controller.			**CO4**
UNIT – V	**Hybrid Control Schemes**	**Periods:09**	
Adaptive Neuro-Fuzzy Inference Systems (ANFIS), Hybrid system: Types of Hybrid Systems: Neuro-Fuzzy Hybrid systems, Neuro Genetic Hybrid systems, Fuzzy Genetic Hybrid systems- Applications of fuzzy logic and neural network.			**CO5**
Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International Editions,2010
2. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2008
3. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic", Prentice Hall, USA .2015

Reference Books

1. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 2019
2. Rajasekaran. S, Pai. G.A.V. "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice-Hall of India, 2003
3. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education 2007

Web References

1. https://lecturenotes.in/subject/922.
2. https://www.ifi.uzh.ch/dam/jcr:00000000-2826-155d-0000-00005e4763e3/fuzzylogicscript.pdf.

Dr. L. M. Varalakshmi

B.Tech – Instrumentation and Control Engineering

2.A.5.249

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	2	-	-	1	-	-	-	-	-	-	1	2	2
2	2	-	3	-	-	1	-	-	-	-	-	-	1	2	2
3	2	-	2	-	-	1	-	-	-	-	-	-	1	2	2
4	2	-	3	-	-	1	2	-	-	-	-	-	1	2	2
5	2	-	3	-	2	2	3	-	-	-	-	-	1	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Method

Assessment	Internal Assessment Marks (IAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Annexure - III

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)
Puducherry

B.TECH.

INSTRUMENTATION AND CONTROL ENGINEERING

ACADEMIC REGULATIONS 2023
(R-2023)

HONOURS / MINOR PROGRAMME - SENSORS TECHNOLOGY

CURRICULUM AND SYLLABI

2.A.5.253.

HONOURS / MINOR PROGRAMME - SENSORS TECHNOLOGY

COURSE DETAILS											
Sl. No.	Semester	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
					L	T	P		CAM	ESM	Total
Theory											
1	IV	U23ICX401	Smart Sensors	PC / IC	3	1	0	4	25	75	100
2	V	U23BMX502	Nano Biosensors	PC / IC	3	1	0	4	25	75	100
3	VI	U23ICX603	Embedded Sensing Technologies	PC / IC	3	1	0	4	25	75	100
4	VII	U23ICX704	IoT and Sensor Networks	PC / IC	3	1	0	4	25	75	100
5	VIII	U23BMX805	Wearable Devices and its Applications	PC / IC	3	1	0	4	25	75	100
	Total							**20**	**125**	**375**	**500**

Equivalent NPTEL courses##				
1	**Course Code** U23XXXN01	Sensors and Actuators	**3**	**12 Weeks Course**
2		Biophotonics	**3**	
3		Embedded Systems Design	**3**	
4		Design for internet of things	**3**	
5		Sensor Technologies: Physics, Fabrication, and Circuits	**3**	

The student shall be given an option to earn 3 credits through one equivalent 12 week NPTEL course instead of any one course listed for honours / minor degree programme that should be completed before the commencement of eighth semester. The equivalent courses are subject to change based on its availability as per NPTEL course list.

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Department	**Instrumentation and Control Engineering / Biomedical Engineering**	Programme: **B.Tech. Honours / Minor**						
Semester	**IV**	Course Category Code: **PC**			*End Semester Exam Type:**TE**			
Course Code	**U23ICX401**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Smart Sensors**	**3**	**1**	**0**	**4**	**25**	**75**	**100**

(Common to all Branches)

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Attain knowledge on fundamentals of smart sensors	**K2**
	CO2	Acquaint on the materials and technologies	**K3**
	CO3	Gain knowledge on the characteristics of smart sensors	**K2**
	CO4	Interpret the data transferred to the MCU	**K2**
	CO5	Comprehend the standards for smart sensing	**K2**

UNIT – I	**Introduction to smart sensors**	**Periods:12**	
Introduction, Temperature IC and Smart Sensors, Pressure IC and Smart Sensors and Accelerometers, Rotation Speed Sensors, Intelligent Opto Sensors, Humidity Frequency Output Sensors, Chemical and Gas Smart Sensors.			**CO1**
UNIT – II	**Materials and Technologies**	**Periods:12**	
Materials: Silicon as a Sensing Material, Plastics, Metals, Ceramics, Structural Glasses, Optical Glasses, Nano-materials, Surface Processing: Spin-Casting, Vacuum Deposition, Sputtering, Chemical Vapor Deposition, Electroplating, MEMS Technologies: Photolithography, Silicon Micromachining, Micromachining of Bridges and Cantilevers, Wafer Bonding.			**CO2**
UNIT – III	**Characteristics of Smart Sensors**	**Periods:12**	
Important Characteristics of Sensors: Determination of the Characteristics - Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality - Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors -Importance and Adoption of Smart Sensors			**CO3**
UNIT – IV	**Getting Sensor Information into the MCU**	**Periods:12**	
Introduction, Amplification and Signal Conditioning: Instrumentation Amplifiers, SLEEP MODE Operational Amplifier, Rail-to-Rail Operational Simplifiers, Switched Capacitor Amplifier, 4- to 20-mA Signal Transmitter, Inherent Power-Supply Rejection, Separate Versus Integrated Signal Conditioning: Integrated Passive Elements, Integrated Active Elements, Digital Conversion: A/D Converters			**CO4**
UNIT – V	**Standards for Smart Sensing**	**Periods:12**	
Introduction, Setting the Standards for Smart Sensors and Systems, IEEE 1451.1, IEEE 1451.2, IEEE 1451.3, IEEE 1451.4, IEEE 1451.5, IEEE 1451.6, IEEE 1451.7, Application Example.			**CO5**

Lecture Periods:45	**Tutorial Periods:15**	**Practical Periods:-**	**Total Periods:60**

Text Books

1. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
2. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 4th edition, Springer, New York, 2014.
3. Sergey Y. Yurish,"Digital Sensors and Sensor Systems: Practical Design", 1st edition, IFSA publishing, New York, 2011.

Reference Books

1. A.K. Shawney, "A Course in Electrical and Electronic Measurements and Instrumentation", Paperback – 1 January 2021.
2. Wilson Jon, "Sensor Technology Handbook", Elsevier Inc, 2005.
3. Pavel Ripka, Alois Tipek, "Modern Sensors Handbook", ISTE LTD, 2007.
4. Simon Monk, "A Hands-On Course in Sensors Using the Arduino and Raspberry Pi", O'Reilly Media, 2019.

Web References

1. https://www.elprocus.com/smart-sensor/
2. https://www.fourfaith.com/industry-news/smart-sensor.html
3. https://www.bosch-sensortec.com/products/smart-sensor-systems/
4. https://www.fierceelectronics.com/electronics/what-are-smart-sensors

* TE – Theory Exam, LE – Lab Exam

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B.Tech – Instrumentation and Control Engineering

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2
2	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2
3	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2
4	1	3	1	3	2	-	-	-	-	-	-	-	2	1	2
5	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond

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Department	**Biomedical Engineering / Instrumentation and Control Engineering**	Programme: **B.Tech. Honours / Minor**						
Semester	**V**	Course Category: **PC**				*End Semester Exam Type: **TE**		
Course Code	**U23BMX502**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Nano Biosensors**	**3**	**1**	**0**	**4**	**25**	**75**	**100**

(Common to all Branches)

Prerequisite	-		
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Explain the principles underlying nano biosensor design and operation	**K2**
	CO2	Familiarize with the detection mechanisms used in nano biosensors.	**K3**
	CO3	Gain knowledge in analyzing the specificity of nano biosensors for target molecules.	**K2**
	CO4	Gain knowledge in describing methods for fabricating nano biosensors.	**K3**
	CO5	Gain knowledge in Integrating nano biosensors into existing technologies for enhanced functionality.	**K2**

UNIT-I	**Introduction to Biosensors and Nanotechnology**	**Periods: 12**	
Basics of Biosensors - - Definition and historical overview - Components of biosensors: Bioreceptor, transducer, and detector - Overview of biosensor applications. Introduction to nanomaterials and their unique properties - Role of nanotechnology in enhancing biosensor performance.			**CO1**
UNIT-II	**Nanomaterials in Biosensors**	**Periods: 12**	
Types of Nanomaterials - - Carbon-based nanomaterials (e.g., carbon nanotubes, graphene) - Metal nanoparticles (e.g., gold, silver) - Semiconductor nanoparticles (quantum dots) - Conducting polymers. Fabrication Techniques- Top-down and bottom-up approaches - Self-assembly and template synthesis - Surface functionalization strategies.			**CO2**
UNIT-III	**Design and Application of Nano Biosensors**	**Periods: 12**	
Design Principles of Nano Biosensors - Transduction mechanisms (optical, electrochemical, mechanical) - Bioreceptor immobilization techniques - Signal amplification strategies.			**CO3**
UNIT-IV	**Applications of Nano Biosensors**	**Periods: 12**	
Clinical diagnostics and point-of-care testing - Environmental monitoring - Food safety and quality control - Drug discovery and pharmacokinetics.			**CO4**
UNIT-V	**Current Trends and Future Directions**	**Periods: 12**	
Innovations in Nano Biosensor Technology- Wearable biosensors - Lab-on-a-chip devices - Single-molecule detection - Internet of Things (IoT) integration.			**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Textbooks

1. Aiguo Wu, "Nano Biosensors: From Design to Applications", Springer, 1st edition, 2016.
2. Sandro Carrara, "Nano biosensors and Nanobioanalyses", Elsevier, 1st edition, 2015.
3. Dmitry Zemlyanov,"Nano biosensors: Carbon Nanotubes and Graphene", CRC Press, 1st edition, 2013.

Reference Books

1. Alexandru Grumezescu, "Nano biosensors: Nanotechnology in the Agri-Food Industry", Academic Press, 1st edition, 2016.
2. Sandro Carrara,"Nano biosensors: Theory and Applications in Healthcare", Springer, 1st edition, 2016.
3. Abhijit Bandyopadhyay,"Nano biosensors: Carbon Nanotubes in Disease Diagnosis", CRC Press, 1st edition, 2012.

Web References

1. https://wires.onlinelibrary.wiley.com/doi/abs/10.1002/wnan.136
2. https://www.ncbi.nlm.nih.gov/
3. https://www.nano.gov/

* TE – Theory Exam, LE – Lab Exam

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2
2	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2
3	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2
4	1	3	1	3	2	-	-	-	-	-	-	-	2	1	2
5	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond

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Department	**Instrumentation and Control Engineering / Biomedical Engineering**	Programme: **B.Tech. Honours / Minor**						
Semester	**VI**	Course Category Code: **PC**			*End Semester Exam Type: **TE**			
Course Code	**U23ICX603**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Embedded Sensing Technologies**	**3**	**1**	**0**	**4**	**25**	**75**	**100**

(Common to all Branches)

Prerequisite	Sensors and Transducers		
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understanding Fundamental Principles of Sensing	**K2**
	CO2	Ability to understand the Core Concepts of Embedded Systems:	**K3**
	CO3	Ability to apply principle of sensing to select appropriate sensing techniques for various applications.	**K2**
	CO4	Ability to integrate embedded systems into different network environments	**K2**
	CO5	Understanding Real-Time Scheduling Algorithms	**K2**

UNIT –I	**Introduction to Sensor Technologies**	**Periods:12**	
Principle of Sensing- Capacitance-magnetic and electromagnetic induction-resistance-piezoelectric effect-heat transfer- light. Physical sensor, optical detectors and sensors.			**CO1**
UNIT –II	**Typical Embedded System**	**Periods:12**	
Core of the embedded system, Sensors and actuators, classification of embedded systems. Communication interface, Embedded firmware- Applications of embedded system - control system and industrial automation			**CO2**
UNIT –III	**Embedded Computing Platform**	**Periods:12**	
Embedded computing – classification, characteristics and challenges –embedded system design process- overview of processors and hardware units in an embedded system- Host and target machines- Model of programs - Assembly, Linking and Loading - Embedded application.			**CO3**
UNIT –IV	**Network interface for embedded system**	**Periods:12**	
Distributed Embedded Architecture- Hardware and Software Architectures, Networks for embedded systems- RS232, RS485, SPI, I2C, CAN, SHARC link supports, Ethernet, Myrinet, Internet.			**CO4**
UNIT –V	**Real-Time Characteristics**	**Periods:12**	
Clock driven Approach, weighted round robin Approach, Priority driven Approach, Dynamic Versus Static systems, effective release times and deadlines, Optimality of the Earliest deadline first (EDF) algorithm, challenges in validating timing constraints in priority driven systems, Off-line Versus On-line scheduling.			**CO5**
LecturePeriods:45	**TutorialPeriods:15**	**Practical Periods:-**	**TotalPeriods:60**

Text Books

1. Shibu K.V. "Introduction to Embedded Systems", Tata McGraw Hill, 2009.
2. Marilyn Wolf, "Computers as components: Principles of Embedded Computing System Design", 4th edition, Morgan Kaufmann publications (Elsevier), United States, 2017.
3. Jiacun Wang, "Real-Time Embedded Systems", First Edition, Wiley Publishers, United States, 2017.

Reference Books

1. Jonathan W Valvano, "Embedded Microcomputer Systems: Real Time Interfacing", CENGAGE Learning Custom Publishing, 3rd edition, 2010.
2. Lyla.B.Das, "Embedded Systems, An Integrated Approach", Pearson, 2013.
3. Raj Kamal, "Embedded systems Architecture, Programming and Design", 2017, 3rd edition, McGraw Hill Education, India
4. Hermann Kopetz, "Real-time systems: design principles for distributed embedded applications", Kluwer academic publishers, 2002.

Web References

1. https://medium.com/@nanibrolly/embedded-systems-vs-internet-of-things-iot-navigating-the-distinctions-12f6b3afb7c9
2. https://sensorsolutions.net/home
3. https://www.geeksforgeeks.org/real-time-systems/

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4. https://www.totalphase.com/blog/2019/11/what-is-importance-of-embedded-networking/
5. https://www.coursera.org/articles/embedded-systems

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	2	2	2	-	-	-	-	-	-	2	1	2
2	3	2	2	2	2	2	-	-	-	-	-	-	2	1	2
3	3	2	2	2	2	2	-	-	-	-	-	-	2	1	2
4	3	2	2	2	2	2	-	-	-	-	-	-	2	1	2
5	3	2	2	2	2	2	-	-	-	-	-	-	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks(CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT1	CAT2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

*Application oriented / Problem solving / Design / Analytical in content beyond

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Department	**Biomedical Engineering / Instrumentation and Control Engineering**	Programme: **B.Tech. Honours / Minor**						
Semester	**VII**	Course Category Code: **PC**				End Semester Exam Type:**TE**		
Course Code	**U23ICX704**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**IoT and Sensor Networks**	**3**	**1**	**0**	**4**	**25**	**75**	**100**

(Common to all Branches)

Prerequisite			
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand the architecture of IoT	**K2**
	CO2	Acquaint on fundamentals of wireless sensor networks	**K2**
	CO3	Interpret the protocols of WSNs	**K2**
	CO4	Gain knowledge on middleware and operating systems for WSNs	**K2**
	CO5	Impart knowledge on case studies on IoT implementations.	**K3**

UNIT – I	**Architecture of IoT**	**Periods:12**	
The History and Reasoning Behind the IoT - The IoT Architectural Reference Model as Enabler - IoT in Practice: Examples: IoT in Logistics and Health – Elements to protect in IoT- Risk sources –Addressing performance and scalability – Addressing – Addressing Security – Addressing Privacy- Addressing Availability and Resilience			**CO1**
UNIT – II	**Introduction to Wireless Sensor Networks(WSN)**	**Periods:12**	
IoT Reference Architecture - Interaction of all sub models – Domain Model – Information Model - Functional Model – Communication Model – Trust, Security and Privacy Background of Sensor Network Technology - Basic Sensor Network Architectural Elements- Brief Historical Survey of Sensor Networks - Challenges and Hurdle - Applications of Wireless Sensor Networks.			**CO2**
UNIT – III	**Protocols for WSNs**	**Periods:12**	
Fundamentals of MAC Protocols - MAC Protocols for WSNs - Sensor-MAC Case Study – Routing Challenges in WSNs - Routing Strategies in WSNs - Transport Protocol Design Issues- Examples of Existing Transport Control Protocols - Performance of Transport Control Protocols			**CO3**
UNIT – IV	**Middleware and Operating systems for WSNs**	**Periods:12**	
WSN Middleware Principles-Middleware Architecture - Existing Middleware : MiLAN - IrisNet - AMF - DSWare - CLMF - MSM – Em –Impala – Dfuse -DDS – Sensor Ware. Operating System- Examples of Operating Systems – TinyOS - Mate – MagnetOS – MANTIS – OSPM - EYES OS – SenOS – EMERALDS – PICOS			**CO4**
UNIT – V	**Case Study – IoT Implementations**	**Periods:12**	
Case study: Smart Grid & IoT, Commercial building automation using IoT, Recent trends in sensor network and Automation in Industrial aspect of IOT.			**CO5**

Lecture Periods:45	**Tutorial Periods:15**	**Practical Periods:-**	**Total Periods:60**

Text Books

1. Raj Kamal, "Internet of Things-Architecture and design principles", McGraw Hill Education.
2. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
3. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Reference Books

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2016
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.
3. Vijay Madisetti, Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally "Internet of Things A Hands-on-Approach" Arshdeep Bahga & Vijay Madisetti, 2014.
4. Barrie Sosinsky, "Cloud Computing Bible", Wiley-India, 2010.

Web References

1. https://www.geeksforgeeks.org/wireless-sensor-network-wsn/

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2. https://mrcet.com/downloads/digital_notes/EEE/IoT%20&%20Applications%20Digital%20Notes.pdf
3. https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT
4. https://www.iotforall.com/wireless-sensors-for-iot
5. https://www.tutorialspoint.com/difference-between-wireless-sensor-networks-and-iot

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1	1	1	1	-	-	-	-	-	-	3	2	3
2	2	2	2	1	2	1	-	-	-	-	-	-	3	2	3
3	2	2	2	1	1	1	-	-	-	-	-	-	3	2	3
4	3	2	3	1	2	1	-	-	-	-	-	-	3	2	3
5	2	2	3	1	2	1	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond

2.A.5.27)

Department	**Instrumentation and Control Engineering / Biomedical Engineering**	Programme: **B.Tech. Honours / Minor**						
Semester	**VIII**	Course Category: **PC**			*End Semester Exam Type: **TE**			
Course Code	**U23BMX805**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Wearable Devices and its Applications**	**3**	**1**	**0**	**4**	**25**	**75**	**100**

(Common to all Branches)

Prerequisite	Sensors and Transducers		
Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Identify the need for development of wearable devices and its implications on various sectors.	**K2**
	CO2	Discus the applications of various wearable inertial sensors for biomedical applications. .	**K3**
	CO3	Comprehend the design and development of various wearable bio-electrode and physiological activity monitoring devices for use in healthcare applications.	**K2**
	CO4	Discuss the usage of various biochemical and gas sensors as wearable devices.	**K3**
	CO5	Acquaint various wearable locomotive sensors as assistive devices for tracking and navigation.	**K3**

UNIT-I	**Introduction to Wearable Devices**	**Periods: 12**	
Motivation for development of Wearable Devices, The emergence of wearable computing and wearable electronics, Types of wearable sensors: Invasive, Non-invasive; Intelligent clothing, Industry sectors' overview – sports, healthcare, Fashion and entertainment, military, environment monitoring, mining industry, public sector and safety.			**CO1**
UNIT-II	**Wearable Inertial Sensors**	**Periods: 12**	
Wearable Inertial Sensors - Accelerometers, Gyroscopic sensors and Magnetic sensors; Modality of Measurement-Wearable Sensors, Invisible Sensors, In-Shoe Force and Pressure Measurement; Applications: Fall Risk Assessment, Fall Detection , Gait Analysis, Quantitative Evaluation of Hemiplegic and Parkinson's Disease patients. Physical Activity monitoring: Human Kinetics, Cardiac Activity, Energy Expenditure measurement: Pedometers, Actigraphs.			**CO2**
UNIT-III	**Wearable Devices for Healthcare**	**Periods: 12**	
Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor. Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring, Detection principles – thermistor, infrared radiation, thermopile, Modality of measurement wearable, adhesive/tattoo type. Conductive textile electrodes, Knitted Piezoresistive Fabric (KPF) sensors.			**CO3**
UNIT-IV	**Wearable Biochemical and Gas Sensors**	**Periods: 12**	
Wearable Biochemical Sensors: Parameters of interest, System Design –Textile based, Microneedle based; Types: Noninvasive Glucose Monitoring Devices, GlucoWatch G2 Biographer, GlucoTrackTM; Pulse oximeter, Portable Pulse Oximeters, wearable pulse oximeter; Wearable capnometer for monitoring of expired carbon dioxide. Wearable gas sensors: Metal Oxide (MOS) type, electrochemical type, new materials-CNTs, graphene, Zeolites; Detection of atmospheric pollutants.			**CO4**
UNIT-V	**Wearable Cameras and Microphones for Navigation**	**Periods: 12**	
Cameras in wearable devices, Applications in safety and security, navigation, Enhancing sports media, Automatic digital diary. Cameras in smart-watches; Use of Wearable Microphones: MEMS microphones, Bioacoustics, Microphones and AI for respiratory diagnostics and clinical trials. Wearable Assistive Devices for the Blind - Hearing and Touch sensation, Assistive Devices for Fingers and Hands, Assistive Devices for wrist, for arm and feet, vests and belts, head-mounted devices.			**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Text Books

1. Toshiyo Tamura and Wenxi Chen, "Seamless Healthcare Monitoring", Springer 2018.
2. Edward Sazonov and Michael R. Neuman, "Wearable Sensors -Fundamentals, Implementation and Applications", Elsevier Inc., 2014.
3. Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay, "Wearable and Autonomous Biomedical Devices and Systems for Smart Environment", Springer 2010.

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1. Subhas Chandra Mukhopadhyay, "Wearable Electronics Sensors - For Safe and Healthy Living", Springer 2015 ECE (BSW) Page 37.
2. Shantanu Bhattacharya, A K Agarwal, NripenChanda, Ashok Pandey and Ashis Kumar Sen, "Environmental, Chemical and Medical Sensors", Springer Nature Singapore Pte Ltd. 2018.
3. M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018.
4. N. Luo, W. Dai, C. Li, Z. Zhou, L. Lu, C. C. Y. Poon, et al., "Flexible Piezoresistive Sensor Patch Enabling Ultralow Power Cuffless Blood Pressure Measurement," Advanced Functional Materials, vol. 26, pp. 1178-1187, 2016.

Web References

1. https://www.nap.edu/read/21794/chapter/7
2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapeutic-systems.
3. https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206 Diagnostic and Therapeutic EquipmentTraining.pdf

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2
2	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2
3	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2
4	1	3	1	3	2	-	-	-	-	-	-	-	2	1	2
5	2	3	2	3	2	-	-	-	-	-	-	-	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond

Annexure - IV

Academic Calendar

(I year) – September 2024 to January 2025

(II/ III /IV year) – July 2024 to November 2024

2.6.5.277

2.6.5.278.

Use of Cell Phones

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Working hours

I hour	08.45 a.m	to	09.35 a.m
II hour	09.35 a.m	to	10.25 a.m
III hour	10.25 a.m	to	11.15 a.m
Break	11.15 a.m	to	11.30 a.m
IV hour	11.30 a.m	to	12.20 p.m
V hour	12.20 p.m	to	01.10 p.m
Lunch	01.10 p.m	to	01.50 p.m
VI hour	01.50 p.m	to	02.40 p.m
VII hour	02.40 p.m	to	03.30 p.m
VIII hour	03.30 p.m	to	04.20 p.m

Lunch break 01.10p.m. to 01.50p.m.

Table 1 Assessment method for Theory Courses

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESM) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Table 2 Question Paper pattern for CAT 1 and CAT 2 - Theory Courses

2 Mark Questions	5 Mark Questions	10 Mark Questions	Total Marks
5	4	2 (out of 3 question)	50

Table 3 Model and End Semester Examination Question Paper pattern for 5 unit courses

2 Mark Questions	5 Mark Questions	10 Mark Questions	Total Marks
10 (two questions from each unit)	5 (one questions from each unit)	3 (out of 5 questions one from each unit)	75

Table 4 Model and End Semester Examination Question Paper pattern for 6-unit courses

Course	2 Mark Questions	5 Mark Questions	8/9 Mark Questions	Total Marks
Part A	5	2 (out of 3 questions, one from each unit)	2 9 mark questions (out of 3 questions, one from each unit)	38
Part B	5	2 (out of 3 questions, one from each unit)	1 8 mark questions (out of 2 questions, one from unit IV & unit V)	37
			1 9 mark questions (compulsory question from unit VI)	

Table 5 Assessment Method for Practical Courses

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESM) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	Model Exam				
Marks	15	5	5	15	10	50	100

Table 6 Assessment Method for Theory cum Practical Courses

Assessment	Continuous Assessment Marks (CAM) - Maximum 50 Marks										End Semester Examination (ESM) Marks (Theory)	Total Marks
	Continuous Assessment (Theory)					Continuous Assessment (Practical)						
	CAT 1	CAT 2	Model	Attendance	Total	Conduction of Practical	Report	Viva	Total	End Semester Examination (ESE) (Practical-Internal Evaluation)		
Marks	5	5	5	5	20*	15	10	5	30**	30	75**	
*To be weighted for 10 Marks					10	**To be weighted for 10 Marks			10		**To be weighted for 50 Marks	100

Table 7 Question Paper pattern for CAT 1 and CAT 2 (Theory cum Practical course)

2 Mark Questions	5 Mark Questions	10 Mark Questions	Total Marks
5	4	2 (out of 3 question)	50

Table 8 Question paper pattern for Model and End Semester Examination (Theory cum Practical course)

2 Mark Questions	5 Mark Questions	14 Mark Questions	Total Marks
9 (3 questions from each unit)	3 (one question from each unit)	1 Compulsory question (with sub-section questions in any of the unit)	75
		2 (out of 3 questions, one from each unit with sub-section)	

Requirements for Appearing End Semester Examination

A student is expected to maintain 100% attendance in all courses as attendance also carries internal marks. A student will be qualified to appear for end semester examinations of a semester only if he/she satisfies the below mentioned requirements.

The student is permitted to appear for End Semester Examinations, only if he/she maintains minimum 75% of attendance. If he/she secured attendance greater than or equal to 60 % and less than 75 % has to pay the necessary condonation prescribed by the college authority with necessary supporting documents for his/her absence.

Redo Category

A student who secures overall attendance less than 60% has to repeat the course with the approval, when it is next offered. A student secures attendance greater than or equal to 60% and less than 75% will be promoted to next higher semester only if less of attendance is due to medical reasons(hospitalization/ accident/illness) or participation in sports event or any competitions or NCC or NSS activities with prior permission from the Head of Institution through the Head of the department with necessary supporting documents and payment of necessary condonation fee as prescribed by the college authority. However, student secures more than 75 % of attendance in the current semester will be moved to next higher semester.

Women Empowerment Cell

For the Welfare of the girl students, a Women Cell has been constituted in the college. The girl students may approach the member secretary for assistance.

Mail id : **wec@smvec.ac.in**

Grievance Redressal Committee

There is a Grievance Redressal committee in our college and the details are available in the website. Students can approach the member of the committee to redress their grievances if any. Mail id: **grievance@smvec.ac.in**

Internal Complaints Committee

The objective of this committee is to avoid sexual harassment of students and women employees in the college by preventing it, recording complaints, and taking appropriate action in response. It also aims to eliminate gender-based discrimination by creating a safe physical and social environment that deters sexual harassment and enforcing the necessary disciplinary actions. For complaints:

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SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(An Autonomous Institution)

(Accredited by NBA-AICTE, New Delhi and Accredited by NAAC with "A" Grade)

Madagadipet, Puducherry - 605 107

Academic Calendar

September 2024 to January 2025

Programme/Regulations: **B.Tech/R-2023**

Year/Sem : I year/I Sem

About Autonomous

Sri Manakula Vinayagar Engineering College has been conferred with Autonomous Status by the University Grants Commission on 26th September 2019 and the same was approved by Pondicherry University on 19th June 2020.

VISION

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

MISSION

M1: Quality Education: To provide comprehensive academic system that amalgamates the cutting-edge technologies with best practices.

M2: Research and Innovation: To foster value- based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship: To inculcate the employability and entrepreneurial skills through value and skill-based training.

M4: Ethical Values: To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

2.9.5.879

2.6.5.280

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(AN AUTONOMOUS INSTITUTION)

I year / I Sem

September 2024

Date	Day	Schedule	Working Day
1	Sun		Holiday
2	Mon		
3	Tue		
4	Wed		
5	Thu	Teachers Day	
6	Fri		
7	Sat	Vinayagar Chaturthi	Holiday
8	Sun		Holiday
9	Mon	Commencement of Classes for I semester / Induction Programme Starts	1
10	Tue		2
11	Wed		3
12	Thu		4
13	Fri		5
14	Sat		6
15	Sun		Holiday
16	Mon	Miladi Nabi/ World Ozone Day	Holiday
17	Tue		7
18	Wed		8
19	Thu		9
20	Fri	Induction Programme Ends	10
21	Sat		Holiday
22	Sun		Holiday
23	Mon		11
24	Tue		12
25	Wed		13
26	Thu		14
27	Fri		15
28	Sat		16
29	Sun		Holiday
30	Mon		17

Total number of working days : 17
Total number of holidays : 5

October 2024

Date	Day	Schedule	Working Day
1	Tue		18
2	Wed	Gandhi Jayanthi	Holiday
3	Thu		19
4	Fri		20
5	Sat		Holiday
6	Sun		Holiday
7	Mon		21
8	Tue		22
9	Wed		23
10	Thu		24
11	Fri	Saraswathy Pooja	Holiday
12	Sat	Vijayadashami	Holiday
13	Sun		Holiday
14	Mon		25
15	Tue		26
16	Wed		27
17	Thu	Online Feedback – I	28
18	Fri	Assignment - I	29
19	Sat		Holiday
20	Sun		Holiday
21	Mon	Submission of QCM – I / Syllabus Coverage – I	30
22	Tue	Submission of Attendance and Assessment Record	31
23	Wed	CAT – I (I & II Hour)	32
24	Thu	CAT – I (I & II Hour)	33
25	Fri	CAT – I (I & II Hour)	34
26	Sat	CAT – I (I & II Hour)	35
27	Sun		Holiday
28	Mon	CAT – I (I & II Hour)	36
29	Tue	CAT – I (I & II Hour)	37
30	Wed		38
31	Thu	Deepavali	Holiday

Total number of working days : 21
Total number of holidays : 10

November 2024

Date	Day	Schedule	Working Day
1	Fri	Puducherry Liberation Day	Holiday
2	Sat		Holiday
3	Sun		Holiday
4	Mon		39
5	Tue		40
6	Wed	Submission of CAT – I Result Analysis	41
7	Thu		42
8	Fri		43
9	Sat		44
10	Sun		Holiday
11	Mon		45
12	Tue		46
13	Wed		47
14	Thu		48
15	Fri		49
16	Sat		Holiday
17	Sun		Holiday
18	Mon		50
19	Tue		51
20	Wed	Online Feedback – II	52
21	Thu	Assignment - II	53
22	Fri	Submission of QCM – II / Syllabus Coverage – II	54
23	Sat	Submission of Attendance and Assessment Record	55
24	Sun		Holiday
25	Mon	CAT – II (I & II Hour)	56
26	Tue	CAT – II (I & II Hour)	57
27	Wed	CAT – II (I & II Hour)	58
28	Thu	CAT – II (I & II Hour)	59
29	Fri	CAT – II (I & II Hour)	60
30	Sat	CAT – II (I & II Hour)	61

Total number of working days : 23
Total number of holidays : 7

December 2024

Date	Day	Schedule	Working Day
1	Sun		Holiday
2	Mon		62
3	Tue		63
4	Wed	Online Feedback - III	64
5	Thu	Submission of CAT – II Result Analysis, Assignment - III	65
6	Fri	Submission of QCM – III/ Syllabus Coverage – III	66
7	Sat		Holiday
8	Sun		Holiday
9	Mon	Model Exam starts	67
10	Tue		68
11	Wed		69
12	Thu		70
13	Fri		71
14	Sat	Model Exam Ends	72
15	Sun		Holiday
16	Mon	Tentative Model Practical Examination	73
17	Tue		74
18	Wed		75
19	Thu	Submission of Model Exam Result Analysis	76
20	Fri	Submission of Attendance and Assessment Record / Last working Day	77
21	Sat		Holiday
22	Sun		Holiday
23	Mon	Tentative – End Semester Practical Examination	
24	Tue		
25	Wed	Christmas	Holiday
26	Thu		
27	Fri		
28	Sat		
29	Sun		Holiday
30	Mon		
31	Tue		

Total number of working days: 16
Total number of holidays : 4

January 2025

Date	Day	Schedule	Working Day
1	Wed	New year	Holiday
2	Thu	Tentative – End Semester Theory Examination	
3	Fri		
4	Sat		Holiday
5	Sun		Holiday
6	Mon		
7	Tue		
8	Wed		
9	Thu		
10	Fri		
11	Sat		
12	Sun		
13	Mon		
14	Tue		
15	Wed		
16	Thu		
17	Fri		
18	Sat		
19	Sun		
20	Mon		
21	Tue		
22	Wed		
23	Thu		
24	Fri		
25	Sat		
26	Sun	Republic Day	Holiday
27	Mon		
28	Tue		
29	Wed		
30	Thu		
31	Fri		

Total number of working days : -
Total number of holidays : -

2.6.5-2881

Use of Cell Phones

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Working hours

I hour	09.00 a.m	to	09.50 a.m
II hour	09.50 a.m	to	10.40 a.m
Break	10.40 a.m	to	10.55 a.m
III hour	10.55 a.m	to	11.45 a.m
IV hour	11.45 a.m	to	12.35 p.m
V hour	01.15 p.m	to	02.05 p.m
VI hour	02.05 p.m	to	02.55 p.m
Break	02.55 p.m	to	03.10 p.m
VII hour	03.10 p.m	to	04.00 p.m
VIII hour	04.00 p.m	to	04.50 p.m

Lunch break 12.35 p.m. to 1.15 p.m.

Table 1 Assessment method for Theory Courses

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESM) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Table 2 Question Paper pattern for CAT 1 and CAT 2 - Theory Courses

2 Mark Questions	5 Mark Questions	10 Mark Questions	Total Marks
5	4	2 (out of 3 question)	50

Table 3 Model and End Semester Examination Question Paper pattern for 5 unit courses

2 Mark Questions	5 Mark Questions	10 Mark Questions	Total Marks
10 (two questions from each unit)	5 (one questions from each unit)	3 (out of 5 questions one from each unit)	75

Table 4 Model and End Semester Examination Question Paper pattern for 6 unit courses

Course	2 Mark Questions	5 Mark Questions	8/9 Mark Questions	Total Marks
Part A	5	2 (out of 3 questions, one from each unit)	2 9 mark questions (out of 3 questions, one from each unit)	38
Part B	5	2 (out of 3 questions, one from each unit)	1 8 mark questions (out of 2 questions, one from unit IV & unit V) 1 9 mark questions (compulsory question from unit VI)	37

Table 5 Assessment Method for Practical Courses

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESM) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	Model Exam				
Marks	15	5	5	15	10	50	100

Table 6 Assessment Method for Theory cum Practical Courses

Assessment	Continuous Assessment Marks (CAM) - Maximum 50 Marks										End Semester Examination (ESM) Marks (Theory)	Total Marks
	Continuous Assessment (Theory)					Continuous Assessment (Practical)						
	CAT 1	CAT 2	Model	Attendance	Total	Conduction of Practical	Report	Viva	Total	End Semester Examination (ESE) (Practical-Internal Evaluation)		
Marks	5	5	5	5	20*	15	10	5	30**	30	75**	100
*To be weighted for 10 Marks					10	**To be weighted for 10 Marks			10		**To be weighted for 50 Marks	

Table 7 Question Paper pattern for CAT 1 and CAT 2 (Theory cum Practical course)

2 Mark Questions	5 Mark Questions	10 Mark Questions	Total Marks
5	4	2 (out of 3 question)	50

Table 8 Question paper pattern for Model and End Semester Examination (Theory cum Practical course)

2 Mark Questions	5 Mark Questions	14 Mark Questions	Total Marks
9 (3 questions from each unit)	3 (one question from each unit)	1 Compulsory question (with sub-section questions in any of the unit) 2 (out of 3 questions, one from each unit with sub-section)	75

Requirements for Appearing End Semester Examination

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(An Autonomous Institution)
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Madagadipet, Puducherry - 605 107

Academic Calendar

July 2024 to November 2024

Programme/Regulations: **B.Tech/R-2023**
Year/Sem : II year/III Sem

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SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(AN AUTONOMOUS INSTITUTION)

II year / III Sem

July 2024

Date	Day	Schedule	Working Day
1	Mon		
2	Tue		
3	Wed		
4	Thu		
5	Fri		
6	Sat		Holiday
7	Sun		Holiday
8	Mon		
9	Tue		
10	Wed		
11	Thu		
12	Fri		
13	Sat		
14	Sun		Holiday
15	Mon	Commencement of Classes for II year	1
16	Tue		2
17	Wed	Muharram	Holiday
18	Thu		3
19	Fri		4
20	Sat		Holiday
21	Sun		Holiday
22	Mon		5
23	Tue		6
24	Wed		7
25	Thu		8
26	Fri		9
27	Sat		10
28	Sun		Holiday
29	Mon	World Nature Conservation Day	11
30	Tue		12
31	Wed		13

Total number of working days : 13
Total number of holiday : 04

August 2024

Date	Day	Schedule	Working Day
1	Thu		14
2	Fri		15
3	Sat		Holiday
4	Sun		Holiday
5	Mon		16
6	Tue		17
7	Wed		18
8	Thu		19
9	Fri		20
10	Sat		21
11	Sun		Holiday
12	Mon		22
13	Tue		23
14	Wed		24
15	Thu	Independence Day	Holiday
16	Fri	Independence Day (Puducherry)	Holiday
17	Sat		Holiday
18	Sun		Holiday
19	Mon		25
20	Tue	Online Feedback-1	26
21	Wed	Assignment-1	27
22	Thu	Submission of QCM-1 / Syllabus Coverage	28
23	Fri		29
24	Sat	Submission of Attendance and Assessment Record	30
25	Sun		Holiday
26	Mon	CAT – 1 (I and II Hour)	31
27	Tue	CAT – 1 (I and II Hour)	32
28	Wed	CAT – 1 ((I and II Hour)	33
29	Thu	CAT – 1 (I and II Hour)	34
30	Fri	CAT – 1 (I and II Hour)	35
31	Sat	CAT – 1 (I and II Hour)	36

Total number of working days : 23
Total number of holiday : 08

September 2024

Date	Day	Schedule	Working Day
1	Sun		Holiday
2	Mon		37
3	Tue		38
4	Wed	Submission of CAT-1 Result Analysis	39
5	Thu	Teachers Day	40
6	Fri		41
7	Sat	Vinayagar Chaturthi	Holiday
8	Sun		Holiday
9	Mon		42
10	Tue		43
11	Wed		44
12	Thu		45
13	Fri		46
14	Sat		47
15	Sun		Holiday
16	Mon	Miladi Nabi/ World Ozone Day	Holiday
17	Tue		48
18	Wed		49
19	Thu		50
20	Fri		51
21	Sat		Holiday
22	Sun		Holiday
23	Mon	Online Feedback-2	52
24	Tue	Assignment - 2	53
25	Wed	Submission of QCM-2/ Syllabus coverage	54
26	Thu	Submission of Attendance and Assessment Record	55
27	Fri	CAT – 2 (I and II Hour)	56
28	Sat	CAT – 2 (I and II Hour) Investor Day	57
29	Sun		Holiday
30	Mon	CAT – 2 (I and II Hour)	58

Total number of working days : 22
Total number of holiday : 08

October 2024

Date	Day	Schedule	Working Day
1	Tue	CAT – 2 (I and II Hour)	59
2	Wed	Gandhi Jayanthy - Holiday	Holiday
3	Thu	CAT – 2 ((I and II Hour)	60
4	Fri	CAT – 2 ((I and II Hour)	61
5	Sat		Holiday
6	Sun		Holiday
7	Mon		62
8	Tue		63
9	Wed		64
10	Thu	Submission of CAT2 Result Analysis	65
11	Fri	Saraswathy Pooja	Holiday
12	Sat	Vijayadasmi	Holiday
13	Sun		Holiday
14	Mon		66
15	Tue		67
16	Wed	Online Feedback-3	68
17	Thu	Assignment-3	69
18	Fri	Submission of QCM-3 / Syllabus coverage	70
19	Sat		Holiday
20	Sun		Holiday
21	Mon	MODEL EXAM-Starts	71
22	Tue		72
23	Wed		73
24	Thu		74
25	Fri		75
26	Sat	MODEL EXAM- Ends	76
27	Sun		Holiday
28	Mon	Tentative Model Practical Examination	77
29	Tue		78
30	Wed		79
31	Thu	Deepavali	Holiday

Total number of working days :21
Total number of holiday : 10

November 2024

Date	Day	Schedule	Working Day
1	Fri	Puducherry Liberation Day	Holiday
2	Sat		Holiday
3	Sun		Holiday
4	Mon	Tentative ES Practical	80
5	Tue	Submission of Model Exam Result Analysis	81
6	Wed	Submission of Attendance and Assessment Record	82
7	Thu		83
8	Fri		84
9	Sat		85
10	Sun		Holiday
11	Mon	Tentative – End Semester Theory Examination	
12	Tue		
13	Wed		
14	Thu		
15	Fri		
16	Sat		Holiday
17	Sun		Holiday
18	Mon		
19	Tue		
20	Wed		
21	Thu		
22	Fri		
23	Sat		
24	Sun		Holiday
25	Mon		
26	Tue		
27	Wed		
28	Thu		
29	Fri		
30	Sat		

Total number of working days : 06
Total number of holiday : 03

2.1.5.285

Use of Cell Phones

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Working hours

I hour	09.00 a.m	to	09.50 a.m
II hour	09.50 a.m	to	10.40 a.m
Break	10.40 a.m	to	10.55 a.m
III hour	10.55 a.m	to	11.45 a.m
IV hour	11.45 a.m	to	12.35 p.m
V hour	01.15 p.m	to	02.05 p.m
VI hour	02.05 p.m	to	02.55 p.m
Break	02.55 p.m	to	03.10 p.m
VII hour	03.10 p.m	to	04.00 p.m
VIII hour	04.00 p.m	to	04.50 p.m

Lunch break 12.35 p.m. to 1.15 p.m.

Marks Distribution of Continuous Assessment Marks (CAM) and End Semester Examination Marks (ESM)

Scheme for Continuous Assessment Test (CAT)

S. No	Course Type	Continuous Assessment components									
		Test Marks	Average of pre/post test/ viva for each experiment	Average of marks for experiment report for each experiment	Model Exam / Report	Assignment	Review - 1	Review - 2	Review - 3	Attendance	Total
1.	Theory	15	-	-	-	5	-	-	-	5	25
2.	Practical	-	10	15	15	-	-	-	-	10	50
3.	Project Phase-I	-	-	-	-	-	15	15	20	-	50
4.	Project Phase-II	-	-	-	-	-	10	10	20	-	40

The internal marks will be provided fully based on the continuous assessment tests

Weightage of Assessment for Theory Course

S. No.	Test	Portion for Test	Test Marks	Duration of Test	Weightage for Internal
1	CAT 1	1½ Units	50	1 ½ hours	10
2	CAT 2	1½ Units	50	1 ½ hours	
3	Model	5 Units	75	3 hours	05
	Continuous Assessment for Theory Course				15

Question Paper Pattern

Question paper for CAT and ESE will be based on the pattern shown in Table (a) and (b)

Table (a) Question Paper pattern for CAT/Model Exam

Test Type	2 Marks	5 Marks	10 Marks	Total Marks
CAT 1 / CAT 2	5(questions) (10 Marks)	4(questions) (20 Marks)	2 (questions) (20 Marks)	50
Model	End Semester Examination Question Pattern			75

Table (b) Question paper pattern for End semester Examination(ESE)

2 Marks	5 Marks	10 Marks	Total Marks
10(20 Marks)	5 (25 Marks) (one question from each unit)	3 (30 Marks) (out of 5 questions, one question from each unit)	75

End Semester Examination Question Paper Pattern for Six Units Courses

Course	2 Mark	5 Mark	8 / 9 Mark	Total Marks
Part A	5	2 (out of 3 questions, one from each unit)	one 8 mark question (out of 2 questions from Unit I and Unit II)	37
			One 9 mark question (compulsory question from unit III)	
Part B	5	2 (out of 3 questions, one from each unit)	Two 9 mark questions (out of 3 questions from IV, V & VI)	38

Requirements for Appearing End Semester Examination

A student is expected to maintain 100% attendance in all courses as attendance also carries internal marks. A student will be qualified to appear for end semester examinations of a semester only if he/she satisfies the below mentioned requirements.

The student is permitted to appear for End Semester Examinations, only if he/she maintains minimum 75% of attendance. If he/she secured attendance greater than or equal to 60 % and less than 75 % has to pay the necessary condonation prescribed by the college authority with necessary supporting documents for his/her absence.

Redo Category

A student who secures overall attendance less than 60% has to repeat the course with the approval, when it is next offered. A student secures attendance greater than or equal to 60% and less than 75% will be promoted to next higher semester only if loss of attendance is due to medical reasons(hospitalization/ accident/illness) or participation in sports event or any competitions or NCC or NSS activities with prior permission from the Head of Institution through the Head of the department with necessary supporting documents and payment of necessary condonation fee as prescribed by the college authority. However student secures more than 75 % of attendance in the current semester will be moved to next higher semester.

Women Empowerment Cell

For the Welfare of the girl students, a Women Cell has been constituted in the college. The girl students may approach the member secretary for assistance.
Mail id : **wec@smvec.ac.in**

Grievance Redressal Committee

There is a Grievance Redressal committee in our college and the details are available in the website. Students can approach the member of the committee to redress their grievances if any. Mail id : **grievance@smvec.ac.in**

Internal Complaints Committee

The objective of this committee is to avoid sexual harassment of students and women employees in the college by preventing it, recording complaints, and taking appropriate action in response. It also aims to eliminate gender-based discrimination by creating a safe physical and social environment that deters sexual harassment and enforcing the necessary disciplinary actions. For complaints :
Mail id : **icc@smvec.ac.in**

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(An Autonomous Institution)
(Accredited by NBA-AICTE, New Delhi and Accredited by NAAC with "A" Grade)
Madagadipet, Puducherry - 605 107

Academic Calendar

July 2024 to November 2024

Programme / Regulations : **B.Tech / R-2020**
Year / Sem : III year / V Sem & IV year / VII Sem

About Autonomous

Sri Manakula Vinayagar Engineering College has been conferred with Autonomous Status by the University Grants Commission on 26th September 2019 and the same was approved by Pondicherry University on 19th June 2020.

VISION

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

MISSION

M1: Quality Education: To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation: To foster value- based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship: To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values: To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(AN AUTONOMOUS INSTITUTION)

III Year / V Sem & IV Year/ VII sem

July 2024

Date	Day	Schedule	Working Day
1	Mon		
2	Tue		
3	Wed		
4	Thu		
5	Fri		
6	Sat		Holiday
7	Sun		Holiday
8	Mon		
9	Tue		
10	Wed		
11	Thu		
12	Fri		
13	Sat		
14	Sun		Holiday
15	Mon	Commencement of Classes for III & IV years	1
16	Tue		2
17	Wed	Muharram	Holiday
18	Thu		3
19	Fri		4
20	Sat		Holiday
21	Sun		Holiday
22	Mon		5
23	Tue		6
24	Wed		7
25	Thu		8
26	Fri	Phase- I /Project Review - I	9
27	Sat		10
28	Sun		Holiday
29	Mon	World Nature Conservation Day	11
30	Tue		12
31	Wed		13

Total number of working days : 13
Total number of holiday : 04

August 2024

Date	Day	Schedule	Working Day
1	Thu		14
2	Fri		15
3	Sat		Holiday
4	Sun		Holiday
5	Mon		16
6	Tue		17
7	Wed		18
8	Thu		19
9	Fri		20
10	Sat		21
11	Sun		Holiday
12	Mon		22
13	Tue		23
14	Wed		24
15	Thu	Independence Day	Holiday
16	Fri	Independence Day (Puducherry)	Holiday
17	Sat		Holiday
18	Sun		Holiday
19	Mon		25
20	Tue	Online Feedback-1	26
21	Wed	Assignment-1	27
22	Thu	Submission of QCM-1 / Syllabus Coverage	28
23	Fri		29
24	Sat	Submission of Attendance and Assessment Record	30
25	Sun		Holiday
26	Mon	CAT – 1 (I and II Hour)	31
27	Tue	CAT – 1 (I and II Hour)	32
28	Wed	CAT – 1 ((I and II Hour)	33
29	Thu	CAT – 1 (I and II Hour)	34
30	Fri	CAT – 1 (I and II Hour)	35
31	Sat	CAT – 1 (I and II Hour)	36

Total number of working days : 23
Total number of holiday : 08

September 2024

Date	Day	Schedule	Working Day
1	Sun		Holiday
2	Mon		37
3	Tue		38
4	Wed	Submission of CAT-1 Result Analysis	39
5	Thu	Teachers Day	40
6	Fri	Phase I/ Project Review - II	41
7	Sat	Vinayagar Chaturthi	Holiday
8	Sun		Holiday
9	Mon		42
10	Tue		43
11	Wed		44
12	Thu		45
13	Fri		46
14	Sat		47
15	Sun		Holiday
16	Mon	Miladi Nabi/ World Ozone Day	Holiday
17	Tue		48
18	Wed		49
19	Thu		50
20	Fri		51
21	Sat		Holiday
22	Sun		Holiday
23	Mon	Online Feedback-2	52
24	Tue	Assignment - 2	53
25	Wed	Submission of QCM-2/ Syllabus coverage	54
26	Thu	Submission of Attendance and Assessment Record	55
27	Fri	CAT – 2 (I and II Hour)	56
28	Sat	CAT – 2 (I and II Hour) Investor Day	57
29	Sun		Holiday
30	Mon	CAT – 2 (I and II Hour)	58

Total number of working days : 22
Total number of holiday : 08

October 2024

Date	Day	Schedule	Working Day
1	Tue	CAT – 2 (I and II Hour)	59
2	Wed	Gandhi Jayanthy - Holiday	Holiday
3	Thu	CAT – 2 ((I and II Hour)	60
4	Fri	CAT – 2 ((I and II Hour)	61
5	Sat		Holiday
6	Sun		Holiday
7	Mon		62
8	Tue	Phase I/ Project Review - III	63
9	Wed		64
10	Thu	Submission of CAT2 Result Analysis	65
11	Fri	Saraswathy Pooja	Holiday
12	Sat	Vijayadasmi	Holiday
13	Sun		Holiday
14	Mon		66
15	Tue		67
16	Wed	Online Feedback-3	68
17	Thu	Assignment-3	69
18	Fri	Submission of QCM-3 / Syllabus coverage	70
19	Sat		Holiday
20	Sun		Holiday
21	Mon	MODEL EXAM-Starts	71
22	Tue		72
23	Wed		73
24	Thu		74
25	Fri		75
26	Sat	MODEL EXAM- Ends	76
27	Sun		Holiday
28	Mon	Tentative Model Practical Examination/ Phase I / Final Project Review	77
29	Tue		78
30	Wed		79
31	Thu	Deepavali	Holiday

Total number of working days :21
Total number of holiday : 10

November 2024

Date	Day	Schedule	Working Day
1	Fri	Puducherry Liberation Day	Holiday
2	Sat		Holiday
3	Sun		Holiday
4	Mon	Tentative ES Practical	80
5	Tue	Submission of Model Exam Result Analysis	81
6	Wed	Submission of Attendance and Assessment Record	82
7	Thu		83
8	Fri		84
9	Sat		85
10	Sun		Holiday
11	Mon	Tentative – End Semester Theory Examination	
12	Tue		
13	Wed		
14	Thu		
15	Fri		
16	Sat		Holiday
17	Sun		Holiday
18	Mon		
19	Tue		
20	Wed		
21	Thu		
22	Fri		
23	Sat		
24	Sun		Holiday
25	Mon		
26	Tue		
27	Wed		
28	Thu		
29	Fri		
30	Sat		

Total number of working days : 06
Total number of holiday : 03

29.5.2024

2.6.5.290

7	Dr.S. Yazhinian	VLSI	Assoc. Prof / ECE / Sri Venkateshwara Engineering College and Technology	9751112057 yazhinian.s@gmail.com
8	Dr. P. Vijayakumar	Wireless Networks and Communications	Associate Professor, School of Electronics Engineering, Vellore Institute of Technology, Melakottaiyur, Chennai – 600127	9894727271 vijayrgcet@gmail.com
9	Dr.D.Palani.	Image Processing	Assistant professor / dept of ECE. University college of engineering, Villupuram -605103	8667377226 palani.dinesh@gmail.com
10	Dr. M.PheminaSelvi	Electronics and Communications	Assistant professor / dept of ECE. University college of engineering, Villupuram -605103	9994267707 vm.femina@gmail.com
11	Dr.V.Devarajan	Wireless Communication	Professor & Head Department of ECE Dhanalakshmi Srinivasan College of Engineering and Technology, Mamallapuram.	9894040479 devarajan@live.fr
12	Dr.B.Karthik	Embedded System	Associate Professor, Department of ECE, Bharath Institute of Higher Education and Research. Chennai.	9842580740 karthikguru33@gmail.com
13	Dr.V.Ganesan	Electronics Circuits	Associate Professor, Department of ECE, Bharath University. Chennai.	9443723032 vganesh1711@gmail.com
14	Dr M. Florance Mary	Wireless Communication and Network Security, Cryptography, IoT, Embedded System, Blockchain, Cyber security, VLSI	Pondicherry Engineering College	6380597811 florancemary@pec.edu
15	Dr.D. Manamalli	Process Control	MIT Campus, Anna University, Chennai	9445405689 manamalli_m@yahoo.com
16	Dr. P. S. Mayurappriyan	Control Systems / Renewable Energy Systems / Power Electronics	Kumaraguru College of Technology, Chinnavedampatti (PO),Coimbatore – 641 049.	0422-2661100 mayurappriyan.ps.eie@kct.ac.in
17	Dr. N. Sivakumaran	Process Control and Instrumentation	National Institute of Technology, Tiruchirappalli 620015	9443745705 nsk@nitt.edu

2.6.5.293

18	Dr.B.Hemakumar	1.Transducers and Measurements 2. Electric Circuit Analysis 3. Process Instrumentation 4. Analytical	Department of EIE, Pondicherry Engineering College, Pillaichavady, Puducherry.	9994196804 hemakumarb@pec.edu
19	Dr.M.PonniBala	Biomedical Image Processing, Softcomputing Techniques	Kongu Engineering College Thoppupalayam, Perundurai, Tamil Nadu 638060	9843999554 ponnibala@kongu.ac.in
20	Dr. Anima Nanda	Composites Multi Objective Optimization Machining Material Characterizations	Sathyabama University, Chennai	9443786840 animananda72@gmail.com
21	Dr. M. Kowsalya	Energy and Power Electronics	VIT ,Vellore	7418077407 mkowsalya@vit.ac.in
22	Dr. Gnanou Florence Sudha	Electronics and Communication Engineering,	Department of ECE, Pondicherry Engineering College, Pillaichavady, Puducherry.	9944337963 gfsudha@pec.edu

Annexure - VI

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION)
(APPROVED BY AICTE, NEW DELHI AND AFFILIATED TO PONDICHERRY UNIVERSITY)
(ACCREDITED BY NBA-AICTE, NEW DELHI, ACCREDITED BY NAAC WITH "A" GRADE)
MADAGADIPET, PUDUCHERRY - 605 107

COMMON COURSES

DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING - COMMON COURSES				
Sl.No	**Offering**	**Course Code**	**Course Name**	**Remark**
1	ICE	U23ICTC01	Linear Integrated Circuits	Common to ICE and BME
2	ICE	U23ICTC02	Digital Logic Circuits	Common to ICE and BME
3	ICE	U23ICTC03	Linear Control Systems	Common to ICE and Mechatronics
Practical				
4	ICE	U23ICPC01	Linear and Digital Integrated Circuits Laboratory	Common to ICE and BME
Professional Elective				
5	ICE	U23ICEC01	Virtual Instrumentation	Common to ICE and Mechatronics
6	ICE	U23ICEC02	Soft Computing Techniques	Common to ICE and BME
7	ICE	U23ICEC03	Intelligent Robotic Systems	Common to ICE and ECE

2.9.5.896

2.9.5.297.

Annexure -V

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION)
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(ACCREDITED BY NBA-AICTE, NEW DELHI, ACCREDITED BY NAAC WITH 'A' GRADE)
MADAGADIPET, PUDUCHERRY - 605 107

DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING

DETAILS OF EXAMINERS FOR QUESTION PAPER SETTER AND EVALUATORS

Sl.No	Name of the Examiner	Specialization	Designation, Department and Institution in which currently working	Contact number and mail id
1	Dr. M.Manivannan	Process Control and Instrumentation	Department of EIE, Annamalai university. Chidambaram - 608 401	9442646555 Manivannan1978@gmail.com
2	Dr.P.A.Sridhar	Biomedical Instrumentation	Assistant Professor, Department of Electronics & Instrumentation Engineering, Kattankulathur Campus, SRM Institute of Science and Technology	7598227170 sridhara1@srmist.edu.in
3	Dr.Palanivel	Process Control, Transducer and Measurements	Associate Professor – Dept of E & I Annamalai university, Annamalai Nagar, Chidambaram	9842565026 S_palanivel@yahoo.com
4	Dr.M.Jagannath	Biomedical Instrumentation	Assoc. Prof, School of Electronic Engineering,VIT, Chennai - 600127	9884386262 jagan.faith@gmail.com
5	Dr.A.Saraswathi	Drives and Control	Assistant Professor / HOD University college of engineering, Villupuram -605103	9994549910 saraswathiask@gmail.com
6	Dr. P. Shanmugaraja	Medical Electronics Embedded Systems	Department of EIE Annamalaiuniversity. Chidambaram - 608 401.	9443275120 psraja70@gmail.com

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**IV**	Course Category: **PC**				End Semester Exam Type: **TE**		
Course Code	**U23ICTC03**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Linear Control Systems**	**2**	**1**	**0**	**3**	**25**	**75**	**100**
(Common to ICE and Mechatronics)								
Prerequisite	Basic Mathematics, Signals and Systems, Physics							

Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
CO1	Comprehend the basic concepts on the modelling of control systems.	**K2**
CO2	Determine the time response analysis of systems.	**K3**
CO3	Perform the frequency response analysis of control systems.	**K3**
CO4	Analyze the stability of the system.	**K2**
CO5	Design the compensation techniques.	**K3**

UNIT – I	**Mathematical Modeling of Systems**	**Periods:09**	
Types of System - Open Loop Systems, Closed Loop Systems, Basic Elements in Control System - Electrical Analogy of Mechanical and thermal systems -Transfer function - D.C and A.C Servo Motor - Block Diagram Reduction Techniques - Signal Flow Graphs.			**CO1**
UNIT – II	**Time Response Analysis**	**Periods:09**	
Standard Test Signals -Time Response of First and Second Order System, Time Domain- Specifications - Generalized Error Series - Steady State Error - Static and Dynamic Error Constants.			**CO2**
UNIT – III	**Frequency Response Analysis**	**Periods:09**	
Sinusoidal Transfer Function- Frequency Domain Specifications - Correlation between Time and Frequency Response – Construction of Bode Plots - Determination of Gain and Phase Margin from Bode Plots - Polar plots - Determination of Phase Margin and Gain margin from Polar plots – Gain Adjustment using polar plots.			**CO3**
UNIT – IV	**Stability of Control Systems**	**Periods:09**	
Characteristics Equation - Location of Roots in S Plane for Stability - Routh Hurwitz Criterion - Root Locus Analysis - Effect of Pole Zero Additions on Root Locus - Nyquist Stability Criterion.			**CO4**
UNIT – V	**Compensator and State Space Analysis**	**Periods:09**	
Introduction to compensation networks - Lag, Lead and Lag Lead networks - Effect of providing Lag, Lead and Lag-Lead compensation on system performance and design using bode plot - Concepts of state – state Variable and state models – physical, phase and canonical model.			**CO5**
Lecture Periods: 30	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1. Nagrath I J and Gopal M, "Control System Engineering", New Age International Pvt Ltd, 6th edition, 2017
2. Ogata K, "Modern Control Engineering", Prentice-Hall of India Pvt Ltd., New Delhi, 5th edition, 2015.
3. Benjamin C Kuo, "Automatic Control Systems ", Prentice Hall India Pvt. Ltd, 9th edition, 2014.

Reference Books

1. Norman S Nise, "Control System Engineering" , John Wiley and sons, inc., 7th edition, 2015
2. SmarajithGhosh, "Control Systems Theory and Applications", Pearson Education, Singapore, 6th edition, 2015
3. Richard C. Dorf, Robert H Bishop, "Modern Control Systems", Pearson Education, 12th edition, 2017.
4. Gopal, M., "Control Systems, Principles and Design", Tata McGraw-Hill Pub. Co., 4th Edition, New Delhi, 2012.
5. Nagoor kani. A., 'Control System Engineering', CBS Publishers and Distributors, 2021.

Web References

1. https://lecturenotes.in/notes/6579-note-for-control-system-engineering-cse-by-gyana-ranjan-biswal
2. https://www.smartzworld.com/notes/control-systems-pdf-notes-cs.
3. https://easyengineering.net/control-systems-engineering-by-nagoor-kani/
4. https://civildatas.com/download/control-systems-engineering-by-i-j-nagrath
5. https://www3.nd.edu/~pantsakl/Publications/348A-EEHandbook05.pdf.

* TE – Theory Exam, LE – Lab Exam

2.9.5.298

2.9.5.299

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	-	-	-	-	3	1	1
2	3	2	2	2	-	-	-	-	-	-	-	-	3	1	1
3	3	2	2	2	-	-	-	-	-	-	-	-	3	1	1
4	3	-	1	2	-	-	-	-	-	-	-	-	3	1	1
5	3	2	1	2	-	-	-	-	-	-	-	-	3	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – HighEvaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

2.9.5.300

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PE**			*End Semester Exam Type: **TE**			
Course Code	**U23ICEC02**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Soft Computing Techniques**	**3**	**0**	**0**	**3**	25	75	100
(Common to ICE and BME)								
Prerequisite	Basic Mathematics, Digital Circuits							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Illustrate the fuzzy sets and the properties of fuzzy logic	**K2**
	CO2	Comprehend fuzzy logic controllers and its applications.	**K2**
	CO3	Familiarize in the neural network architecture.	**K2**
	CO4	Impart knowledge on various training algorithm of neural network and its application	**K2**
	CO5	Interpret the concepts of optimization algorithms.	**K2**

UNIT – I	**Introduction to Fuzzy Logic**	**Periods:09**	
Classical sets - Fuzzy sets – properties of fuzzy sets – operations on fuzzy sets, Cartesian Product, Fuzzy relations, linguistic variables, Linguistic approximation. Fuzzy statements: Assignments, Conditional and Unconditional statements.			**CO1**
UNIT – II	**Fuzzy Logic Control System**	**Periods:09**	
Introduction to Fuzzy logic controller: Architecture, Fuzzification, Membership functions: Triangular, Trapezoidal, Gaussian. Inference Mechanism, knowledge base, fuzzy rule base, Inference method: Mamdani, Sugeno and TSK models, Defuzzification, Applications of Fuzzy logic controller.			**CO2**
UNIT – III	**Introduction to Neural Network**	**Periods:09**	
Introduction to neural networks, Biological neural networks, Artificial Neural network, Review of genetic algorithm- Single and Multi-layer feed forward network- Activation function, types (step and sigmoid function), threshold function, Classification of learning: Supervised, Unsupervised and Reinforced. McCulloh Pitts neuron: architecture, algorithm and applications.			**CO3**
UNIT – IV	**Neural Networks Control**	**Periods:09**	
Back propagation neural net: standard architecture and algorithm, Hopfield net: architecture and algorithm, Kohonnen's Self Organizing map, Adaptive Resonance Theory ART 1: Architecture and operation- Neural networks for control: Schemes of neuro control, Applications of neuro controller. Case studies: Neuro controller for DC motor speed control, Neuro controller for a Temperature Process.			**CO4**
UNIT – V	**Optimization**	**Periods:09**	
Optimization - Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Simulated Annealing – Random Search – Downhill Simplex Search.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International, 4th editions, 2010.
2. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2008.
3. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic", Prentice Hall, USA, 2015.

Reference Books

1. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 2019.
2. Rajasekaran. S, Pai. G.A.V., "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice-Hall, 2004.
3. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education, 2007.
4. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 2001.

Dr. L. M. Varalakshmi

B.Tech – Instrumentation and Control Engineering

2.9.5.306.

Department	**Instrumentation and Control Engineering**	Programme: **B.Tech.**						
Semester	**VI**	Course Category Code: **PE**			*End Semester Exam Type:**TE**			
Course Code	**U23ICEC01**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Virtual Instrumentation**	**3**	**0**	**0**	**3**	**25**	**75**	**100**
(Common to ICE and Mechatronics)								
Prerequisite	-							

Course Outcomes	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Comprehend the concepts of virtual instruments	**K2**
	CO2	Apply the Programming concepts in VI	**K3**
	CO3	Interpret the concepts of instrument interfacing by VI tools.	**K2**
	CO4	Acquaint the various instrument control interfaces.	**K2**
	CO5	Elucidate the concepts of VI in real time applications.	**K2**

UNIT – I	**INTRODUCTION**	**Periods:09**	
Evolution of LabVIEW - Block diagram and architecture of a virtual instrument – Graphical programming and comparison with conventional programming - Controls and indicators- Labels and Text –Shape, size and color – Data type, Format, Precision and representation – Data types – Data flow programming-Editing – Debugging and Running a Virtual Instrument.			**CO1**
UNIT – II	**PROGRAMMING STRUCTURE**	**Periods: 09**	
Front panel - Block diagram - VIS and sub-VIS, Display types – Digital – Analog – Chart – Oscilloscopic types, Loops: For Loops, While Loops, arrays, clusters, Charts and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.			**CO2**
UNIT – III	**DATA ACQUISITION**	**Periods: 09**	
Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.			**CO3**
UNIT – IV	**INSTRUMENT CONTROL**	**Periods: 09**	
Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office and Industrial applications, VISA and IVI.			**CO4**
UNIT – V	**APPLICATIONS**	**Periods: 09**	
Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.			**CO5**

Lecture Periods:45	**Tutorial Periods:**	**Practical Periods:-**	**Total Periods:45**

Text Books

1. Gupta , "Virtual Instrumentation Using Lab view", 2nd edition, Tata McGraw-Hill Education, 2010
2. Jovitha Jerome, "Virtual Instrumentation using LabVIEW", PHI Learning Pvt. Ltd., 2010.
3. T. S. Kang and D. M. Han, "Virtual Instrumentation: A Practical Approach", CRC Press, 2007.

Reference Books

1. Gary Jonson, "Labview Graphical Programming", 4th edition, McGraw Hill, New York, 2012.
2. Gupta.S., Gupta.J.P., "PC interfacing for Data Acquisition and Process Control", 2nd edition, Instrument Society of America, 2012.
3. Sokoloff; "Basic concepts of Labview 4", Prentice Hall Inc., New Jersey 2013.
4. N. Mathivanan, "Virtual Instrumentation: Concepts and Applications", PHI Learning Private Limited, 2008.
5. Stephen T. Morse, "Virtual Instrumentation with LabVIEW: A Hands-On Guide", Prentice Hall, 2005.

Web References

1. https://www.ni.com/
2. https://www.youtube.com/user/Labview/playlists

* TE – Theory Exam, LE – Lab Exam

2.9.5.302.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
2	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
3	2	2	-	-	-	1	-	-	-	-	-	-	1	1	1
4	3	2	1	1	-	1	-	-	-	-	-	-	1	1	1
5	3	2	1	1	-	1	-	-	-	-	-	-	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

Evaluation Methods

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	5	5	5	5	5	75	100

* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

2.9.5.304

5. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks using MATLAB 6.0", Tata McGraw Hill Education, 1st edition, 2017.

Web References

1. https://lecturenotes.in/subject/922.
2. https://www.ifi.uzh.ch/dam/jcr:00000000-2826-155d-0000-00005e4763e3/fuzzylogicscript.pdf.
3. https://nptel.ac.in/courses/106/105/106105173/.

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	2	-	-	-	-	-	-	3	2	1
2	3	3	-	3	3	2	-	-	-	-	-	-	2	2	1
3	3	3	2	3	3	2	-	-	-	-	-	-	2	2	1
4	3	2	3	3	3	2	-	-	-	-	-	-	2	2	1
5	3	3	3	2	2	2	-	-	-	-	-	-	2	2	1

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* Application oriented / Problem solving / Design / Analytical in content beyond the syllabus

Dr. L. M. Varalakshmi

B.Tech – Instrumentation and Control Engineering

2.9.5.308