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UNIVERSITY OF MUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Instrumentation Engineering

Third Year with Effect from **AY 2018-19**

As per **Choice Based Credit and Grading System**
with effect from the AY 2016–17

From Co-coordinator's Desk:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated, and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai, has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's), course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of Studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, **Choice Based Credit and Grading System** is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System enable a much-required shift in focus from teacher-centric to learner-centric education. Since the workload estimated is based on the investment of time in learning, not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes. Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner's performance. **Choice Based Credit and Grading System** were implemented for First Year of Engineering (Undergraduate) from the academic year 2016-2017. Subsequently this system will be carried forward for Second Year of Engineering (Undergraduate) in the academic year 2017-2018 and so on.

Dr. Suresh K. Ukarande
Coordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Preamble:

The overall technical education in our country is changing rapidly in manifolds. Now it is very much challenging to maintain the quality of education with its rate of expansion. To meet present requirement a systematic approach is necessary to build the strong technical base with the quality. Accreditation will provide the quality assurance in higher education and to achieve recognition of the institution or program meeting certain specified standards. The main-focus of an accreditation process is to measure the program outcomes, essentially a range of skills and knowledge that a student will have at the time of graduation from the program that is being accredited. Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I, as a Chairman, Board of Studies in Instrumentation Engineering of University of Mumbai, happy to state here that, Program Educational Objectives (PEOs) were finalized for undergraduate program in Instrumentation Engineering, more than ten senior faculty members from the different institutes affiliated to University of Mumbai were actively participated in this process. Few PEOs and POs of undergraduate program in Instrumentation Engineering are listed below;

Program Educational Objectives (PEOs)

- Graduates will have successful career in industry or pursue higher studies to meet future challenges of technological development.
- Graduates will develop analytical and logical skills that enable them to analyze and design Instrumentation and Control Systems.
- Graduates will achieve professional skills to expose themselves by giving an opportunity as an individual as well as team.
- Graduates will undertake research activities in emerging multidisciplinary fields.

Program Outcomes (POs)

- **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **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.
- **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.
- **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.

- **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.
- **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.
- **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **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.
- **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.
- **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.

Dr. S. R. Deore,
Chairman,
Board of Studies in Electrical Engineering,
Member - Academic Council
University of Mumbai

Program Structure for
TE Instrumentation Engineering
University of Mumbai
(With Effect from 2018-19)

Scheme for Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ISC601	Process Instrumentation System	4	-	-	4	-	-	4
ISC602	Industrial Data Communication	3	-	-	3	-	-	3
ISC603	Electrical machines and Drives	4	-	-	4	-	-	4
ISC604	Digital Signal Processing	4	-	-	4	-	-	4
ISC605	Advanced Control System	3	-	-	3	-	-	3
ISDL0602X	Department Level Optional Course II	3	-	-	3	-	-	3
ISL601	Process Instrumentation System – Lab Practice	-	2	-	-	1	-	1
ISL602	Industrial Data Communication – Lab Practice	-	2	-	-	1	-	1
ISL603	Electrical machines and Drives – Lab Practice	-	2	-	-	1	-	1
ISL604	Digital Signal Processing – Lab Practice	-	2	-	-	1	-	1
ISL605	Advanced Control System – Lab Practice	-	2	-	-	1	-	1
ISL 606	Mini-project - II	-	2	-	-	1	-	1
Total		**21**	**12**	**-**	**21**	**06**	**-**	**27**

Examination Scheme for Semester VI

Course Code	Course Name	Examination Scheme					Total Marks
		Theory		Term Work	Oral	Pract. & Oral	
		End Sem Exam (ESE)	Internal Assessment (IA)				
		Max Marks	Max Marks	Max Marks	Max Marks	Max Marks	
ISC601	Process Instrumentation System	80	20	-	-		100
ISC602	Industrial Data Communication	80	20	-	-		100
ISC603	Electrical machines and Drives	80	20	-	-		100
ISC604	Digital Signal Processing	80	20	-	-		100
ISC605	Advanced Control System	80	20	-	-		100
ISDL0602X	Department Level Optional Course II	80	20	-	-		100
ISL601	Process Instrumentation System – Lab Practice	-	-	25	25		50
ISL602	Industrial Data Communication – Lab Practice	-	-	25	-	-	25
ISL603	Electrical machines and Drives – Lab Practice	-	-	25	25	-	50
ISL604	Digital Signal Processing – Lab Practice	-	-	25	-	25	50
ISL605	Advanced Control System – Lab Practice	-	-	25	-	25	50
ISL 606	Mini-project - II	-	-	25#	-	-	25
	Total	**480**	**120**	**150**	**50**	**50**	**850**

Note: As per above Examination Scheme, the Minimum marks are as follows –

Max. Marks	Min. marks
80	32
50	20
25	10
20	8

Mini-project based on internal oral and project report.

Subject code	Subject Name	Teaching scheme (Hrs)			Credit assigned			
ISC 601	Process Instrumentation System	Theory	Pract	Tut	Theory	Pract	Tut	Total
		4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract and Oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg.					
ISC 601	Process Instrumentation System	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISC 601	Process Instrumentation System	4
Course objective	1. To make the students to familiar with different Process Dynamics & process control actions. 2. Students are expected to learn classification & working of Controllers & Tuning Methods. 3. Students are expected to understand various control schemes. 4. To familiarize concept of Multivariable Control & Discrete state process control Requirement.	
Course Outcome	The students will be able to 1. Understand & Learn Process Control Terminologies, Process Dynamics & their mathematical model. 2. Understand different types of control actions & their selection. 3. Learn Features & Classify controllers like electronic, pneumatic and hydraulic & their Tuning Techniques. 4. Learn various process control schemes & their applications and selection. 5. Understand Multivariable Control systems & their Interaction 6. Develop relay logic for various processes & symbols.	

Details of Syllabus:

Prerequisite: Measurement of physical parameters, sensors/transducers and basic control system.

	Process Instrumentation System		
Module	Content	Hrs	CO Mapping
1	**Introduction to Process Control** Process Control Terminology, Development of Typical Process Control loops like Pressure, Temperature, flow & Level. Process characteristics, control system parameters, Dynamic elements in a control loop, Dead time processes and smith predictor compensator. Inverse response behaviour of processes and compensator. Dynamic behaviour of first and second order systems. Interacting and non-interacting systems. Development	08	CO1

	of Mathematical Model for first & second order system with Example.		
2	**Process Control Actions** Types-Discontinuous, continuous (P, I, D) and composite control actions (PI, PD, and PID), Effects of control actions, selection criteria.	**06**	**CO2**
3	**Process Controllers and Tuning** Need for controller, General features, specifications, classification & working of Pneumatic, Hydraulic and Electronic controllers. Need for controller Tuning. Tuning Methods-Process reaction curve method, Ziegler-Nichols method, Cohen coon correction for quarter amplitude, Frequency response method, Relay based tuning. Concept of Auto Tuning. Introduction to Model based Controller.	**08**	**CO3**
4	**Control Schemes** Feedback, Feed forward, cascade, Ratio, split range, selective control, adaptive control, inferential control, and selection Guidelines.	**12**	**CO4**
5	**Multivariable Control** Introduction to SISO & MIMO systems, Block diagram analysis of multivariable systems, Interaction, relative gain analysis, Decoupler design	**06**	**CO5**
6	**Discrete-State process control** Need for Discrete state process control systems, process specification and event sequence description, Relay Logic symbols, Development of Relay ladder Logic diagram and case study examples.	**08**	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Books Recommended:

Text Books:

1. Curtis D. Johnson, "Process Control Instrumentation Technology", PHI /Pearson Education 2002.
2. George Stephanopoulos, "Chemical process control", PHI-1999.

Reference Books:

1. Bela G. Liptak, "Instrument Engineer's Hand Book – Process Control", Chilton Company, 3rd Edition, 1995.

2. M.Chidambaram, "Computer Control of Processes", Narosa, 2002.
3.Deshpande P.B and Ash R.H, "Elements of Process Control Applications", ISA Press, New York, 1995.
4.D. Patranabis, "Principles of Process Control", Second edition, TMH.
5.F.G. Shinsky, "Process Control System", TMH.
6.N.E. Battikha, "Condensed Handbook of Measurement and Control",3rd Edition., ISA Publication.
7.Donald P. Eckman, "Automatic Process Control", Wiley Eastern Ltd.
8.Franklyn W. Kirk, Nicholas R. Rimboi, "Instrumentation", First edition,1996, D.

Suggested E Books:

1. Instrumentation & Controls- Process control Fundamental by PA Control.Com
2. Dr. M.J.Willis, "Conventional process control schemes"
3. Tony R Kuphaldt,"Lessons in Industrial Instrumentation"
4. W.C.Dunn, "Fundamentals of Industrial Instrumentation"

Subject code	Subject Name	Teaching			Credits Assigned			
		Theory	Prac	Tut.	Th	Pract.	Tut.	Total
ISC602	Industrial Data Communication	3	-	-	3	-	-	3

Subject Code	Subject Name	Examination Scheme							
		Theory(out of100)							
		Internal Assessment(out			End sem Exam	Term Work	Pract and oral	Oral	Total
		Test1	Test 2	Avg.					
ISC 602	Industrial Data Communication	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC602	**Industrial Data Communication**	3
Course Objectives	1. To expose students to the basics of communication 2. To create awareness about the the OSI refrence model. 3. To acquaint the students with the different types of networks at various levels such as sensor level,device network and control network. 4. To provide sufficient knowledge about the HART. 5. To impart the fundamentals of foundation field bus.	
Course Outcomes	The students will be able to 1. Explain the importance of modulation in communication. 2. Examine the importance of OSI,TCP/IP model,various networking components. 3. Compare the different types of networks at various levels of field communication. 4. Use HART for communication 5. Establish Foundation fieldbus communication. 6. Investigate the various wireless devices.	

Details of syllabus:

Prerequisite: Awareness of transmitters, different process loops, Basics of communication system.

Module	Content	Hours	CO Mapping
1.	**Introduction to Communication System:** Elements of communication system, Noise in communication Systems. Amplitude Modulation: Introduction, Time and frequency domain analysis, Frequency Modulation, Phase Modulation, Effect of noise in FM. Digital Modulation, PAM,PPM,PWM,FSK,QPSK.	08	CO1
2.	**Introduction to Networks:** OSI reference model**,** TCP/IP model, Transmission media, UTP-STP cable, co-axial cable, N/W components: Repeaters, bridge, hub, switch, router, gateways. **Open Control N/W: RS232, RS422,EIA485** Modbus Structure, Implementation, GPIB. Proprietary Control N/W:Modbus Plus	05	CO2
3	**Networks at different levels:** Sensor level network: AS-i, CAN, Devicenet, Interbus and LON Device networks: Foundation Fieldbus H1-HART Profibus-PA Control Network: BACnet,control-net, FF-HSE, Profibus-DP, Ethernet, TCP/IP	08	CO3
4	**HART:** Architecture, Physical, Data Link, Application, Communication Technique, Normal and burst mode of communication, Troubleshooting, Benefits of HART	04	CO4
5	**Foundation Fieldbus:** Fieldbus requirement, features, advantages, fieldbus components, types, architecture–physical, data link, application layer, system and network management, wiring, segment functionality checking, installation in safe and hazardous area and troubleshooting, function block application process. **OPC Architecture**	06	CO5
6	**Wireless Technologies:** Satellite systems, Wireless LANs (WLANs), WiFi, VPAN, Zigbee, bluetooth GPRS and – their comparison, limitations and characteristics, Introduction to IOT and IIOT,RFID	05	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

1 . Question paper will comprise of 6 questions, each carrying 20 Marks.

2. Total 4 questions need to be solved.

3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.

4. Remaining questions will be mixed in nature.

5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books:

1. Deon Reynders,Steve Mackay,Edwin Wright, : "Practical Industrial Data Communications" ,1st edition ELSEVEIR,2005.
2. Lawrence M Thompson, : "Industrial Data Communication", 2nd edition , 1997.

Reference Books:

1. Daniel T Miklovic, "Real Time Control Networks", ISA 1993.
2. Bela G Liptak, "Process Software and Digital Networks",3rd edition2002.
3. Andrew S. Tanenbaum, "Computer Networks", 4th edition, PHI/Pearson Education,2002.
4. Behrouz A. Forouzan, "Data Communications and Networking", 2nd update edition, Tata McGraw Hill Publishing Company, New Delhi,2000.
5. Douglas E.Corner, "Computer Networks and Internets"2nd edition, Pearson Education Asia,5th Indian reprint, 2001.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC603	Electrical Machines and Drives	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISC603	Electrical Machines and Drives	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC603	Electrical Machines and Drives	4
Course Objective	1. To learn the basic concept and characteristics of Electrical motors. 2. To equip the students with the knowledge of semiconductor devices& their applications.	
Course Outcome	Students will be able to: 1. Explain working of DC motors and study their characteristics. 2. Describe the working principle of 3-phase I.M. 3. Discuss the constructional features of single-phase I.M. 4. Compare basic characteristics and ratings of power electronic devices. 5. Use controlled rectifiers, Inverters & choppers with different loads. 6. Illustrate working of AC & DC drives.	

Details of Syllabus:

Prerequisite: Knowledge of Faraday's laws, Lenz's law. Semiconductor devices such as diodes and transistors and their characteristics.

Module	Contents	Hrs	CO mapping
1	**DC Machines:** Types of DC motors, EMF equation generating & motoring action. Characteristics of DC motors. Speed control methods of DC motors. Applications of DC motors	08	**CO1**
2	**3-Phase Induction Motors:** Construction& working principle of3-phase IM. Slip, rotor frequency torque slip characteristic, power stages in IM	08	**CO2**
3	**Fractional HP Motors:** Construction & working principle of 1-phase I.M.split phase IM. Shaded pole IM Basic concepts of Stepper Motor, Servomotor	06	**CO3**
4	**Semiconductor Devices:**Introduction, characteristic, ratings & applications of power diode, power BJT, power MOSFET & IBGT Construction & characteristic, ratings of SCR, TRIAC Triggering methods of Thyristors using DIAC,UJT & PUT only.	08	**CO4**
5	**Applications of power semiconductor devices:** Controlled Rectifier: Principle of operation of 1-phase controlled converters, 1-phase half bridge & full bridge	12	**CO5**

	converter performance with R-L load. Basic operation of 3-phase converter AC power control with TRIAC-DIAC Inverter: Principle of operation of basic inverter, bridge inverter, PWM inverter DC-to-DC Converter: Basic operation of chopper, study of different types of chopper circuits like step up & step down chopper		
6	**Drives:** DC motor drives: 1-phase & 3-phase converter drives for continuous & discontinuous operation, chopper fed drive. AC motor drives and control: Control strategies of IM like stator voltage control & frequency control. Variable frequency VSI drives. Variable frequency CSI drives.	06	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

6) Question paper will comprise of 6 questions, each carrying 20 Marks.
7) Total 4 questions need to be solved.
8) Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
9) Remaining questions will be mixed in nature.
10) In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Sawhney A.K., Electrical & Electronics Measurement and Instrumentation, Dhanapat Rai &Co. Pvt Ltd
2. Nagrath I.J., Kothari D.P., Electrical Machines, second edition,Tata McGraw Hill, New Delhi.
3. B.L.Theraja, Fundamentals of Electrical & Electronics, S.Chand, Technical.
4. V.K. Mehta , Rohit Mehta, Principles of Electrical Engg. & Electronics, S.Chand
5. P.S. Bhimbra, Power Electronics, Khanna publishers, 2004
6. M. H. Rashid, Power Electronics, 2nd Edition, PHI, 2005

Reference Books:

1. Say M.G.,The performance & Design of Alternating Current Machines, 3rd edition, Oxford University
2. P.C. Sen, Power Electronics, Tata McGraw Hill, 2005
3. Mohan Undeland Robbins, Power Electronics- Converters application & Design, Wiley Eastern,1996
4. Dubey, Dorald, Thyristorised Power Controller, Wiley Eastern Ltd.1993
5. S.K. Datta, Power Electronics & control, PHI 1986
6. S.K. Bhattacharya, Industrial Electronics & Control, TATA McGraw Hill, 2007
7. B.K.Bose, Modern power Electronics & AC Drives Pearson Education Inc.2002

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC604	**Digital Signal Processing**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		4	-	-	4	-	-	4

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISC604	**Digital Signal Processing**	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC604	**Digital Signal Processing**	**4**
Course Objectives	1. To introduce the basic concept of discrete time signal processing and Acquired knowledge about DSP and its fundamentals. 2. To familiarize with Fourier transform algorithms and convolution of DT sequences. 3. Ability to design IIR digital filter and realization of its structures using different forms. 4. To design FIR filter using different methods. 5. To understand the basic concept of DSP processor and Adaptive filtering for practical applications.	
Course Outcomes	Students will be able to - 1. Describe the basic concept of discrete time signal processing such as sampling, aliasing, concept of DSP. 2. Demonstrate an ability to apply Discrete Fourier Transform, Fast Fourier transform and convolution techniques to signals. 3. Apply the concepts of all-pass and minimum-phase systems to analyses the LTI system, Also realization of system by direct form I, II, Cascade, Parallel and Structure form. 4. Design FIR filter by different techniques. 5. Describe how IIR filters are designed and Implemented by different methods. 6. Explain DSP processors and adaptive filters such as LMS, RLS for various applications.	

Details of Syllabus:

Prerequisite: Knowledge of Fundamentals of Engineering Mathematics, Knowledge of Signals and Systems, Basic programming skill

Module	Contents	Hrs	CO mapping
1	**Introduction**:- Review of discrete time signals and systems, Basics of Z transform, Block diagram of DSP, Advantages and applications, Sampling theorem, Reconstruction of signals, Aliasing.	04	**CO1**
2	**Discrete Fourier Analysis**: - DFT and its property, Decimation in time FFT algorithms, Decimation in frequency FFT algorithms, convolution by DFT, Overlap add and Overlap save method, Goertzel algorithm, The chirp Z transform algorithm	12	**CO2**
3	**Analysis of Digital Filter**: - Classification of filter on their pole zero diagram. Frequency response of IIR filters frequency response analysis of all types of linear phase system. Difference between IIR and FIR Filters. Realization of systems: -Realization of IIR systems by Direct Form-I, Direct form-II, Cascade and Parallel. Realization of FIR systems by Direct form, cascade and linear phase system. Lattice structures.	06	**CO3**
4	**Design of digital FIR filters**:- Classification of filters, Ideal filter characteristics, Symmetric and asymmetric FIR filters, Minimum Phase and All pass filters,FIR filter design by window technique and frequency sampling method, Linear phase and Zero phase filters, Hilbert transform.	08	**CO4**
5	**Design of digital IIR filters**:- Comparison with FIR filters, Review of Analog filters, Butterworth, Chebyshev approximations, Frequency transformation, Design of digital IIR filters using Bilinear transformation method, Impulse Invariant transformation method, Pole zero placement method, Matched Z transform (MZT) method.	10	**CO5**
6	**Recent trends in DSP system design**: - Introduction, Architecture of TMS 320C54X, CPU, Arithmetic logic unit, Multiplier/Adder unit, Engineering applications of DSP processors. Introduction to adaptive filters: -Need of Adaptive filter and its application areas, Least mean square (LMS) filter, Recursive least square(RLS) filter.	08	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Oppenheim, Schafer, "Discrete-Time Signal Processing", PHI,3rd edition, 2009.
2. John G. Proakis, "Digital Signal Processing",Pearson ,4th edition, 2007.
3. Sanjit K. Mitra, "Digital Signal Processing", McGraw Hill, 4nd edition, 2013.
4. Emmanuel Ifeachor, "Digital Signal Processing: A Practical Approach", PHI,2nd edition, 2001.
5. Vinay Ingale, "Digital signal processing using MATLAB", Cengage, 3rd edition, 2012.
6. Richard Lyons, "Understanding Digital Signal Processing" PHI, 1st edition, 2001.

Reference Books:

1. Thomas J. Cavicchi, "Digital Signal Processing" Wiley, 1st edition, 2009.
2. B. Venkataramani, M Bhaskar, "Digital Signal Processors", McGraw Hill, 2ndedition,2010.
3. Chi-Tsong Chen, "Digital Signal Processing: Spectral Computation", Oxford, 1stedition, 2007.
4. Dr.Shaila D. Apte, "Digital Signal Processing" Wiley, 2nd edition, 2009.
5. Robert A. Schilling," Introduction to Digital Signal Processing using MATLAB", Cengage, 2nd edition, 2012.
6. Ramesh Babu, "Digital Signal Processing" Scitech, 4thedition, 2011.
7. Monson H. Hayes, "Schaums Outline of Digital Signal Processing", McGraw Hill, 2ndedition,2010.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISC605	Advanced Control System	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End Sem Exam				
		Test1	Test2	Avg.					
ISC605	Advanced Control System	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC605	Advanced Control System	3
Course Objectives	To make students understand - 1. the concept of nonlinear control system, and different linearization methods to linearize the nonlinear system. 2. the concept of sliding mode control and its features. 3. the stability analysis of nonlinear control system through describing function and Lyapunov's method. 4. the concept of Internal Model Control and its application in control engineering 5. the importance of adaptive control system with their different types in control engineering as well as in process industries 6. the basic concept of Optimal Control.	
Course Outcomes	The Students will be able to - 1. Differentiate linear and nonlinear system, study characteristics of common physical nonlinearities. 2. Perform linearization of the nonlinear systems by using linearization techniques. 3. Construct phase-plane trajectories, study behavior of limit cycle and concept of sliding mode control. 4. Investigate the stability of nonlinear system by describing function method. 5. Investigate the stability of nonlinear system by Lyapunov's method 6. Design and develop the IMC structure for particular system with Uncertainty and Disturbances.	

Details of Syllabus:

Prerequisite: Knowledge of Linear algebra, Fourier Series, and Nyquist stability criterion.

Module	Contents	Hrs	CO mapping
1	**Nonlinear Control Systems** Definition of nonlinear systems, Difference between linear and nonlinear systems, characteristics of nonlinear systems, Common physical nonlinearities.	02	**CO1**
2	**Linearization Methods** Jacobian Linearization, Concept of relative degree, feedback linearization for systems with no internal dynamics.	02	**CO2**

3	**Phase plane Analysis** Basic concepts, phase trajectories, phase portrait, Constructing phase portraits by analytical method, Graphical Method -Delta Method Singular points and their classification, limit cycles and behaviour of limit cycles. Introduction to Sliding Mode Control**.**	08	**CO3**
4	**Describing Function Analysis** Describing Function Fundamentals, Describing Functions of saturation, dead zone, relay and their combinations, Stability analysis of nonlinear systems via describing function method.	08	**CO4**
5	**Lyapunov Stability Analysis** Stability of equilibria, Asymptotic stability, Lyapunov stability theorems, Stability analysis of linear systems, Construction of Lyapunov functions using Krasovskii method and variable gradient method.	08	**CO5**
6	**Internal Model Control** Introduction to Model-Based Control, Open loop controller Design, Model Uncertainty and Disturbances, Development of IMC structure, IMC-Based PID Controller Design	08	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1) Question paper will comprise of 6 questions, each carrying 20 Marks.
2) Total 4 questions need to be solved.
3) Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4) Remaining questions will be mixed in nature.
5) In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. I. J. Nagrath and M. Gopal, Control System Engineering, 3rd Edition, New Age International (P) Ltd., Publishers - 2000.
2. K. Ogata, Modern Control Engineering, Prentice Hall of India, 4th edition, 2002.
3. Dr. K.P. Mohandas, "Modern Control Engineering", revised edition, Sanguine Publishers, Bangalore, 2006.

Reference Books:

1. Gene F. Franklin, J David Powell, Abbas Emami-Naeini, "Feedback Control of Dynamic Systems", 5th edition Pearson Educations.
2. Shankar Sastry, Marc Bodson, "Adaptive Control", Prentice Hall of India (P) Ltd., 1993.
3. John Doyle, Bruce Francis, Allen Tannenbaum, "Feedback Control Theory".
4. Pierre R. Belanger, "Control Engineering", Saunders college Publishing.

5. Norman Nise, “Control System Engineering”, 4th edition Wiley International Edition.
6. Christopher Edwards, Sarah K. Spurgeon, “Sliding Mode control: Theory and Application”, 1998.
7. Karl J. Astrom, B. Wittenmark, “Adaptive Control”, 2nd Edition, Pearson Education Asia, First Indian Reprint, 2001
8. Stanislaw H. Zak, “Systems and Control”, Indian Edition, Oxford University Press, 2003.
9. Donald E. Kirk, “Optimal Control Theory- An Introduction”,
10. M. Gopal, “Modern Control System Theory”, Wiley Eastern Ltd., New Delhi.

Sub code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pra	Tut.	Theory	Pract.	Tut.	Total
ISDLO6021	**Material Science**	3	-	-	3	-	-	3

Sub code	Subject Name	Examination Scheme							
		Theory Marks 100							
		Internal Assessment(20)			End sem Exam	Term Work	Pract and oral	Oral	Total
		Test1	Test2	Avg.					
ISDLO6021	**Material Science**	20	20	20	80	-	-	-	100

Subject Code	**Subject Name**	**Credits**
ISDLO 6021	**Material Science**	**3**
Course Objectives	1. To understand the fundamentals of Material Science and Metallurgy. 2. To create awareness about the different mechanical testing in industry. 3. To determine the mechanical properties of metal, non-metal and alloys.	
Course Outcomes	The students will be able to 1. Classify and brief the properties of materials. 2. Describe about the mechanical testing. 3. Explain structure of materials. 4. Acquire knowledge about heat treatment of steel 5. Examine micro-macro metals. 6. Analyze different non ferrous alloys	

Details of Syllabus :

Prerequisite: Knowledge of metals ,non-metals and basic physics.

Module	Content	Hrs.	CO Mapping
1	**Classification and properties of material** Metal, non-metal such as ceramic, plastic and polymers, composite material Structure of material: Structure, general relationship of structure level to various engineering properties, atomic structure, bonding in solid, atomic arrangement in solid, crystal structure of metal, space lattice, unit cell, indexing of lattice plane and direction, plastic deformation, mechanism, deformation of single crystal and polycrystalline metals, imperfection in crystal, dislocation theory of slippage, work hardening, strengthening mechanism in	06	**CO1**
2	**Mechanical Testing** Tension test, engineering and true stress-strain curves, evaluation of properties, ductility, brittleness and toughness. Types of engineering stress-strain curve, compression test. Hardness testings- Brinell hardness Test, Poldi hardness Test, Rockwell hardness Test, Vickers hardness Test. Durometers, micro hardness. Relation among the various hardness test and hardness to tensile	06	**CO2**
3	**Equilibrium diagrams:** Related terms and their definitions, construction, common types of equilibrium diagrams, rules of solid solubility, Gibb's phase rules and non-equilibrium cooling. Plane carbon steel, iron-carbon phase diagram, classification of iron carbon alloys, classification, properties & application of steel. Alloy steel: effects of alloying element, function and uses of alloying elements.	06	**CO3**
4	**Heat transfer of steel:** Principal of heat treatment, phase transformation in steel during heating, transformation of Austenite during cooling, time-temperature transformation diagram, critical cooling rate, continuous transformation diagram, Heat treatment Process: annealing, normalizing, hardening, tempering, and case hardening, Hardenability of steel, significance of hardenability, the jominy-end quench test, other hardening heat treatment such as hardening, tempering, annealing.	06	**CO4**

5	**Macro and micro examination of metals** Macro examination: Specimen preparation, Sulphar painting, flow lines, welded section, Micro examination: Grinding, polishing, etching, optical metallurgical microscopy. Cast Iron: Classification, grey and white cast iron, modular and ductile iron, malleable cast iron, alloyed cast iron, effects of various parameter on structure and properties of cast iron, Application and heat treatment of cast iron.	06	**CO5**
6	**Engineering non-ferrous alloys** Brass, Bronze, Tin, Aluminum, Silicon, Beryllium bronze, Copper nickel alloy, aluminum alloys, titanium and its alloy, solder and bearing material, Common applications and some specification of various non-ferrous alloys in field such as 1. Die casting industry, 2. Automobile 3. Aircraft industry	06	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weight age of each module will be proportional to number of respective Lecture hours as mentioned in the syllabus.

Text Books :

1. Davis H.E. Trcxell G.E. &Wickocil C.T., "Testing of Engg. Materials", McGrawHill Book Co. Inc.
2. Smith W. F.,:"Principles of material science", Addison Welsey Publishing Co. Inc
3. V. D. Kodgire,:" Material Science and Metallurgy for engineers", Everest publishing House, Pune
4. Van Valck L.H. ,:"Principle of material science and engineering", Addison Wesley Publication Co. Inc.
5. B. K. Agrawal ,:" Introduction to engineering materials", Tata Mcgraw Hill Co. Ltd

Reference Books :

1. ASM Handbook : Surface Engineering Volume 5.
2. TME Handbook : Material, Finishing and coating Volume 3.

Subject code	Subject Name	Teaching Scheme (Hrs)			Credit Assigned			
		Theory	**Pract**	**Tut.**	**Theory**	**Pract.**	**Tut.**	**Total**
ISDL06022	**Computer Organization and Architecture**	3	-	-	3	-	-	3

Subject code	Subject Name	Examination Scheme							
		Theory (out of 100)				Term Work	Pract. and oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg					
ISDL06022	**Computer Organization and Architecture**	20	20	20	80	-	-	-	**100**

Subject Code	**Subject Name**	**Credits**
ISDL06022	**Computer Organization and Architecture**	3
Course Objectives	1. To conceptualize the basics of organizational and architectural issues of a digital computer. 2. To analyse performance issues in processor and memory design of a digital computer. 3. To understand various data transfer techniques in digital computer. 4. To analyse processor performance improvement using instruction level parallelism.	
Course Outcomes	The students will be able to: 1. To describe basic structure and operation of a digital computer. 2. To design fixed-point and floating-point addition, subtraction, multiplication & division and other arithmetic unit algorithms. 3. To describe the different ways of communicating with I/O devices and standard I/O interfaces. 4. To analyze the hierarchical memory system including cache memories and virtual memory. 5. To describe pipelining and its Hazards 6. To Explain the Pentium processor Hardware design	

Details of Syllabus :

Module	Topics	Hrs.	CO Mapping
1	**Basic Structure of Computers**: Functional UNIT computer, Difference between CO & CA. System Bus, Data Types, Instruction Cycle, Instruction cycle with interrupt	04	CO1
2	**Computer Arithmetic Introduction:** Fixed Point Representation, Floating - Point Representation (IEEE-754) Addition and subtraction, Multiplication Algorithms (Booth Multiplication Algorithm), Division Algorithms, Floating Point Arithmetic operations.	08	CO2
3	**Micro Programmed Control:** Control Memory, micro code Sequencing, Micro program Examples, Functional description of Control Unit, Hard Wired Control unit, Micro programmed Control unit.	06	CO3
4	**The Memory System:** Basic Concepts of Semiconductor RAM Memories, Read-Only Memories, Memory hierarchy, Cache Memories organization, Virtual Memories, Introduction to RAID basic structure. Input-Output Organization: Peripheral Devices, Input-Output Interface, Direct Memory Access, Input-Output Processor (IOP), Serial Communication; Introduction to Interconnect (PCI) Bus.	09	CO4
5	**Pipeline And Vector Processing:** Flynn's taxonomy, Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline and Pipeline Hazards.	05	CO5
6	**Case Study :Pentium architecture** Overview, Bus operations , Pipelining, Branch Prediction , Instruction and Data Cache ,Floating Point Unit	04	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Examination:

1. Question paper will comprise of 1 compulsory question of 10 marks and 5 questions, each carrying 20 marks, out of which 3 questions need to be solved.
2. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books :

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, Fifth Edition, Tata McGraw-Hill.
2. John P. Hayes, “Computer Architecture and Organization”, Third Edition.
3. William Stallings, “Computer Organization and Architecture: Designing for Performance”, Eighth Edition, Pearson.

Reference Books:

1. B. Govindarajulu, “Computer Architecture and Organization: Design Principles and Applications”, Second Edition, Tata McGraw-Hill.
2. Dr. M. Usha and T. S. Srikanth, “Computer System Architecture and Organization”, First Edition, Wiley-India.
3. Ramesh Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, Fifth Edition,Penram.
4. The Intel Family Of Microprocessors: Hardware and Software Principles and Applications Author: James L. Antonakos

Subject Code	Subject Name	Teaching Scheme (Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDLO6023	Bio-Sensors and Signal Processing	3	-	-	3	-	-	3

Sub Code	Subject Name	Examination Scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test 1	Test2	Avg.					
ISDLO6023	Bio-Sensors and Signal Processing	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDLO6023	Bio-Sensors and Signal Processing	3
Course objectives	1. To provide basic knowledge of various bio-sensors and their uses in biomedical applications. 2. To provide understanding of principle and operation of different types of bio-sensors like potentiometric, optical and amperiometric sensors. 3. To introduce the students to basic signal processing methods used in bio-signal measurement and analysis.	
Course Outcomes	Students would be able 1. To describe the basic concept behind bioelectric phenomena. 2. To classify the different types of bio-sensors and describe their characteristics. 3. To distinguish between the different biosensors used for physical and chemical measurands. 4. To explain the various types of transducers found in biosensors and their significance. 5. To explain about the various basic signal processing techniques used in bio-signal acquisition and analysis. 6. To apply the appropriate biosensor for different applications.	

Details of Syllabus :

Prerequisite: Knowledge about bio-signals and their specifications, Knowledge about the basic working principle of various transducers

Module	Contents	Hrs	CO Mapping
1	**Bioelectricity and Bio-electric Phenomena** Sensors / receptors in the human body, basic organization of nervous system-neural mechanism and circuit processing. Electrode theory, electrode-tissue interface, metal-electrolyte interface, electrode-skin interface, electrode impedance, electrical conductivity of electrode jellies and creams.	04	CO1
2	**Introduction to biological sensors** Sensor architecture and Classification of biosensors: Medically significant measurands, functional specifications of medical sensors; Bio-sensor characteristics: linearity, repeatability, hysteresis, drift; Bio-sensor models in the time & frequency domains.	04	CO2
3	**Physical and Chemical Biosensors** Bio-sensors for physical measurands: strain, force, pressure, acceleration, flow, volume, temperature and bio potentials. Bio-sensors for measurement of chemicals: Potentiometric sensors, ion selective electrodes, Amperometric sensors, Clark Electrode biosensors, Catalytic biosensors, Immuno-sensors.	09	CO3
4	**Transducers in Biosensors** Various types of transducers; principles and applications - Resistive, Capacitive, Inductive, Photoelectric, piezoelectric, mechanical and molecular electronics based transducers in biosensors. Chemiluminiscene - based biosensors, Liquid and solid ion exchange membrane electrode, Enzyme electrode, Principle of fiber optic cable, fiber optic sensors, Photo acoustic sensors in biomedical field.	09	CO4
5	**Bio-signal Acquisition and Processing** Measuring ultra-small signals, noise. Electrical signals produced by cells, Various types of signal processing techniques used for bio-signals.	05	CO5
6	**Applications of Biosensors** Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food, Low cost-biosensor for industrial processes for online monitoring; biosensors for environmental monitoring.	05	CO6

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be compulsory class test (on Minimum 02 Modules) and the other is either a class test or assignment on live problems or Course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.

5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

1. Richard S.C. Cobbold, "Transducers for Biomedical Measurements: Principles and Applications", John Wiley & Sons, 1992.
2. A.P.F. Turner, I. Karube & G.S. Wilson, "Biosensors: Fundamentals & Applications", Oxford University Press, Oxford, 1987.
3. Rangan C.S., Sarma G.R., and Mani V.S.V., "Instrumentation devices and system", Tata McGraw Hill Publishing Company limited, New Delhi, 2006.
4. John G.Webster, "Medical Instrumentation: Application and Design", John willey and sons, 1999.
5. Jacob Kline, "Handbook of Bio Medical Engineering", Academic press Inc., Sandiego, 1988.

Reference Books:

1. Richard Aston: Principles of Biomedical Instrumentation and Measurement, Merril Publishing Co., Columbus, 1990.
2. Ernest O. Doeblin: Measurement Systems, Application and Design, McGraw-Hill, 1985.
3. R. S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill.

Subject code	Subject Name	Teaching Scheme		Credit Assigned		
		Theory	Pract. / Tut.	Theory	Pract. / Tut.	Total
ISDL06024	**Nuclear Instrumentation**	3	-	3	-	3

Sub Code	**Subject Name**	**Examination Scheme**							
		Theory(out of 100)				**Term work**	**Pract. and Oral**	**Oral**	**Total**
		Internal Assessment			**End sem Exam**				
		Test1	**Test2**	**Avg.**					
ISDLO6024	**Nuclear Instrumentation**	20	20	20	80	-	-	-	100

Subject Code	**Subject Name**	**Credits**
ISDL06024	**Nuclear Instrumentation**	**3**
Course Objectives	1. To introduce the basic concept of radioactivity, properties of alpha, beta and gamma rays and study various radiation detectors 2. To study the electronics and counting systems 3. To study applications of nuclear instrumentation in medicines, Industry and in Agriculture.	
Course Outcomes	Students would be able 1. To explain basics of radioactivity, properties of alpha, beta and gamma rays. 2. To compare construction and working of various radiation detectors. 3. To describe electronics and counting systems used in nuclear instrumentation to process nuclear detector signal. 4. To list various factors influencing resolution of gamma energy spectrum and specifications of nuclear ADC. 5. To apply nuclear radiation detectors in medicine 6. To apply nuclear instrumentation in industry.	

Pre-Requisites: Students should know the basics of digital, analog electronics and signal conditioning circuits which is required in understanding the working of nuclear instruments.

Module	Topics	Hrs.	CO
1	**Radioactivity** : General properties of Nucleus, Radioactivity, Nature of Nuclear Radiation's, Properties of Alpha, Beta and Gamma rays, Natural and artificial radio-activity. Radioactivity Laws, Half-life period, radioactive series, Isotopes and Isobars, Various effects-photoelectric, Compton scattering and pair production, stopping power and range of charged nuclear particles.	06	**CO1**
2	**Radiation Detectors** : Techniques for radiation detection, Detectors for Alpha, beta and gamma rays, Detector classification, Gas filled detectors - volt ampere characteristics, Ionization chamber, Proportional counter, Geiger Muller counter, Designing features, Scintillation detectors, Photomultiplier tube, dark currents, pulse resolving power, efficiency of detection, Solid state detectors (Lithium ion drifted – Si-Li, Ge-Li, Diffused junction, surface barrier detectors)	12	**CO2**
3	**Electronics and Counting systems:** Pre-amp, shaping amplifiers, Discriminators, Scalars and count rate meters, Pulse shaping, peak stretchers, photon counting system block diagram, single channel analyser SCA (pulse height analyser - PHA), Coincidence detection	04	**CO3**
4	**Nuclear Spectroscopy systems:** Factors influencing resolution of gamma energy spectrum, Energy resolution in radiation detectors, Multichannel analysers (MCA), Role of Nuclear ADC's – performance parameters.	04	**CO4**
5	**Radiation Monitors &Application in Medicines**: Radiation uptake studies – block diagram and design features. Gamma camera – design, block diagram, medical usage. Nuclear instrumentation for health care, Radiation Personnel Health Monitors like neutron monitors, Gamma Monitors, Tritium monitors, Iodine monitors and PARA (particulate activity radiation alarms).	06	**CO5**
6	**Industrial Applications**: Basic Nuclear Instrumentation system – block diagram, Personal monitors like Thermo Luminescence Detectors (TLD). Dosimeters, Tele-detectors. Nuclear Instrumentation for power reactor. Nuclear Instrumentation for Toxic fluid tank level measurement, weighing, thickness gauges, Agriculture applications like food irradiation, Underground Piping Leak detection, water content measurement etc.	04	**CO6**

Assessment:

Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus wherein sub questions of 4 to 5 marks will be asked.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books:

4. G.F. Knoll, "Radiation Detection & Measurement", 2nd edition, John Wiley & Sons, 1998.
5. P.W. Nicholson, "Nuclear Electronics", John Wiley, 1998.
6. S.S. Kapoor & V.S. Ramamurthy, "Nuclear Radiation Detectors", Wiley Easter Limited, 1986.

Reference Books:

1. Gaur & Gupta, "Engineering Physics", Danpat Rai & Sons, 2001.
2. Irvin Kaplan, "Nuclear Physics", Narosa, 1987.
3. M.N. Avdhamule & P.G. Kshirsagar, "Engineering Physics", S.Chand & Co., 2001.
4. R.M. Singru, "Introduction to Experimental Nuclear Physics", Wiley Eastern Pvt. Ltd., 1974.
5. Hand Book of Nuclear Medical Instruments, Edited by B.R.Bairi, Balvinder Singh, N.C. Rathod, P.V. Narurkar, TMH Publishing New Delhi, 1974.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL601	Process Instrumentation System- Lab Practice	Theory	Pract	Tut	Theory	Pract	Tut	Total
		-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem exam	Term work	Pract. And oral	Oral	Total
		Test 1	Test 2	Avg					
ISL 601	Process Instrumentation System- Lab Practice	-	-	-	-	25	-	25	50

Subject Code	Subject Name	Credits
ISL 601	Process Instrumentation System- Lab Practice	1
Course objective	1. To make the students to familiar with different Process Dynamics & process control actions. 2. Students are expected to learn classification & working of Controllers & Tuning Methods. 3. Students are expected to understand various control schemes. 4. To familiarize concept of Multivariable Control & Discrete state process control Requirement.	
Course Outcome	The students will be able to 1. Understand & Learn Process Control Terminologies, Process Dynamics & their mathematical model. 2. Understand different types of control actions & their selection. 3. Learn Features & Classify controllers like electronic, pneumatic and hydraulic & their Tuning Techniques. 4. Learn various process control schemes & their applications and selection. 5. Understand Multivariable Control systems & their Interaction 6. The students will be able to develop relay logic for various processes & symbols.	

Syllabus: Same as that of Subject ISC601 Process Instrumentation System.

List of Laboratory Experiments:

Sr. No.	Detailed Content	CO Mapping
1	Study Features & operation of ON-OFF Controller & its Application.	**CO3**
2	Familiarization of various control actions (pure and composite) using PID controller with Real time Process OR Simulator.	**CO2**
3	Testing Features, specifications, wiring & operation of an electronic PID controller.	**CO3**
4	Tuning of an Electronic PID controller.	**CO3**
5	Analysis of Feedback Control using Level / Pressure / Flow / Temperature Control Loop.	**CO4**
6	Study Feed Forward Control system using Temperature control Loop.	**CO4**
7	Study of split range control system using Pressure Control set up.	**CO4**
8	Study of Ratio control system using Flow Control Loop.	**CO4**
9	Study of Cascade control system.	**CO4**
10	Study Dynamic behaviour of First Order Hydraulic system.	**CO1**
11	Study Dynamic behaviour of Second Order Hydraulic system.	**CO1**
12	Development & Implementation of Relay Ladder Logic for Discrete state process control system.	**CO6**
13	Assignment on Relative gain analysis.	**CO5**

Note:

*Factory / Industrial visit is suggested to understand the Practical knowledge of the subject.

Oral Examination:
Oral examination will be based on Laboratory work & Entire syllabus.

Term Work:
Term work shall consist of minimum eight experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments)	: 10 Marks
Laboratory work (programs/assignments / journal)	: 10 Marks
Attendance (Class Room & Laboratory)	: 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of Laboratory work and minimum passing in the term work.

Sub code	Subjec tName	Teaching Scheme(Hrs)			CreditsAssigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL602	**Industrial Data Communication-Lab Practice**	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination Scheme							
		Theory(out of100)							
		Internal Assessment(out of20)			End sem Exam	Term Work	Pract and oral	Oral	Total
		Test1	Test 2	Avg.					
ISL602	**Industrial Data Communication-Lab Practice**	-	-	-	-	25	-	-	25

Subject Code	**Subject Name**	**Credits**
ISL602	**Industrial Data Communication-Lab Practice**	**1**
Course Objectives	1. To expose the students to the basics of communication 2. To create awareness about the the OSI refrence model . 3. To acquaint the students with the different types of networks at various levels such as sensor level,device network and control network. 4. To provide sufficient knowledge about the HART. 5. To impart the fundamentals of foundation field bus.	
Course Outcomes	The students will be able to 1. Explain the importance of modulation in communication. 2. Examine the importance of OSI,TCP/IP model,various networking components. 3. Compare the different types of networks at various levels of field communication. 4. Use HART for communication 5. Establish Foundation fieldbus communication. 6. Investigate the various wireless devices.	

Syllabus: Same as that of Subject ISC602 **Industrial Data Communication**.

List of Laboratory Experiments/ Assignments:

Sr. No.	Detailed Content	CO Mapping
1	To Study the various modulation techniques(AM,FM,PWM)	**CO1**
2	To Study the networking components	**CO2**
3	To understand LAN	**CO3**
4	To study HART Protocol.	**CO4**
5	To calibrate various transmitters using HART	**CO4**
6	To study the components of Foundation Field Bus.	**CO5**
7	To study Zigbee	**CO6**
8	Assignment on MODBUS protocol.	**CO3**
9	Assignment onEthernet.	**CO3**
10	Assignment on application of IOT	**CO6**

Any other additional experiments/assignments based on syllabus which will help students to understand topic/concept.

Term Work:

Term work shall consist of minimum four experiments and four assignments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments/assignments) : 10 Marks

Laboratory work (programs / journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of

Laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL603	**Electrical Machines and Drives – Lab Practice**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg					
ISL603	**Electrical Machines and Drives– Lab Practice**	-	-	-	-	25	-	25	50

Subject Code	**Subject Name**	**Credits**
ISL603	**Electrical Machines and Drives – Lab Practice**	1
Course Objectives	1. To learn operation & speed control methods of electric motors. 2. To learn operations of semiconductor devices & their applications.	
Course Outcomes	Students will be able to 1. Perform speed control of DC motor by different methods 2. Describe working principle of three-phase and single -phase induction motors. 3. Study the characteristics of semiconductor devices 4. Use semiconductor devices to build different circuits.. 5. Apply drives for speed control of DC motor. 6. Discuss the working of AC drive for I.M.	

Syllabus same as that of subject ISC603 Electrical Machines and Drives

List of Laboratory Experiments:

Sr. No.	**Detailed Contents**	**CO mapping**
1	Speed control methods of DC motor	**CO1**
2	Starting of 3-phase IM by DOL/Autotransformer/rotor resistance method	**CO2**
3	Study of different types of fractional horse power motor	**CO2**
4	Plot V-I characteristics of SCR	**CO3**
5	Plot V-I characteristics of Triac	**CO3**

6	Triac based AC power control circuit.	**CO3**
7	Half wave & full wave controlled rectifier	**CO4**
8	SCR Based Inverter	**CO4**
9	MOSFET/IGBT Based Inverter	**CO4**
10	DC motor speed control drive	**CO5**
11	AC drive for I.M.	**CO6**

**Any other additional experiments based on syllabus which will help students to understand topic/concept.

Oral Examination:

Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum Eight experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks
Laboratory work (programs /journal) : 10 Marks
Attendance : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL604	**Digital Signal Processing- Lab Practice**	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
						Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL604	**Digital Signal Processing- Lab Practice**	-	-	-	-	25	25	-	50

Subject Code	**Subject Name**	**credits**
ISL604	**Digital Signal Processing- Lab Practice**	1
Course objectives	1. Study simulation software platform for digital signal processing and Plot different type of signals. 2. To understand the concept of linear, circular convolution, correlation and simulate it by computer software. 3. To understand Fourier transform and its algorithms such as FFT and IFFT and simulate it. 4. To design and implement filters both FIR and IIR using computer simulation. 5. To study DSP processors, adaptive filters and their applications.	
Course Outcomes	Students will be able to - 1. Verify sampling theorem using simulation software. 2. Demonstrate DT Fourier analysis, convolution and correlation concept using simulation software. 3. Perform Fast Fourier Transform of signals. 4. Design and implement FIR and IIR filters using computer simulation software platform. 5. Realize filters by direct form I, II, Cascade and Parallel form. 6. Study DSP processors, Adaptive filters and their applications.	

Syllabus same as that of subject ISC604 Digital Signal Processing

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO mapping
1	Generation of DT sinusoidal signal and verification of sampling theorem.	**CO1**
2	Finding the Impulse response of the system.	**CO2**
3	Program for finding linear convolution, Circular convolution, and linear convolution by using circular convolution technique.sequences.	**CO2**
4	Program for finding correlation (auto and cross).	**CO2**
5	Computation of N point DFT of a given sequence and to plot magnitude and	**CO3**

6	Computing circular convolution by DFT and IDFT of signals.	**CO3**
7	Implementation of FFT algorithms (DIT, DIF) etc.	**CO3**
8	Designing of FIR filter using windowing technique.	**CO4**
9	Design and Implement IIR filter to meet given specifications.	**CO4**
10	Assignment on Filter Implementation direct form I, II, Cascade, Parallel	**CO5**
11	Study of Adaptive filters such as LMS, RLS and its applications.	**CO6**
12	Study of DSP processor and its applications.	**CO6**

Any other additional experiments based on syllabus which will help students to understand topic/concept.

Oral Examination:
Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum Eight experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Experiments) : 10 Marks
Laboratory work (programs /journal) : 10 Marks
Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
ISL605	**Advanced Control System - Lab Practice**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
		-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL605	**Advanced Control System - Lab Practice**	-	-	-	-	25	25	-	50

Subject Code	Subject Name	credits
ISL605	**Advanced Control System- Lab Practice**	1
Course objectives	1. Students should be able to examine stability of limit cycle 2. The students should be able to examine stability of nonlinear system using DF techniques and Lyapunov's functions 3. The students should be able to design the IMC structure. 4. The students should able to examine the stability using sliding mode control 5. Students can be able to optimize the any particular system.	
Course Outcomes	Students will be able to 1. Construct the phase-plane trajectories using Delta Method. 2. Classify stability of limit cycle as per obtained response of the system 3. Derive DF for common nonlinearities and investigate stability of system with limit cycle. 4. Determine Lyapunov's function and also able to investigate the stability of nonlinear system 5. Design the IMC structure and apply same for stability analysis. 6. Design IMC based PID controller.	

Syllabus same as that of subject ISC605 Advanced Control System

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO mapping
1	Construct the trajectory for system represented by second order differential equation and for any initial condition by using Delta Method.	**CO1**
2	Study behaviour of limit cycle with the help of Vander Pol's equation.	**CO2**
3	Derivation of DF for nonlinearities – relay with saturation, relay with dead-zone, dead-zone and saturation etc.	**CO3**
4	Investigate the stability of system with nonlinearities – relay, saturation, dead-zone and existence of limit cycle using DF technique.	**CO3**
5	Verify Sylvester theorem for the definiteness of the Lyapunov Function.	**CO4**

6	Determine the stability of the system and construct the Lyapunov function for Linear Time invariant system	**CO4**
7	By using Krasovskii method determine the stability of the system and construct the Lyapunov function.	**CO4**
8	By using Variable Gradient method determine the stability of the nonlinear system	**CO4**
9	Effect of filter tuning parameter on step response of the first and second order systems	**CO5**
10	Design of IMC controller for a system subject to step input.	**CO5**
11	Design of IMC controller for a system subject to ramp input.	**CO5**
12	Design of IMC based PID controller.	**CO6**
13	Design of IMC controller for delay and non-minimum phase systems.	**CO5**

Any other additional experiments based on syllabus which will help students to understand topic/concept.

Oral Examination:
Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum eight experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Experiments) : 10 Marks
Laboratory work (programs /journal) : 10 Marks
Attendance : 5 Marks
The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL606	Mini Project-II	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL606	Mini Project-II	-	-	-	-	25#	-	-	25

Mini Project will be based on internal oral and project report.

Term Work:

The main intention of Mini Project is to make student enable to apply the knowledge and skills learned from the courses studied to solve/implement predefined challenging practical problems of interdisciplinary nature .The students undergo various laboratory/tutorial/simulation laboratory courses in which they do experimentation based on the curriculum requirement. The students should be encouraged to take challenging problems of interdisciplinary nature. The emphasis should be on

- Learning additional skills
- Development of ability to define and design the problem and lead to its accomplishment with proper planning.
- Learn the behavioral science by working in a group.

The group may be of maximum four (04) students. Each group will be assigned one faculty as a supervisor. The college should keep proper assessment record of progress of the project and at the end of the semester it should be assessed for awarding TW marks. The TW may be examined by approved internal faculty appointed by the head of the institute. The TW marks will be allocated based on the internal examination of demonstration in front of the examiner. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained about the completed task.

The students may use this opportunity to learn different design techniques in instrumentation, control and electronics. This can be achieved by making a proper selection of Mini Project.