AC - 29/6/2021
Item No. 6.7

UNIVERSITY OF MUMBAI

Bachelor of Engineering
In
Instrumentation Engineering

Second Year with Effect from AY 2020-21
Third Year with Effect from AY 2021-22
Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year2019–2020)

AC - 29/6/2021
Item No. 6.7

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	T.Y of B.E in Instrumentation Engineering
2	Eligibility for Admission	**After Passing Second Year Engineering as per the Ordinance 0.6242**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6242**
5	No. of Years / Semesters	**8 semesters**
6	Level	~~P.G.~~ / **U.G.**/ ~~Diploma / Certificate~~ (Strike out which is not applicable)
7	Pattern	~~Yearly~~ / **Semester** (Strike out which is not applicable)
8	Status	~~**New**~~ / Revised **REV- 2019 'C' Scheme**
9	To be implemented from Academic Year	**With effect from Academic Year: 2021-2022**

Date: 29/6/2021

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr. Anuradha Majumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preamble

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 Science and Technology (in particular Engineering)of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are 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. Choice based Credit and grading system enables 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 and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr. AnuradhaMuzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of ‘C ‘ scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme ‘A' and ‘B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD’s/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr. Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

PREAMBLE

Technical education in our country is progressing rapidly in manifolds. To maintain the quality of education a systematic approach is necessary,which can beobtained by building a strong technical base with the quality. Accreditation provides quality assurance in higher education and recognition to the institution or program, meeting certain specified standards. The main-focus of an accreditation process is to measure the program outcomes, essentially the range of skills and knowledge that a student will have at the time of graduation from the program. Faculty of Science & Technology of the University of Mumbai has taken a lead in incorporating a philosophy of outcome-based education in the process of curriculum development. The earlier syllabus was more focused on providing information and knowledge across various domains, which led to loading of students heavily, in terms of direct contact hours.

I, as a Chairman, Board of Studies in Instrumentation Engineering of University of Mumbai, happy to state here that,the revised curriculum focused on not only providing knowledge content but also on skill-based activities like attitudes, self-learning, and project-based activities.More than 30 senior faculty members from the different affiliated institutes of University of Mumbai were actively participated in this process. They are either Heads of Departments or their senior representatives from the Department of Instrumentation Engineering. The salient features of revised syllabus of Instrumentation Engineering, REV 2019 'C' Scheme are:

1. The overall credits and approach of the curriculum proposed in the present revision are in line with AICTE model curriculum.
2. Course objectives and course outcomes are framed as per NBA guidelines (Bloom's Taxonomy) and are clearly defined for each course.
3. Detailed guidelines are presentedto understand the depth and the approach to course to be taught, which will enhance learner's learning process.
4. The credit and grading system enables a learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching.
5. Minimizes the burden of contact hours, total credits of the entire program will be approximately 172. Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skillsets.
6. It also focuses on continuous evaluation which will enhance the quality of education.
7. Credit assignment for courses is based on 15 weeks teaching-learning process, however, the content of courses is to be taught in 12-13 weeks and the remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond the syllabus, etc.
8. The revised curriculum emphasizes on skill-based laboratories and project-based learning by introducing mini projects in the second and third year of programs, which will facilitate self-learning of students.

Dr. Alice Cheeran - Chairperson (BoS in Instrumentation Engineering)
Dr. Mukesh D. Patil - Member
Dr. M. J. Lengare - Member
Dr. Sharad P. Jadhav - Member
Dr. Dipak Gawali– Member

Program Structure for Second Year Instrumentation Engineering
(With Effect from 2021-2022)
Scheme for Semester -VI

Course Code	CourseName	TeachingScheme (ContactHours)		CreditsAssigned		
		Theory	Pract. Tut.	Theor	Pract.	Total
ISC601	Industrial Process Control	3	--	3	--	3
ISC602	Digital Signal Processing	3	--	3		3
ISC603	Industrial Data Communication	3	--	3	--	3
ISDOC601X	Department Optional Course– 2	3	--	3	--	3
ISL601	Industrial Process Control Lab	--	2	--	1	1
ISL602	Digital Signal Processing Lab	--	2	--	1	1
ISL603	Python Programming Lab	--	4#	--	2	2
ISM601	MiniProject–2 B	--	4$	--	2	2
Total		**12**	**12**	**12**	**06**	**18**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	PR & OR	Total
		Internal Assessment			End Sem Exam	Exam. Duration (inHrs)			
		Test1	Test	Avg					
ISC601	Industrial Process Control	20	20	20	80	3	--	--	100
ISC602	Digital Signal Processing	20	20	20	80	3	--	--	100
ISC603	Industrial Data Communication	20	20	20	80	3	--	--	100
ISDOC601X	Department Optional Course– 2	20	20	20	80	3	--	--	100
ISL601	Industrial Process Control Lab	--	--	--	--	--	25	25	50
ISL602	Digital Signal Processing Lab	--	--	--	--	--	25	25	50
ISL603	Python Programming Lab	--	--	--	--	--	25	25	50
ISM601	MiniProject–2 B	--	--	--	--	--	25	25	50
Total				**80**	**320**		**100**	**100**	**600**

$ indicates workload of Learner (Not Faculty), for Mini Project.
# out of 4 hours, 2 hours theory shall be taught to entire class and 2 hours practical in batches

Department Optional Course – 2 (Semester-VI)

ISDOC6011	Instrumentation for Agriculture	**No Lab work**
ISDOC6012	Optimization Techniques	
ISDOC6013	Database Management Systems	
ISDOC6014	Biosensors and Signal Processing	

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC601	Industrial Process Control	3	-	-	3	-	-	3

Subject Code	Subject Name	Examination scheme							
		Theory Marks (100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment (20)			End Sem Exam				
		Test1	Test2	Avg.					
ISC601	Industrial Process Control	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC601	Industrial Process Control	3
Course objectives	1. To impart the knowledge of different industrial unit operations. 2. To make the students capable to design and develop instrumentation and control schemes for industrial processes. 3. To give them overview of various process industries, hazardous areas and their classification.	
Course Outcomes	The students will be able to: 1. Explain working and control of heat exchanger and evaporator 2. Explain working and control boiler and furnace 3. Elaborate working and control of distillation and reactor 4. Explain working and control of dryer and crystallizer 5. Describe the processes of batch and continuous process industries and instrumentation involved in them. 6. Classify hazardous areas in the industry.	

Details of Syllabus:

Prerequisite: Temperature, flow, pressure sensors, fundamentals of process instrumentation and control, control schemes like feedback, feedforward, cascade, split range, selective etc., basics of unit operations.

Module	Content	Hrs	CO Mapping
1	**Heat transfer unit operations-I:** Introduction to unit operations and processes, concept of heat transfers and energy balance, heat transfer coefficient. **Heat exchanger control:** classification as per fluid flow arrangement and construction, feedback, feed-forward, bypass control schemes, fouling in heat exchangers. **Evaporator control:** Evaporator terminologies, Types of Evaporator, control systems for Evaporator – feedback, cascade, feed forward and selective control.	06	CO1
2	**Heat transfer unit operations-II:** **Boiler control:** Types, working and operation of boilers, Terms related- Shrink and swell effect and excess oxygen, boiler efficiency, Boiler controls- Drum level control- Single, two and three elements, and Combustion Control- Type 1, 2, 3 and 4, steam temperature control, boiler pressure control, furnace draft control. **Furnacecontrol:** Start- up heaters, fired re-boilers, process andsafety controls.	09	CO2
3	**Heat and mass transfer unit operations-I:** **Distillation column:** Basic principle, Distillation equipment and its accessories.Batch and continuous distillation, Binary product distillation, multi-product distillation, Vacuum distillation. **Distillation column control strategies**- Top and bottom product composition controls-inferential and direct, Pressure controls, Vapors recompression, Feed controls- Column feed controls,economizer. **Reactor control:** Reactor characteristics, runaway reaction, various schemesof temperature control of reactors.	09	CO3

4	**Heat and mass transfer unit operations-II:** **Dryer control:** Process of drying, types and control strategies of dryer- Tray, , fluidized bed, rotary and spray dryer. **Crystallizers control:** Process of crystallization, Super-saturation methods, types of crystallizer and control strategies- evaporating crystallizer, cooling crystallizers, vacuum crystallizers.	06	CO4
5	**Continuous and Batch Process Industries:** **Refinery Industry:** Process flow diagram, separation, conversion methods, sensors and control schemes. **Iron and steel Industry**: Process flow diagram, Sensors and Control schemes. **Pharmaceutical industries**- Penicillin-G production, sensors and control schemes.	05	CO5
6	**Safety in Instrumentation control systems:** Area and material classification as per IEC and NEC standard, techniques used to reduce explosion hazards, intrinsic safety, and installation of intrinsically safe systems.	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 Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20Marks.
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. W. L. McCabe and Julian Smith, Unit operation and chemical engineering‖, Tata McGraw Hill, Sixth edition, 2001.
2. Bela G. Liptak, Instrument engineers handbook-Process control ,Chilton book company, third edition,1995.
3. Bela G. Liptak, Instrumentation in the processing industries, Chilton book company-first edition, 1973.

Reference Books:

1. Douglas M. Considine, Process industrial instruments and controls handbook‖, McGraw Hill-4th edition,1993.
2. George T. Austin, Shreve‘s chemical process industries‖, Mc-GrawHill- fifth edition,1984.
3. George Stephenopoulos, Chemical process control, PHI-1999.
4. David Lindsey, Power Plant control and instrumentation – control of boilers HRSG, Institution of Engineering and Technology,

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC602	Digital 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				
		Test1	Test2	Avg.					
ISC602	Digital Signal Processing	20	20	20	80			-	100

Subject Code	Subject Name	Credits
ISC602	Digital Signal Processing	3
Course Objectives	1. To introduce the basic concept of discrete time signal processing and acquire 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.	
Course Outcomes	Students will be able to 1. Understand the basic concepts of discrete-time signals and systems, sampling, aliasing, and DSP. 2. Analyse LTI systems in time-domain and realize it using different structures. 3. Analyse LTI systems in frequency domain. 4. Demonstrate an ability to apply Discrete Fourier Transform, Fast Fourier transform. 5. Design FIR filter by different techniques. 6. Describe how IIR filters are designed and Implemented by different methods.	

Details of Syllabus:
Prerequisite: Knowledge of Fundamentals of Engineering Mathematics, Basic programming skills.

Module	Contents	CO	Hrs.
1.	**Introduction to Signals and Systems:** Discrete-time signals and systems: classification of signals, sampling process/theorem, aliasing effect and reconstruction, classification of systems, input-output description of systems, block-diagram representation of discrete-time systems. Basic elements of Digital Signal Processing (DSP), analog to digital conversion (ADC), comparison between DSP and Analog Signal Processing (ASP) with applications of DSP.	CO1	06
2.	**Analysis of discrete-time systems** Linear convolution, causality and stability of discrete time systems, autocorrelation, cross-correlation, z-transform and its properties, solving difference equations and analysis of discrete-time systems in z-domain, transfer function, pole-zero plot. Implementation of discrete-time systems: Structures for the realization, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) structures.	CO2	07
3.	**Frequency analysis of discrete-time signals** Frequency response of LTI systems, ideal frequency selective filters, magnitude and phase response, Discrete-time Fourier Series, properties of DFS, The Discrete Time Fourier Transform (DTFT), symmetry properties and theorems of DTFT. Energy density spectrum and power density spectrum.	CO3	06
4.	**Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)** Discrete Fourier transform (DFT), properties of DFT, symmetry properties, circular convolution, linear filtering methods based on DFT, Frequency analysis of signals using DFT, Efficient computation of DFT, Fast Fourier Transform (FFT) algorithms: radix-2 decimation-in-time (DIT) and decimation-infrequency (DIF)FFT algorithms.	CO4	07
5.	**Design of FIR filters** Introduction to FIR filters, linear phase filters, symmetric and anti-symmetric filters, FIR design by Fourier approximation, window method, frequency sampling method, comparison between FIR and IIR filters.	CO5	06
6.	**Design of digital IIR filters from analog filters** Introduction to analog IIR filters, Butterworth approximation, Chebyshev approximation. Design of digital IIR filter: approximation derivative method, impulse invariance method, bilinear transformation, Frequency transformations in analog and digital domain.	CO6	07

Internal Assessment:

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

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. V. Oppenheim and R. W. Schafer, Discrete Time Signal Processing, Pearson Education, 2000.
2. J. G. Proakis and D. J. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, PHI, 4th Edition, 2007.
3. NagoorKani, "Digital Signal Processing", McGraw Hill Publications, 2017.

Reference Books:

1. B. Porat, A Course in Digital Signal Processing, J. Wiley and Sons, 1996.
2. J. R. Johnson, Introduction to Digital Signal Processing, PHI, 1989.
3. Rabiner, Gold, Theory and Applications of Digital Signal Processing, TMH, 1996.
4. S. K. Mitra, Digital Signal Processing-A Computer Based Approach, MGH, 1997.
5. E. C. Ifeachor and B. W. Jervis, Digital Signal Processing-A practical Approach, Addison-Wesley publication, 2002.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC603	Industrial Data Communication	3	-	-	3	-	-	3

Subject Code	Subject Name	Examination scheme							
		Theory Marks (100)				Termwork	Pract. and Oral	Oral	Total
		Internal Assessment (20)			End Sem Exam				
		Test 1	Test2	Avg.					
ISC603	Industrial Data Communication	20	20	20	80	-	-	-	100

Subject Code	Subject Name	credits
ISC603	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	Hrs	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	06	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	06	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 Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20Marks.
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			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDOC6011	Instrumentation for Agriculture	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.					
ISDOC6011	Instrumentation for Agriculture	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDOC6011	Instrumentation for Agriculture	3
Course Objectives	To impart background information required for studying application of instrumentation in agriculture.	
Course Outcomes	The student will be able to: 1. Illustrate necessity of instrumentation in agriculture. 2. Demonstrate soil properties and sensors used to measure the same. 3. Develop automation scheme for irrigation. 4. Develop automation scheme for green house. 5. Apply instrumentation to agricultural equipment. 6. Demonstrate instrumentation in continuous and batch process in agriculture-based product.	

Details of Syllabus:

Prerequisite: Fundamental knowledge of sensors & transducers

Module	Contents	Hrs.	CO mapping
1	**Introduction:** Necessity of instrumentation and control for agriculture sensor requirement, remote sensing, biosensors in agriculture, standards for food quality.	3	CO1
2	**Soil Properties:**Engineering properties of soil pH, conductivity, resistivity, temperature, soil moisture and salinity. **Sensors:**Ion concentration measurement, method of soil analysis, Instrumentation for environmental conditioning of seed germination and growth, introduction to sonic anemometers, hygrometers/ soil moisture measurement (resistance-based method, voltage-based method, thermal based method), fine wire thermocouples, open & close path gas analyzers.	7	CO2
3	**Instrumentation in Irrigation:** irrigation methods: overhead, Centre pivot, lateral move, micro irrigation systems &it's performance, comparison of different irrigation systems, irrigation scheduling, irrigation efficiencies, auto drip & sprinkler irrigation systems. Water distribution & management control, irrigation canal management systems, design considerations in irrigation channels, upstream & downstream control concept.	7	CO3
4	**Greenhouse Parameters & Instrumentation:** Basic concept of Greenhouse, merits & demerits, ventilation, cooling & heating, wind speed, temperature & humidity, soil moisture, rain gauge, carbon dioxide enrichment measurement & control, Leaf area length Evapo-transpiration, temperature, wetness & respiration measurement & data logging, electromagnetic radiations photosynthesis.	7	CO4
5	**Applications in Agricultural Equipment:** Automation in earth moving equipment& farm equipment, implementation of hydraulic, pneumatic & electronics control circuits in harvesters cotton pickers, tractor etc. classification of pumps: pump characteristics, pump selection & installation.	7	CO5
6	**Instrumentation in Continuous & Batch process:** Flow diagram, sensors & instrumentation set up of: Sugar plant, Fermenter (batch process), Dairy industry, Juice extraction and Oil extraction.	8	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 of4 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. D. Patranabis, Principles of Industrial instrumentation,TMH (2010), ISBN-13: 9780070699717
2. Michael. A.M, Irrigation: Theory and Practice, Vikas Publishing House Pvt Ltd, Second edition (2008), ISBN-13: 978-8125918677
3. Curtis D. Johnson, Process control and instrumentation technology, 8th Edition, 2015,Person, ISBN: 9789332549456, 9332549451
4. Akalank Kumar Jain, Vidhi Jain Food Safety and Standards Act, Rules & Regulations, Akalank Publications; 13th Edition (2015), ISBN-13: 9788176393584
5. Rosana G. Moreira, Automatic Control for Food Processing Systems (Food Engineering Series), Springer; 2001 edition (28 February 2001), ISBN-13: 9780834217812
6. Wills B.A., Mineral Processing Technology, 4th Ed.,Pergamon Press.

Reference Books:

1. Bela G. Liptak, Instrument Engineers' Handbook, Process Control and Optimization, CRC Press; 4 edition (29 September 2005), ISBN-13: 978-0849310812.
2. Robert H. Brown, CRC Handbook of Engineering in Agriculture, Volume II: Volume 1 (C R C SERIES IN AGRICULTURE), CRC Press; 1 edition (30 June 1988), ISBN13: 978-0849338625.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDOC6012	Optimization Techniques	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.					
ISDOC6012	Optimization Techniques	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDOC6012	Optimization Techniques	3
Course Objectives	1. Student should understand the process of optimization, formulation of practical engineering problem into optimization problem and applying necessary and sufficient conditions of optimality to check the feasibility of the problem. 2. Students should study the concepts of linear as well as nonlinear programming methods. 3. Based on the nature of problem i.e. linear, nonlinear, one dimensional, multidimensional, students can use appropriate method to solve it. 4. Students will understand how to apply numerical unconstrained methods to solve constrained optimization problem.	
Course Outcomes	Students would be able 1. Translate descriptive statements of the design engineering problems in to a mathematical statement of optimization. 2. Write optimality conditions for unconstrained and constrained problems and use Lagrange multiplier and KKT necessary conditions for solving problems. 3. Translating linear programming problem (LPP) in to standard form and then use simplex or two phase simplex method. 4. Use alternate form of two-phase simplex method called Big-M method also write dual problem for the given LP Problem for solving it. 5. Explain gradient-based search and direct search methods for design optimization problems. 6. Use the numerical methods for unconstrained optimization.	

Details of Syllabus:

Prerequisite: Knowledge of derivative, partial differentiation, Matrix Algebra, Taylor series.

Module	Contents	Hrs	CO Mapping
1	**Introduction to Optimization:** Definition and meaning of optimization, need of optimization, optimization problem formulation – statement of an optimization problem, terminology- design vector, objective function, objective function surface, design constraints, constraint surface, Iteration, convergence, classification of optimization problem, conventional versus -optimum design process, -optimal control problem, problem formulation process, engineering applications of optimization.	06	CO1
2	**Classical Optimization Techniques:** Fundamental concepts- local and global minima, local and global maxima, quadratic form, necessary and sufficient condition of single and multivariable optimization with no constraints, multivariable optimization with equality and inequality constraints (Kuhn-Tucker condition), Lagrange Theorem	05	CO2
3	**Linear Programming – Simplex Method** Definition of linear programming problem (LPP), standard form of LPP, terminology, basic concepts, Simplex Algorithm and flowchart, simplex method, two-phase simplex method	08	CO3
4	**Linear Programming – Revised Simplex Method** Duality in linear programming – standard primal LP problem, dual LP problem, Treatment of equality constraints, determination of the primal solution from the dual solution, dual variables as Lagrange multipliers, KKT conditions for the LP problem,	09	CO4
5	**Numerical Methods for Unconstrained Optimum Design – Direct Method** General algorithm for unconstrained minimization methods, rate of convergence, unimodal and multimodal function, reduction of a single variable, one dimensional minimization methods- Equal Interval method, Golden section search method.	06	CO5
6	**Numerical Methods for Unconstrained Optimum Design – Indirect Method** Gradient of a function, Steepest Descent, Conjugate gradient (Fletcher-Reeves), Step size determination – polynomial interpolation, properties of gradient vector	05	CO6

Internal Assessment:

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

Theory Examination:

1. Question paper will comprise of 6questions, 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 5marks 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. Jasbir S. Arora, Introduction to Optimum Design, 3rd Edition, Academic Press – 2012.

2. Ashok D. Belegundu, Optimization concepts and applications in Engineering, Pearson Education, 2002.

Reference Books:

1. S. S. Rao, Optimization, 3rd Enlarged Edition, New Age International (P) Ltd., Publishers, New Delhi, 2010.

2. T. E. Edger and D. M. Himmeblaue, Optimization of Chemical Processes, McGraw Hill International Editions, 1989.

3. William L. Luyben, Process Modeling, Simulation, and Control For Chemical Engineers, McGraw-Hill Publishing Company,1990.

4. Kalyanmoy Deb, “Optimization for Engineering Design”, Prentice Hall of India (P) Ltd., New Delhi, 1998.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISDOC 6013	Database Management System	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.					
ISDOC 6013	Database Management System	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISDOC 6013	Database Management System	3
Course Objectives	1. Learn and practice data modeling using the entity-relationship and developing database designs. 2. Understand the use of Structured Query Language (SQL) and learn SQL syntax. 3. Apply normalization techniques to normalize the database 4. Understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.	
Course Outcomes	The student will be able to: 1. To describe data models and schemas in DBMS. 2. Explain the features of database management systems and Relational database. 3. Use SQL- the standard language of relational databases. 4. Identify the functional dependencies and Design a database. 5. Describe the concept of Transactions Management and Concurrency. 6. Explain the concept of Query Processing and Optimization.	

Details of Syllabus:

Module	Contents	Hrs.	CO mapping
1	**Introduction Database Concepts:** Introduction, Characteristics of databases, File system V/s Database system, Users of Database system, Concerns when using an enterprise database, Data Independence, DBMS system architecture, Database Administrator **Entity–Relationship Data Model:** Introduction, Benefits of Data Modeling, Types of Models, Phases of Database Modeling, The Entity-Relationship (ER) Model, Generalization, Specialization and Aggregation, Extended Entity Relationship (EER) Model.	6	CO1
2	**Relational Model and Algebra:** Introduction, Mapping the ER and EER Model to the Relational Model, Data Manipulation, Data Integrity, Advantages of the Relational Model, Relational Algebra, Relational Algebra Queries, Relational Calculus.	6	CO2
3	**Structured Query Language (SQL):** Overview of SQL, Data Definition Commands, Set operations, aggregate function, null values, Data Manipulation commands, Data Control commands, Views in SQL, Nested and complex queries.	6	CO3
4	**Integrity and Security in Database:** Domain Constraints, Referential integrity, Assertions, Trigger, Security, and authorization in SQL **Relational–Database Design:** Design guidelines for relational scheme, Function dependencies, Normal Forms- 1NF, 2 NF, 3NF, BCNF and 4NF	8	CO4
5	**Transactions Management and Concurrency:** Transaction concept, Transaction states, ACID properties, Implementation of atomicity and durability, Concurrent Executions, Serializability, Recoverability, Implementation of isolation, Concurrency Control: Lock-based, Timestamp-based, Validation-based protocols, Deadlock handling, Recovery System: Failure Classification, Storage structure, Recovery & atomicity, Log based recovery, Shadow paging.	8	CO5
6	**Query Processing and Optimization:** Overview, Issues in Query Optimization, Steps in Query Processing, System Catalog or Metadata, Query Parsing, Query Optimization, Access Paths, Query Code Generation, Query Execution, Algorithms for Computing Selection and Projection, Algorithms for Computing a Join, Computing Aggregation Functions, Cost Based Query Optimization.	5	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. G. K. Gupta, Database Management Systems, McGraw – Hill.
2. Korth, Slberchatz,Sudarshan, Database System Concepts, 6th Edition, McGraw – Hill
3. Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, PEARSON Education.
4. Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management, Thomson Learning, 5th Edition.

Reference Books:

1. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press
2. Mark L. Gillenson, Paulraj Ponniah, Introduction to Database Management,Wiley
3. Sharaman Shah, Oracle for Professional, SPD.
4. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems,TMH
5. DebabrataSahoo, Database Management Systems, Tata McGraw Hill, Schaum‟s Outline

Subject code	Subject Name	Teaching scheme			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				
		Test1	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 explain different biosensors and transducers used for physical measurands. 4. To explain the various types of chemical biosensors and transducers and their significance in chemical measurands. 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 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. Propagation of action potential, Electrode theory, electrode-tissue interface (metal-electrolyte interface), electrode-skin interface, electrode impedance.	05	CO1
2	**Introduction to biological sensors** Sensor architecture and Classification of biosensors: Medically significant measurands, functional specifications of medical sensors; Biosensor characteristics: linearity, repeatability, hysteresis, drift; Bio-sensor models in the time & frequency domains.	05	CO2
3	**Physical Biosensors and Transducers** Biosensors for physical measurands: strain, force, pressure, acceleration, flow, volume, temperature and bio-potentials. Various types of transducers; principles and applications- Resistive, Capacitive, Inductive, Photoelectric, piezoelectric, mechanical and molecular electronics based transducers in biosensors. Principle of fiber optic cable, fiber optic sensors, Photo acoustic sensors in biomedical field.	09	CO3
4	**Chemical Biosensors and Transducers** Bio-sensorsfor measurement of chemicals: Potentiometric sensors, ion selective electrodes, Amperometric sensors, Clark Electrode biosensors, Catalytic biosensors, Immuno-sensors. Chemiluminiscene- based biosensors, Liquid and solid ion exchange membrane electrode, Enzyme electrode.	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 healthcare, biosensors for veterinary, agriculture and food, Low cost-biosensor for industrial processes for on line monitoring; biosensors for environmental monitoring.	06	CO6

Internal Assessment:

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

Theory Examination:

1. Question paper will comprise of 6questions, each carrying 20 Marks.
2. Total 4questions 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, Tata McGraw-Hill, 1985.
3. R. S. Khandpur, Handbookof Biomedical Instrumentation, Tata McGraw Hill.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL601	Industrial Process Control Lab	-	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.					
ISL601	Industrial Process Control Lab	-	-	-	-	25	-	25	50

Subject Code	Subject Name	credits
ISL601	**Industrial Process Control-Lab Practice**	1
Course objectives	1. To impart the knowledge of different industrial unit operations. 2. To make them capable to design and develop instrumentation and control scheme for industrial processes. 3. To give them exposure to work in process industry. 4. To explain students about hazardous area and safety design system.	
Course Outcomes	The students will be able to 1. Explain working and control of heat transfer unit operations- heat exchanger and evaporator 2. Explain working and control of heat transfer unit operations- boiler and furnace 3. Explain working and control of heat and mass transfer unit operations- distillation and reactor 4. Explain working and control of heat and mass transfer unit operations- dryer and crystallizer 5. Describe the processes of batch and continuous process industries and instrumentation involved in them. 6. Classify hazardous areas in the industry.	

Syllabus: Same as that of Subject ISC601 Industrial Process Control.

List of Laboratory Experiments/Assignments:

Sr. No.	Detailed Content	CO Mapping
1	Demonstrate the operation and control scheme of Heat exchanger	**CO1**
2	Learn working of various Unit Operations (Boilers/furnace / Distillation column etc.) using online learning resources.	**CO2/CO3**
3	Demonstrate the reactor control system.	**CO3**
4	Demonstrate the operation & control scheme of dyer/crystallizer.	**CO4**
5	Prepare a report on any one industry.	**CO5**
6	Develop some charts on hazardous area classification.	**CO6**
7	Assignment/Exercise on heat transfer unit operations- heat exchanger,evaporator	**CO1**
8	Assignment/Exercise on heat transfer unit operations-boiler, furnace	**CO2**
9	Assignment/Exercise on heat and mass transfer unit operations-Distillation, reactor	**CO3**
10	Assignment/Exercise on heat and mass transfer unit operations-Crystallization, dryer	**CO4**
11	Assignment/Exercise on continuous or batch process industries	**CO5**
12	Assignment/Exercise on hazardous area classification	**CO6**

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

- Industry visit is advised to understand the unit operations, industrial processes and their control.

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

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 (Journal/program) : 10 marks
Assignment : 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
ISL602	Digital Signal Processing Lab	-	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.					
ISL602	Digital Signal Processing Lab	-	-	-		25	25	-	50

Subject Code	Subject Name	Credits
ISL602	Digital Signal Processing Lab	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.	
Course Outcomes	Students will be able to 1. Verify sampling theorem using simulation software. 2. Demonstrate convolution and correlation concepts using simulation software. 3. Analyse frequency response of LTI systems using DTFT. Perform Discrete Fourier Transform of signals. 4. Design and implement FIR and IIR filters using computer simulation software platform. 5. Design and implement IIR filters using computer simulation software platform. 6. Design and implement IIR filters using computer simulation software platform.	

Syllabus: Same as that of Subject ISC602 Digital Signal Processing

List of Experiments:

Sr. No.	Contents	CO
1.	Write a Program to generate the basic signals and verify sampling theorem.	CO1
2.	Write a Program to implement the basic operations on the given signals	CO1
3.	Write a Program to implement Linear Convolution of the two given sequences.	CO2
4.	Write a Program to obtain the auto-correlation and Cross-correlations of the given sequences.	CO2
5.	Write a Program to obtain the transfer function and plot is pole-zero plot	CO3
6.	Write a Program to find the DTFT of the given sequence and plot its magnitude and phase plot	CO3
7.	Write a Program to find the DFT of the given sequences. Plot its magnitude and phase plot. Also find its IDFT to obtain the original sequence.	CO4
8.	Write a Program to obtain the circular convolution of the two given sequences.	CO4
9.	Write a Program to obtain the linear convolution using circular convolution of two given sequences.	CO4
10.	Write a Program to obtain the DFT of the given sequences using DIT-FFT algorithm and plot its magnitude and phase spectrum.	CO4
11.	Write a Program to design low-pass and high-pass FIR filters using window functions.	CO5
12.	Write a Program to design a digital IIR low-pass filter using Butterworth/Chebyshev approximations.	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			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL603	Python Programming Lab	--	4#		--	2	-	2

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.					
ISL603	Python Programming Lab	--	--	--	--	25	25	-	50

out of 4 hours, 2 hours theory shall be taught to entire class and 2 hours practical in batches

Subject Code	Subject Name	Credits
ISL603	**Python Programming Lab**	2
Course Objectives	To know the basics of algorithmic problem solving 1. To read and write simple Python programs. 2. To develop Python programs with conditionals and loops. 3. To define Python functions and call them. 4. To use Python data structures - lists, tuples, dictionaries.	
Course Outcomes	Upon completion of the course, students will be able to 1. Read, write, execute by hand simple Python programs. 2. Represent compound data using Python lists, tuples, dictionaries. 3. To develop Python programs with conditionals and loops. 4. To learn simple Python programs for solving linear algebra operations. 5. Structure simple Python programs for visualizing the data. 6. To develop Python programs to solve different numerical methods.	

List of the Laboratory Experiments:

Module	Contents	CO mapping
1.	Write a program to demonstrate different number data types in Python.	CO1
2.	Write a program to perform different Arithmetic Operations on numbers in Python	CO2
3.	Write a program to create, concatenate and print a string and accessing sub-string from a given string.	CO2
4.	Write a program to create, append, and remove lists in python.	CO2
5.	Write a program to demonstrate working with tuples in python	CO2
6.	Write a program to demonstrate working with dictionaries in python.	CO3
7.	Write a python program to find largest of three numbers.	CO3
8.	Write a Python program to convert temperatures to and from Celsius,	CO4

	Fahrenheit.	
9.	Write a Python script that prints prime numbers less than 20.	CO5
10.	Write a python program to find factorial of a number using Recursion.	CO5
11.	Write a program that accepts the lengths of three sides of a triangle as inputs. The program output should indicate whether or not the triangle is a right triangle (Recall from the Pythagorean Theorem that in a right triangle, the square of one side equals the sum of the squares of the other two sides).	CO5
12.	Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first file should be input and written to the second file.	CO4
13.	Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.	CO4
14.	Write a program to generate different sinusoidal signal and plot it using Matplotlib.	CO5
15.	Using scipy's quad function, write a program that solves the following integral numerically:$I = \int_0^1 \cos(2\pi x)\, dx$.	CO6
16.	Write a function with name plotquad which takes the same arguments as the quad command (i.e. f, a and b) and which • (i) creates a plot of the integrand f(x) and • (ii) computes the integral numerically using the quad function. The return values should be as for the quad function.	CO6

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

Practical and Oral Examination:

Practical and Oral examination will be based on entire syllabus.

Term Work:
Term Work: Term work shall consist of minimum 10 programs from the list of suggested programs and one Mini-project of your choice or from the list given above.

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

Laboratory work (Performing Experiments): 20 Marks
Laboratory work (programs/ journal) : 10 Marks
Mini Project : 15 Marks
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
ISM601	Mini Project – 2B	--	4$	--	--	2	--	2

$ indicates workload of Learner (Not Faculty)

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.					
ISM601	Mini Project – 2B	--	--	--	--	25	--	25	50

Subject Code	Subject Name	Credits
ISM601	Mini Project – 2B	1.5
Course Objectives	**The course is aimed** 1. To acquaint with the process of identifying the needs and converting it into the problem. 2. To familiarize the process of solving the problem in a group. 3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems. 4. To inculcate the process of self-learning and research.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Identify problems based on societal /research needs. 2. Apply Knowledge and skill to solve societal problems in a group. 3. Develop interpersonal skills to work as member of a group or leader. 4. Draw the proper inferences from available results through theoretical/ experimental/simulations. 5. Analyse the impact of solutions in societal and environmental context for sustainable development. 6. Use standard norms of engineering practices 7. Excel in written and oral communication. 8. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning. 9. Demonstrate project management principles during project work.	

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.

- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

In this case in one semester students' group shall complete project in all aspects including,

- Identification of need/problem
- Proposed final solution
- Procurement of components/systems
- Building prototype and testing

Two reviews will be conducted for continuous assessment,

- First shall be for finalisation of problem and proposed solution
- Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.

- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

****