UNIVERSITY OF MUMBAI

Bachelor of Engineering

in

Instrmentation Engineering

Second Year with Effect from AY2020-21

(REV-2019'C' Scheme) from Academic Year2019–20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

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 12-13 weeks and remaining 2-3 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
Member, Academic Council, RRC in Engineering
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
Member, Academic Council, RRC in Engineering
University of Mumbai

From Chairman's Desk

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 Science & 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. Alice N. Cheeran
Chairman,
Board of Studies in Instrumentation Engineering,
Member - Academic Council
University of Mumbai

Program Structure for Second Year Instrumentation Engineering
(With Effect from 2020-2021)
Scheme for Semester- III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC301	Engineering Mathematics-III	3	--	1	3	--	1	4
ISC302	Transducers-I	4		--	4		--	4
ISC303	Analog Electronics	3	--	--	3	--	--	3
ISC304	Digital Electronics	3	--	--	3	--	--	3
ISC305	Electrical Networks and Measurements	4	--	--	4	--	--	4
ISL301	Transducers-I - Lab	--	2	--	--	1	--	1
ISL302	Analog Electronics - Lab	--	2	--	--	1	--	1
ISL303	Digital Electronics - Lab	--	2	--	--	1	--	1
ISL304	Object Oriented Programming Lab	--	3#	--	--	1.5	--	1.5
ISM301	Mini Project – 1 A	--	3$	--	--	1.5	--	1.5
Total		**17**	**12**	**1**	**17**	**06**	**1**	**24**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	PR & OR	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test2	Avg.					
ISC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
ISC302	Transducers-I	20	20	20	80	3	--	--	100
ISC303	Analog Electronics	20	20	20	80	3	--	--	100
ISC304	Digital Electronics	20	20	20	80	3	--	--	100
ISC305	Electrical Networks and Measurements	20	20	20	80	3	--	--	100
ISL301	Transducers-I - Lab	--	--	--	--	--	25	25	50
ISL302	Analog Electronics - Lab	--	--	--	--	--	25	25	50
ISL303	Digital Electronics - Lab	--	--	--	--	--	25	25	50
ISL304	Object Oriented Programming Lab	--	--	--	--	--	25	25	50
ISM301	Mini Project – 1 A	--	--	--	--	--	25	25	50
	Total	--	--	**100**	**400**	--	**150**	**125**	**775**

$ indicates work load of Learner (Not Faculty), for Mini Project
# Out of 3 hours, 1 hours theory shall be taught to entire class and 2 hours practical in batches

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC301	Engineering Mathematics-III	3	--	1	3	--	1	4

Subject code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC301	Engineering Mathematics-III	20	20	20	80	25	-	-	125

Subject Code	Subject Name	Credits
ISC301	Engineering Mathematics-III	4
Course Objectives	**The course is aimed** 1. To learn the Laplace Transform, Inverse Laplace Transform of various functions and its applications. 2. To understand the concept of Fourier Series its complex form and enhance the problem solving skill. 3. To understand the concept of complex variables, C-R equations, harmonic functions and its conjugate and mapping in complex plane. 4. To understand the basics of Linear Algebra. 5. To use concepts of vector calculus to analyze and model engineering problems.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Understand the concept of Laplace transform and its application to solve the real integrals in engineering problems. 2. Understand the concept of inverse Laplace transform of various functions and its applications in engineering problems. 3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems. 4. Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic function. 5. Use matrix algebra to solve the engineering problems. 6. Apply the concepts of vector calculus in real life problems.	

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and vector product of three and four vectors

Course Objectives:

Module	Detailed Contents	Hrs.
01	**Module: Laplace Transform** 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform. 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $sin(at), cos(at), sinh(at), cosh(at)$ and $t^n, n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. **Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	**6**
02	**Module: Inverse Laplace Transform** 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). **Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations.	6
03	**Module: Fourier Series:** 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. **Self-learning Topics:** Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	6
04	**Module: Complex Variables:** 4.1 Function *f*(z) of complex variable, limit, continuity and differentiability of *f*(z) Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function *f*(z)when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories **Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.	6

05	**Module: Linear Algebra: Matrix Theory** 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley- Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix **Self-learning Topics:** Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices**.**	6
06	**Module: Vector Differentiation and Integra**l 6.1 **Vector differentiation**: Basics of Gradient, Divergence and Curl (Without Proof). 6.2 **Properties of vector field:** Solenoidal and irrotational (conservative) vector fields. 6.3 **Vector integral:** Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. **Self-learning Topics:** Gauss' divergence Theorem and applications of Vector calculus.	6

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practical.
2. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
3. A group of 4 - 6 students should be assigned a self-learning topic. Students should prepare a presentation/ problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1. Attendance (Theory and Tutorial)	05 marks
2. Class Tutorials on entire syllabus	10 marks
3. Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.

2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:-

1. Advanced engineering mathematics, H.K. Das, S. Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC302	Transducers-I	4	--	--	4	--	--	4

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC302	Transducers-I	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC302	Transducers-I	4
Course Objectives	**The course is aimed** 1. To introduce the students for the purpose of explaining the measurement systems, errors of measurement. 2. To understand the definition and classification of sensors and transducers based of their principle of operation and their applications in the various industries. 3. To familiarize the student with the identification, classification, construction, working principle and application of various transducers used for displacement, level, temperature, speed and vibration measurement.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Explain the measurement systems, sources errors of measurement. 2. List and compare various standards used for selection of transducers/sensors. 3. Describe the working principles of various displacement sensors and transducers. 4. Interpret and apply different temperature transducers/sensors for industrial applications. 5. Formulate and Design the solutions for given applications using appropriate level sensors and transducer. 6. Apply the techniques of speed and vibration measurement in different industries.	

Prerequisite: Units and standards of measurement, concept of transducers (resistive, piezoelectric, pressure, optical and pyro sensors, etc.), Knowledge of basic measurement.

Details of Syllabus:

Module	Contents	Hrs.	CO Mapping
1.	**Instrumentation System** Units and standards of measurement, Introduction, block diagram, functional elements of measurement system, static and dynamic characteristics of transducer, Measurement and calibration systems- Requirement. sources of errors and their statistical analysis, standards and calibration.	**04**	**CO1**
2.	**Sensor and Transducer:** Definition, working principle, classification (active, passive, primary, secondary, mechanical, electrical, analog, digital), selection criteria, transducer specifications, test condition and operating conditions.	**04**	**CO2**
3.	**Displacement transducers:** **Resistive type transducers:** potentiometer (linear and logarithmic), piezo-resistive effect. **Inductive type transducers:** LVDT, RVDT (transfer function, linearity, sensitivity, source, frequency dependence, phase null, and signal conditioning). **Capacitive type transducers:** Linear and rotary (with change in distance between plates, change in dielectric constant and change in overlapping area) **Digital transducer:** translational and rotary encoders (absolute position and incremental position encoders). **Proximity sensors:** inductive, capacitive, optical, ultrasonic, hall-effect and magnetic. **Pneumatic transducer:** flapper- nozzle transducer**.** Comparative study for Displacement Transducers with applications, and materials for capacitive, resistive, inductive and ultrasonic transducers**.**	**12**	**CO3**
4.	**Temperature transducers:** Modes of heat transfer, laws of conduction, convection and radiation, Temperature scales, classification of Temperature Sensors, Overview of mechanical temperature Sensors (thermometer, thermostat). **Resistance temperature detector (RTD):** Principle, types, Configurations, construction and working of RTD, Material for RTD, Signal Measurement techniques for RTD, Comparative Response curves for RTD, 2 wire, 3wire and 4 wire RTD Element, Lead wire Compensation in RTD, self-heating effect, Specifications, advantages, disadvantages and applications of RTD and sums. **Thermistors**: Principle, types (NTC and PTC), characteristics, Construction and working of Thermistor, Materials, specifications of Thermistor, applications and sums. **Thermocouples:** Principle, thermoelectric effect, See beck effect, Peltier effect, laws of thermocouple, types of thermocouple with Characteristic	**14**	**CO4**

	curve, thermocouple table, Sensitivity, constructional Features of Thermocouples., Thermo couple specifications, electrical noise and noise reduction techniques, cold junction Compensation method, thermopile, thermocouple emf measurement method, Thermo well Material of construction and its specifications and sums. **Pyrometers:** Principle, Construction and working of Radiation and optical pyrometers and its Applications. Comparative study for Temperature Transducers.		
5.	**Level Transducers:** working principle, types, materials, design criterion: float, displacers, bubbler, and DP- cell, ultrasonic, capacitive, microwave, radar, radioactive type, laser type transducers, level gages, resistance, thermal, TDR/ PDS type (Time domain reflectometry/ Phase difference sensors), solid level detectors, fiber optic level detectors, Level switches. Comparative study for Level Transducers.	**08**	**CO5**
6.	**Speed and Vibration Measurement:** stroboscopes, toothed rotor, eddy current, electromagnetic transducers (moving coil, moving magnet), AC and DC tachometers: Hall Effect proximity pickup, photoelectric, photo-reflective, pulse counting method. Seismic, LVDT, piezoelectric.	**06**	**CO6**

Internal Assessment:

Internal Assessment consists of two tests out of which, one should be a 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. B.C Nakra, K.K. Chaudhary, Instrumentation, Measurement and Analysis, Tata McGraw-Hill Education, 01-Oct-2003 - Electronic instruments - 632 page.
2. Patranabis D, Sensors and Transducers, Prentice Hall India Learning Private Limited; 2 edition (2003) - 344 pages.
3. A. K. Sawhney, Puneet Sawhney,A course in Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai and Co. Rai, 1996 -
4. Rangan, Mani, Sharma.Instrumentation systems and Devices, 2nd Ed.,Tata McGraw Hill.
5. D.V.S. Murthi, “Instrumentation and Measurement Principles”, PHI, New Delhi, Second ed. 2003.

Reference Books:

1. Doeblin E.D., Measurement system, Tata McGraw Hill., 4th ed, 2003.

2. Bela G. Liptak, Instrument Engineers' Handbook, Fourth Edition, Volume One: Process Measurement and Analysis, June 27, 2003.
3. Neubert Hermann K. P., Instrument Transducer, 2nd ed., Oxford University Press, New Delhi, 2003.
4. Johnson Curtis D., Process Control Instrumentation Technology, 8th Ed., 2005
5. S.P. Sukhatme, Heat Transfer, 3rd edition, University Press.
6. B.E. Jones, Instrument Technology.
7. Chortle Keith R., Fundamentals of Test, Measurement Instrument Instrumentation, ISA Publication.
8. Alan S Morris, Measurement and Instrumentation Principles; 3rd Edition

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC303	Analog Electronics	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.					
ISC303	Analog Electronics	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC303	Analog Electronics	3
Course Objectives	**The course is aimed** 1. To familiarize the student with basic electronic devices and circuits. 2. To analyze the DC biasing circuits, low and high frequency AC analysis of various electronic devices. 3. To introduce the students with basic construction and operation of differential and multistage amplifier. 4. To design different types voltage regulators and discuss the power amplifiers. 5. To employ various devices for industrial and consumer electronics.	
Course Outcomes	**On successful completion of course learner/student will be able to:** **1.** Demonstrate the application of diodes and formulate the DC analysis of BJT. **2.** Formulate and attribute BJT biasing techniques and its frequency response. **3.** Apply the basic construction and characteristics of FET to analyze the DC and AC circuits. **4.** Utilize the basic construction and characteristics of MOSFET to formulate the DC and AC circuits. **5.** Describe the Differential and multistage amplifier and its stages in detail. **6.** Discuss the power amplifiers and design power supply using different IC	

Pre-requisite: Introduction of PN junction

Details of Syllabus:

Module	Contents	Hrs.	CO mapping
1.	**Bipolar Junction Transistor:** Introduction to Diodes and its applications as Clipper and Clamper, Bipolar Junction Transistor, Device structure and physical operation, characteristics, the BJT as an amplifier and a switch, DC Analysis of BJT Circuits, Biasing BJT Amplifier Circuits, Stability Analysis.	**08**	**CO1**
2.	**BJT AC Analysis:** Amplification in AC domain, BJT transistor modelling, The r_e Transistor model, Hybrid equivalent model for CE configuration, Derivation of parameters trans-conductance, input resistances, voltage gain and current gain. Single stage BJT amplifiers CE configuration (with and without feedback), Small Signal equivalent circuit, frequency response of a CE amplifier, low frequency response, high frequency response.	**08**	**CO2**
3.	**Field effect Transistors:** Introduction to JFET, Types, Construction, Operation, Static Characteristics, Pinch off voltage, FET Volt-Ampere characteristics, FET Configurations (CS/CD/CG) and their Comparison. Biasing of FET. FET as an amplifier and its analysis (CS) and its frequency response.	**06**	**CO3**
4.	**MOS Field effect Transistors:** Introduction to MOSFET as basic element in VLSI, Device structure and physical operation, current – voltage characteristics, the MOSFET as an amplifier and a switch, DC Analysis of MOSFET Circuits, Biasing MOSFET Amplifier Circuits, frequency response of a CS amplifier, low frequency response.	**06**	**CO4**
5.	**Differential and Multistage Amplifiers:** Preview, the Differential Amplifier, Basic BJT Differential Pair (SIBO, SIUO, DIBO, DIUO), Capacitive coupled and Direct coupled multistage amplifier. Differential Amplifier with Active Load, Gain Stage and Simple Output Stage, Diff-Amp Frequency Response.	**04**	**CO5**
6.	**Power Amplifier:** Definition and amplifier types, Series fed class A amplifier, Transformer coupled class A amplifier, Class B amplifier operation and circuits, Amplifier distortion, Push Pull Amplifier, **Power supply design** using 78xx series, 79xx series and adjustable voltage IC regulators like 723 and 317. Switched Mode Power Supply (SMPS) – Block diagram with advantages and disadvantages over conventional power supply.	**07**	**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. Robert L. Boylestad, Louis Nashelsky, *"Electronic Devices and Circuit Theory"*, PHI publishers, 2004
2. Thomas L. Floyd," Electronic Devices", Pearson 2015.
3. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar , "*Microelectronic Circuits,: Theory and Applications"*, OUP, 2013
4. D. A. Neamen, "Micro *Electronic Circuit Analysis and Design*", McGraw-Hill, New Delhi, 2010.

Reference Books:

1. J. Millman and C. C. Halkias*, "Integrated Electronics: Analog and Digital Circuits and Systems",* Tata McGraw-Hill Publishing Company, 1988.
2. D. A. Bell, "*Electronic Devices and Circuits*", OUP, India, 2010.
3. T. F. Boghart, J. S. Beasley and G. Rico, "*Electronic Devices and Circuits*", Pearson Education, 2004.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC304	Digital Electronics	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.					
ISC304	Digital Electronics	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC304	Digital Electronics	3
Course Objectives	**The course is aimed** 1. To provide an understanding of the principles of digital electronics and use of number systems. 2. To give knowledge about combinational circuits. 3. To describe working and design methods of sequential circuits. 4. To familiarize with the basics of asynchronous sequential circuits and design techniques. 5. To provide understanding of memory devices and state machines. 6. To make the students understand basic logic families and their applications.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Represent numerical values in various number systems and perform number conversions between different number systems. 2. Analyze and design, digital combinational circuits using logic gates with IEEE/ANSI standard symbols. 3. Formulate and design sequential logic circuits. 4. Formulate and design asynchronous sequential logic circuits. 5. Explain nomenclature and technology in memory devices. 6. Apply the concept of logic families and their application to design the digital system.	

Pre-requisite: Knowledge of number systems and Boolean logic.

Details of Syllabus:

Module	Contents	Hrs.	CO mapping
1.	**Binary number system:** Binary Arithmetic, Binary codes: Weighted, BCD, 8421, Gray code, Excess 3 code, ASCII, Error detecting code. **Reduction methods:** Boolean laws, De-Morgan's Theorem, Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS), Karnaugh map Minimization, Don't care conditions.	**06**	**CO1**
2.	**Design of combinational logic circuits:** Adders, Subtractors, Code conversion, Parity checker, Magnitude comparators, BCD adder, Multiplexer, Demultiplexer, Encoder and Decoder. Implementation of combinational logic circuits using Multiplexer and Demultiplexer. Hazards in logic circuits and its elimination.	**10**	**CO2**
3.	**Sequential logic circuits :** Flip flops- SR, D and Master slave JK, T, Realization of one flip flop using other flip flops, Asynchronous & Synchronous counters, Modulo n counter, shift registers.	**06**	**CO3**
4.	**Asynchronous sequential circuits:** Circuit Design – primitive state / flow table, Minimization of primitive state table, state assignment, Excitation table, Excitation map, cycles.	**05**	**CO4**
5.	**Logic families:** Basics of digital integrated circuits, basic operational characteristics and parameters. TTL, Schottky clamped TTL, tri-state gate ECL, IIL, MOS devices CMOS comparison of logic families. PMOS, NMOS and E2 CMOS, BiCMOS.	**06**	**CO5**
6.	**Memory and programmable logic devices:** PROM / EPROM / EEPROM / EAPROM Programmable Logic Devices – Programmable Logic Array (PLA), Programmable Array Logic (PAL), Introduction to Complex Programmable Logic Device (CPLD), Field Programmable Gate Arrays (FPGA).	**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 weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Text Books

1. M. Morris Mano, *"Digital Design",* Prentice Hall of India, 2003.
2. John .M Yarbrough, *"Digital Logic Applications and Design",* Thomson-Vikas publishing house, 2002.
3. Barry B. Brey, *"The Intel Microprocessors*", Pearson/Prentice Hall, 2006.
4. B. Ram, *"Fundamentals of Microprocessors and Microcontrollers",* Dhanpat Rai Publications, 2004.

References Books:

1. Charles H. Roth., *"Fundamentals of Logic Design",* Thomson Publication Company, 2003.
2. Donald P. Leach and Albert Paul Malvino*, "Digital Principles and Applications",* Tata McGraw Hill Publishing Company Limited, 2003.
3. R. P. Jain, *"Modern Digital Electronics",* Tata McGraw–Hill publishing company limited, 2003.
4. Thomas L. Floyd, *"Digital Fundamentals",* Pearson Education, 2003.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC305	Electrical Networks and Measurements	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.					
ISC305	Electrical Networks and Measurements	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC305	Electrical Networks and Measurements	4
Course Objectives	**The course is aimed** 1. To introduce the concept of circuit elements lumped circuits, circuit laws and reduction. 2. To introduce the concept of circuit elements and analyze DC and AC circuits using various theorems. 3. To analyze the transient response of series and parallel A.C. circuits. 4. To analyze two port model of circuit and evaluate its parameters. 5. To synthesize the circuits using different techniques. 6. To demonstrate basic analog and digital Instruments. 7. To identify the various techniques for measurement of R-L-C.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Analyze AC and DC circuits using different theorems. 2. Evaluate transient and steady-state the parameters of passive electrical networks. 3. Analyze network using poles and zeros and determine their parameters like Z, Y, and ABCD. 4. Synthesize the networks using canonical forms. 5. Demonstrate construction and working principle and applications of analog and digital instruments. 6. Formulate electrical bridges and evaluate electrical parameter like R, L, C.	

Prerequisite: Analysis of DC networks for independent sources, mesh, node analysis, network theorems, and fundamentals of RLC networks.

Detailed Syllabus

Module	Contents	Hrs.	CO mapping
1.	**Network Theorems** Analysis of networks with dependent sources: mesh analysis, nodal analysis, super mesh and super node concept, source transformation technique, superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem. Solution of networks with AC sources, Analysis of coupled circuits (self-inductance, mutual inductance, and dot convention).	**12**	**CO1**
2.	**Transient Analysis** Initial Conditions in Elements, Solution of a First order and Second order differential equations, Transients in R-L, R-C and RLC Circuits.	**06**	**CO2**
3.	**Network Functions and Two-Port parameters** Network functions for one port and two port networks, driving point and transfer functions, ladder network, poles and zeros of network functions, time domain behaviour from pole-zero plot. Two-Port parameters, Open circuit, Short circuit, transmission and hybrid parameters, relationship between parameter sets, reciprocity and symmetry conditions, parallel connection of two port networks.	**08**	**CO3**
4.	**Fundamentals of Network Synthesis.** Causality and stability, Hurwitz polynomials, positive real functions, synthesis of one port networks with two kinds of elements. Properties and synthesis of L-C, R-C, R-L driving point impedances, synthesis of R-L-C function.	**08**	**CO4**
5.	**Analog & Digital Meters** D'Arsonaval galvanometers, PMMC and PMMI instruments. Shunts and multipliers, Construction and working principle of: ammeters, voltmeters, ohmmeters, power factor meter, energy meter, Q meters, Analog multimeters. Electronic Voltmeters, Digital Voltmeter and digital multimeter. CRO, Measurement of phase and frequency.	**07**	**CO5**
6.	**Measurement of R, L, C** Measurement of medium, low and high resistance, Megger AC bridges, measurement of self and mutual inductances (Maxwell and Hay Bridges). Measurement of capacitance (Schering Bridge). Derivations and numerical related to all bridges.	**07**	**CO6**

Internal Assessment Test:

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. Kuo Franklin F., *"Network analysis and synthesis",* Wiley International, 1962.
2. Van Valkenburg M.E., *"Network analysis",* Eastern Economy Edition, 1983.
3. A. K. Sawhney, Puneet Sawhney, *"A course in Electrical and Electronic Measurement and Instrumentation",* Dhanpat Rai and Co. Rai, 1996.

Reference Books:

1. Hayt William, Kemmerly Jr.Jack E*., "Engineering circuit Analysis",* Tata McGraw Hill, 2002.
2. Edminister Joseph A., Nahvi Mohmood, *"Electric Circuits",* Tata McGraw Hill, 1999.
3. Shyammohan Sudhakar, *"Circuits and Networks Analysis and Synthesis",* Tata McGraw Hill, 2000.
4. Ravish Singh, " Electrical Networks Analysis and Synthesis", Mc-Graw Hill

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL301	Transducers-I - Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL301	Transducers-I - Lab	--	--	--	--	25	25	-	50

Subject Code	Subject Name	Credits
ISL301	Transducers-I –Lab	1
Course Objectives	**The course is aimed** 1. To make students understand the Identification, construction, working principle of various transducers used for Displacement measurement, Temperature measurement, Level measurement and miscellaneous measurement. 2. To experimentally verify the principle and characteristics of various transducers.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Demonstrate various measurement techniques and measuring instruments. 2. Demonstrate Flapper Nozzle system. 3. Plot and validate the performance characteristics of displacement transducers 4. Validate the characteristics of various temperature transducers. 5. Describe the construction and operation of various level transducers. 6. Demonstrate the performance characteristics of miscellaneous	

Syllabus: Same as that of Subject ISC302 Transducers-I

List of Experiments:

Sr. No	Contents	CO Mapping
1.	Demonstrate the basic measurements techniques and Measuring Instruments.	CO1
2.	Plot response curve for Flapper Nozzle system and validate the results with stand values.	CO2
3.	Plot and validate the LVDT characteristics.	CO3

4.	Test and evaluate distance using ultrasound transducer.	CO3
5.	Measure and verify the given displacement using Potentiometer.	CO3
6.	Plot and validate the characteristics of RTD	CO4
7.	Draw and validate the characteristics of various Thermocouples.	CO4
8.	Draw and validate the characteristics of Thermistors.	CO4
9.	Test and compare temperature measurement with and without Thermo-well.	CO4
10.	Perform and validate Liquid Level Measurement using DP Cell	CO5
11.	Plot and validate performance characteristics of capacitive level sensor.	CO5
12.	Perform and distinguish Liquid Level Measurement using Tubular Level Gauge and ultra-sonic sensor.	CO5
13.	Plot the static characteristics of different proximity sensors.	CO6
14.	Demonstrate the Humidity measurement.	CO6

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

Practical/Oral Examination:

Practical Examination will be based on performing one Experiment in the Laboratory from the List of Experiments given in the syllabus & the Oral Examination will be based on ISC 302 Transducer-I

Term Work:

1) Minimum of **Ten** experiments covering all cos can be conducted during the semester for term work and practical examination.
2) Assignments based on syllabus which will help students to understand the Topic can be given during the semester as a support to Evaluate Term work.

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

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (journal) : 10 Marks
Attendance (class Room plus Lab Practice) : 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
ISL302	Analog Electronics-Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL302	Analog Electronics-Lab	--	--	--	--	25	25	--	50

Subject Code	Subject Name	Credits
ISL302	Analog Electronics-Lab	1
Course Objectives	**The course is aimed** 1. To familiarize the student with basic electronic devices and circuits. 2. To modal and analyze applications of diodes, bipolar and MOSFET, DC biasing circuits, AC analysis and low and high Frequency response, 3. To experiment with differential and multistage amplifier. 4. To design different types of power supply.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. DC analysis of BJT. 2. Analyze BJT biasing techniques and frequency response. 3. Plot and evaluate parameters using FET characteristics. 4. Draw and evaluate parameters of MOSFET characteristics. 5. Implement and simulate Differential amplifier configuration 6. Design of power supply.	

Syllabus: Same as that of Subject ISC303 Analog Electronics.

List of Experiments:

Sr. No	Contents	CO mapping
1.	Design the Diode circuit as Clipper and Clamper.	CO1
2.	Verify the input -output characteristics of BJT in CE configuration.	CO1
3.	Implementation of a biasing circuit for BJT and estimate the parameters.	CO1
4.	Plot and validate the frequency response of BJT amplifier.	CO2
5.	Analyse the JFET circuit and validate its transfer characteristics.	CO3
6.	Plot and validate the frequency response of FET amplifier.	CO3
7.	Analyse the MOSFET circuit and validate its transfer characteristics.	CO4
8.	Plot the frequency response of MOSFET amplifier	CO4
9.	Simulate the multistage amplifier and analyse its frequency response with the help of simulation software.	CO5
10.	Simulate the differential amplifier and analyse its frequency response with the help of simulation software.	CO5
11.	Simulate the class A power amplifier and analyse with the help of simulation software.	CO6
12.	Design of fixed voltage regulator using adjustable regulator IC.	CO6

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

Practical/Oral Examination:
Practical Examination will be based on performing one Experiment in the Laboratory from the List of Experiments given in the syllabus & the Oral Examination will be based on **ISC303 Analog Electronics.**.

Term Work:

Term work shall consist of minimum 08 Experiments covering all COs and any 02 practical should be verified with simulation software**.**

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

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (journal) : 10 Marks
Attendance (class Room plus Lab Practice) : 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
ISL303	Digital Electronics- Lab	--	2	--	--	1	--	1

Subject Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISL303	Digital Electronics- Lab	--	--	--	--	25	25	--	50

Subject Code	Subject Name	Credits
ISL303	Digital Electronics- Lab	1
Course Objectives	**The course is aimed** 1. To provide an understanding of the principles of digital electronics and use of number systems. 2. To give knowledge about combinational circuits, 3. To describe working and design methods of sequential circuits. 4. To familiarize with the basics of asynchronous sequential circuits and design techniques. 5. To provide understanding of memory devices and state machines. 6. To make the students understand basic logic families and their applications.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Demonstrate numerical values in various number systems and perform number conversions between different number systems. 2. Exemplify operation of logic gates using IEEE/ANSI standard symbols. Analyze and design, digital combinational circuits. 3. Design and validate sequential logic circuits. 4. Design and verify asynchronous sequential logic circuits. 5. Demonstrate nomenclature and technology in memory devices. 6. Analyze logic families and their application to design the digital system.	

Syllabus: Same as that of Subject ISC304 Digital Electronics.

List of Experiments:

Sr. No	Detailed Contents	CO Mapping
1	Implement conversion of Gray/Binary code.	**CO1**
2	Truth table verification and implementation of all gates using Universal gates.	**CO2**
3	Implementation of half/ full adder/ Subtractor.	**CO2**
4	Implementation of magnitude comparator.	**CO3**
5	Realise full adder using 2:1 Multiplexer.	**CO3**
6	Realise full Subtractor using 2:1 Multiplexer.	**CO3**
7	Implementation of various flip-flops.	**CO4**
8	Design and implement RS flip flop into other flip flops.	**CO4**
9	Design and implement JK flip flop into other flip flops.	**CO4**
10	Design and implement modulo-n counter.	**CO5**
11	Design and implement ring counter.	**CO5**
12	Design and implement universal shift register.	**CO5**
13	Implement BCD to seven segments display.	**CO6**
14	Design finite state machine for a digital lock	**CO6**

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

Practical/Oral Examination:
Practical Examination will be based on performing one Experiment in the Laboratory from the list of Experiments given in the syllabus & the Oral Examination will be based on **ISC304 Digital Electronics.**.

Term Work:

Term work shall consist of minimum 08 Experiments covering all COs and any 02 practical should be verified with simulation software**.**

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

Laboratory work (Experiments/assignments) : 10 Marks
Laboratory work (journal) : 10 Marks
Attendance (class Room plus Lab Practice) : 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			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL304	Object Oriented Programming - Lab	-	3#	-	-	1.5	-	1.5

Subject Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. and Oral	Oral	Total
ISL304	Object Oriented Programming- Lab	-	-	-	-	25	25	-	50

out of 3 hours, 1 hours theory shall be taught to entire class and 2 hours practical in batches.

Subject Code	Subject Name	Credits
ISL304	Object Oriented Programming- Lab	1.5
Course Objectives	**The course is aimed** 1. To learn the object-oriented programming concepts 2. To study various java programming constructs like multithreading, exception handling, packages etc. 3. To explain components of GUI based programming	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Apply fundamental programming constructs. 2. Illustrate the concept of packages, classes and objects. 3. Elaborate the concept of strings arrays and vectors. 4. Implement the concept of inheritance and interfaces. 5. Implement the notion of exception handling and multithreading. 6. Develop GUI based application	

Prerequisite: Structured Programming Approach

Details of Syllabus:

Module	Contents	Hrs.	CO Mapping
1	**Introduction to Object Oriented Programming** **OO Concepts:** Object, Class, Encapsulation, Abstraction, Inheritance, Polymorphism. **Features of Java, JVM** **Basic Constructs/Notions:** Constants, variables and data types, Operators and Expressions, Revision of Branching and looping	**02**	**CO1**
2	**Classes, Object and Packages** Class, Object, Method. Constructor, Static members and methods Passing and returning Objects Method Overloading, Packages in Java, creating user defined packages, access specifiers.	**02**	**CO2**
3	**Array, String and Vector** Arrays, Strings, String Buffer, Wrapper classes, Vector	**02**	**CO3**
4	**Inheritance and Interface** Types of Inheritance, super keyword, Method Overriding, abstract class and abstract method, final keyword, Implementing interfaces, extending interfaces	**02**	**CO4**
5	**Exception Handling and Multithreading** Error vs Exception, try, catch, finally, throw, throws, creating own exception, Thread lifecycle, Thread class methods, creating threads, Synchronization	**02**	**CO5**
6	**GUI programming in JAVA** **Event Handling:** Event classes and event listener **Introduction to AWT:** Working with windows, Using AWT controls-push Buttons, Label, Text Fields, Text Area, Checkbox and Radio Buttons.	**02**	**CO6**

Text books:

1. Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press.
2. Sachin Malhotra and Saurabh Chaudhary, "Programming in Java", Oxford University Press, 2010

Reference Books:

1. Ivor Horton, 'Beginning JAVA', Wiley India.
2. Dietal and Dietal, 'Java: How to Program', 8/e, PHI
3. 'JAVA Programming', Black Book, Dreamtech Press.

List of Experiments/ Assignments:

Sr. No.	Detailed Contents	CO mapping
1.	Program on various ways to accept data through keyboard and unsigned right shift operator.	**CO1**
2.	Program on branching, looping, labelled break and labelled continue.	**CO1**
3.	Program to create class with members and methods, accept and display details for single object.	**CO2**
4.	Program on constructor and constructor overloading	**CO2**
5.	Program on method overloading	**CO2**
6.	Program on passing object as argument and returning object	**CO2**
7.	Program on creating user defined package	**CO2**
8.	Program on 1D array	**CO3**
9.	Program on 2D array	**CO3**
10.	Program on String	**CO3**
11.	Program on String Buffer	**CO3**
12.	Program on Vector	**CO3**
13.	Program on single and multilevel inheritance (Use super keyword)	**CO4**
14.	Program on abstract class	**CO4**
15.	Program on interface demonstrating concept of multiple inheritance	**CO4**
16.	Program on dynamic method dispatch using base class and interface reference.	**CO4**
17.	Program to demonstrate try, catch, throw, throws and finally.	**CO5**
18.	Program to demonstrate user defined exception	**CO5**
19.	Program on multithreading	**CO5**
20.	Program on concept of synchronization	**CO5**
21.	Program to create GUI application without event handling using AWT controls	**CO6**
22.	Program to create GUI application without event handling using AWT controls	**CO6**
23.	Program to create GUI application without event handling using AWT controls	**CO6**
24.	Program to create GUI application with event handling using AWT controls	**CO6**
25.	Mini Project based on content of the syllabus. (Group of 2-3 students)	**CO1-CO6**

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

Practical and Oral Examination:

Practical and Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum 20 programs from the list of suggested programs, two assignments covering whole syllabus and one Mini-project of your choice.

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

Laboratory work (Performing Experiments): 10 Marks

Laboratory work (programs/ journal) : 05 Marks

Mini Project : 05 Marks

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
ISM301	Mini Project – 1 A	--	3[$]	--	--	1.5	--	1.5

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.					
ISM301	Mini Project – 1 A	--	--	--	--	25	--	25	50

Subject Code	Subject Name	Credits
ISM301	Mini Project – 1 A	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 life long 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

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