

AC
Item No.

UNIVERSITY OF MUMBAI



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

FACULTY OF TECHNOLOGY

Instrumentation Engineering

Second Year with Effect from **AY 2017-18**

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

Final Year with Effect from **AY 2019-20**

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

From Co-coordinator's Desk:

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

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

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

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

Preamble:

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

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

Program Educational Objectives (PEOs)

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

Program Outcomes (POs)

- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

- **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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

**Program Structure for
SE Instrumentation Engineering
University of Mumbai
(With Effect from 2017-18)**

Scheme for Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ISC301	Applied Mathematics – III	4	-	1	4	--	1	5
ISC302	Analog Electronics	4	-	-	4	-	-	4
ISC303	Transducers – I	4	-	-	4	-	-	4
ISC304	Digital Electronics	4	-	-	4	-	-	4
ISC305	Electrical Networks and Measurement	4	-	1	4	-	1	5
ISL301	Object Oriented Programming and Methodology	-	4#	-	-	2	-	2
ISL302	Analog Electronics Lab practice	-	2	-	-	1	-	1
ISL303	Transducer-I Lab Practice	-	2	-	-	1	-	1
ISL304	Digital Electronics Lab practice	-	2	-	-	1	-	1
Total		20	10	02	20	05	02	27

Out of four hours, 2 hours theory shall be taught to entire class and 2 hours practical in batches

Examination Scheme for Semester III

Course Code	Course Name	Examination Scheme					Total Marks
		Theory		Term Work	Oral	Pract. & Oral	
		End Sem Exam (ESE)	Internal Assessment (IA)				
		Max Marks	Max Marks	Max Marks	Max Marks	Max Marks	
ISC301	Applied Mathematics-III	80	20	25	-	-	125
ISC302	Analog Electronics	80	20	-	-	-	100
ISC303	Transducer –I	80	20	-	-	-	100
ISC304	Digital Electronics	80	20	-	-	-	100
ISC305	Electrical Networks and Measurement	80	20	25	-	-	125
ISL301	Object Oriented Programming and Methodology	-	-	50	-	25	75
ISL302	Analog Electronics Lab Practice	-	-	25	-	25	50
ISL303	Transducer-I Lab Practice	-	-	25	-	25	50
ISL304	Digital Electronics Lab Practice	-	-	25	-	-	25
Total		400	100	175	-	75	750

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

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

Course Code	Course Name	Teaching Scheme (Contact HOURS)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut	Total
ISC301	Applied Mathematics - III	4	-	1	4	-	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.					
ISC301	Applied Mathematics - III	20	20	20	80	25	-	-	125

Subject Code	Subject Name	credits
ISC301	Applied Mathematics - III	5
Course objectives	<ol style="list-style-type: none"> 1. To build the strong foundation in Mathematics of students needed for the field of Instrumentation Engineering. 2. To provide students with mathematics fundamentals necessary to formulate, solve and analyses complex engineering problems. 3. To prepare student to apply reasoning informed by the contextual knowledge to engineering practice. 4. To provide opportunity for students to work as part of teams on multi-disciplinary projects 	
Course Outcomes	<p>The students will be able to –</p> <ol style="list-style-type: none"> 1. Demonstrate basic knowledge of Laplace Transform. 2. Obtain the time response of systems using inverse Laplace transform. 3. Find the Fourier series, Complex form of Fourier series, Fourier Integral and Fourier transform of the functions. 4. Study the differential vector algebra and its properties. 5. Study vector line integral and theorems in plane and surface. 6. Check for analytical functions and find the analytical function and study the mapping. 	

Details of Syllabus:

Prerequisite: Knowledge of Matrix algebra, Differentiation, Integration, Probability, and Series expansion.

Module	Contents	Hrs.	CO mapping
1	<p>Laplace Transform Laplace Transform (LT) of Standard Functions: Definition of Laplace transform, Condition of Existence of Laplace transform, Laplace transform of e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$, t^n, 1 (No Proof of formulas), Heaviside unit step function, Dirac-delta function (No Proof of formula), Laplace transform of Periodic function (Proof of formula) Properties of Laplace Transform: Linearity, first shifting theorem, second shifting theorem multiplication by t^n, Division by t, Laplace Transform of derivatives and integrals, change of scale, convolution theorem, Evaluation of integrals using Laplace transform. (No proof of any property)</p>	8	CO1
2	<p>Inverse Laplace Transform: Partial fraction method, Method of convolution, Laplace inverse by derivative Applications of Laplace Transform: Solution of ordinary differential equations, Solving RLC circuit differential equation using Laplace transform of first order and second order only (not framing of differential equation)</p>	5	CO2
3	<p>Fourier Series Introduction: orthogonal and orthonormal set of functions, Definition, Dirichlet's conditions, Euler's formulae Fourier Series of Functions: Exponential, trigonometric functions of any period $=2L$, even and odd functions, half range sine and cosine series Complex form of Fourier series, Fourier integral representation, Fourier Transform and Inverse Fourier transform of constant and Exponential function, Fourier sine and cosine transform of Exponential, sine and cosine function</p>	12	CO3
4	<p>Vector Algebra Scalar and Vector Product: Scalar and vector product of three and four vectors and their properties (Only introduction, No question to be asked) Vector Differentiation: Gradient of scalar point function, divergence and curl of vector point function Properties: Solenoidal and irrotational vector fields, conservative vector field</p>	7	CO4
5	<p>Vector Integral: Line integral Green's theorem in a plane (Verification question can be asked), Gauss' divergence theorem and Stokes' theorem (No question on Verification to be asked)</p>	6	CO5

6	<p>Complex Variable</p> <p>Analytic Function: Necessary and sufficient conditions (No Proof), Cauchy Reiman equation Cartesian form (No Proof) Cauchy Reiman Equation in polar form (with Proof), Milne Thomson Method and its application, Harmonic function, orthogonal trajectories</p> <p>Mapping: Conformal mapping, bilinear transformations, cross ratio, fixed points, bilinear transformation of straight lines and circles</p>	10	CO6
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Text books:

1. H.K. Das, “Advanced engineering mathematics”, S . chand , 2008
2. A. Datta, “*Mathematical Methods in Science and Engineering*”, 2012
3. B.S. Grewal, “*Higher Engineering Mathematics*”, Khanna Publication

Reference Books:

1. B. S. Tyagi, “*Functions of a Complex Variable,*” Kedarnath Ram Nath Publication
2. B. V. Ramana, “*Higher Engineering Mathematics*”, Tata Mc-Graw Hill Publication
3. Wylie and Barret, “*Advanced Engineering Mathematics*”, Tata Mc-Graw Hill 6th Edition
4. Erwin Kreysizg, “*Advanced Engineering Mathematics*”, John Wiley & Sons, Inc
5. Murry R. Spieget, “*Vector Analysis*”, Schaum’s outline series, Mc-Graw Hill Publication

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC302	Analog Electronics	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.							
ISC302	Analog Electronics	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC302	Analog Electronics	4
Course Objectives	<ol style="list-style-type: none"> To familiarize the student with basic electronic devices and circuits. To provide understanding of operation of diodes, bipolar and MOS transistors, DC biasing circuits, Transistors as switching device, Power circuits and systems. To introduce the students the basic properties of OpAmp, analysis and design of electronic circuits using OpAmp 	
Course Outcomes	<p>Students will be able to</p> <ol style="list-style-type: none"> Explain working of Diode and Zener diode and its applications Analyze, simulate, and design amplifiers using BJT biasing techniques, frequency response. Analyze circuits using MOSFET. Explain power amplifiers and power supply. Explain op-amp parameters Design various circuits using operational amplifiers. 	

Details of Syllabus:

Prerequisite: Knowledge of semiconductor theory.

Module	Contents	Hrs.	CO mapping
1	P-N Junctions diode PN Junction diode small signal model, p-n junction under forward bias and reverse bias conditions, Rectifier Circuits, Clipping and Clamping circuits, Zener diode and its applications.	4	CO1
2	Bipolar Junction Transistors (BJTs) Physical structure and operation modes, Active region operation of transistor, D.C. analysis of transistor circuits Biassing the BJT: Different type of biasing circuit and their analysis. Bias stability, Thermistor compensation, thermal runaway. Basic BJT amplifier configuration, Transistor as a switch. High frequency model of BJT amplifier. Effect of positive and negative feedback, advantages of negative feedback, Feedback Connection Type.	11	CO2
3	Field Effect Transistor (FET)	11	CO3

	Junction FET, its working and VI characteristic. Enhancement-type MOSFET: structure and physical operation, current voltage characteristics. Depletion-type MOSFET. JFET and MOSFET as an amplifier. Biasing in JFET and MOSFET amplifiers. Basic JFET and MOSFET amplifier configuration: common source, common gate and common drain types. High frequency model of FET, Low and High frequency response of common source amplifier.		
4	Power Amplifiers Class A large signal amplifiers, Harmonic distortion, Transformer coupled audio power amplifier, Class B amplifier, Class AB operation, Power BJTs, Regulated power supplies, Series voltage regulator.	6	CO4
5	Operation Amplifier (Op-amps) Ideal Op-amp. Op-amp characteristics, Op-amp feedback analysis.	4	CO5
6	Applications of Op-amp. Practical op-amp circuits: inverting amplifier, non-inverting amplifier, weighted Summation circuit, summation, subtractor, integrator, differentiator. Large signal operation of op-amps. Instrumentation amplifier. Active filters, Op-amp as V to I and I to V converter, logarithmic amplifiers, waveform generators, Schmitt triggers, comparators. Oscillators: Introduction, Condition for Oscillation, RC phase shift, Weinbridge, Hartley, Colpitts and Crystal controlled oscillator.	12	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. J. Millman and C. C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, Tata McGraw-Hill Publishing Company, 1988.
2. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw-Hill.

Reference Books:

1. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, Eighth edition, PHI publishers, 2004.
2. J. Millman and Taub, Pulse and Digital Circuits, Tata McGraw Hill.
3. Ramakant A. Gaikwad, Op-amp and Integrated circuits, Fourth edition, PHI Publication, 2002.
4. Sergio Franco, Design with Op-amp and Analog Integrated circuits, Tata McGraw Hill Edition, New Delhi.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC303	Transducers –I	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.						
ISC303	Transducers-I	20	20	20	80	-	-	-	100	

Subject Code	Subject Name	Credits
ISC303	Transducers-I	4
Course objectives	<ol style="list-style-type: none"> To explain the measurement systems, errors of measurement. To provide an understanding of the operation of sensors and transducers. To familiarize the student with the Identification, classification, construction, working principle and application of various transducers used for Displacement, level, temperature measurement. 	
Course Outcomes	<p>The students will be able to</p> <ol style="list-style-type: none"> Explain the measurement systems, errors of measurement Explain the working principles of sensors and transducers. Discuss the working principle of displacement transducers and their applications. Discuss the working principle of transducers used for Temperature measurement, comparative study of various transducers. Explain the working principle of transducers used for level measurement, comparative study of various transducers and their applications. Identify various transducers in the industry and understand working of miscellaneous sensors. 	

Details of Syllabus:

Prerequisite: Knowledge of basic measurement.

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. Error: definition, classification, statistical analysis of errors, Error correction methods.	4	CO1
2	Sensor and Transducer: Definition, working principle,	4	CO2

	classification (active, passive, primary, secondary, mechanical, electrical, analog, digital), selection criteria, sources of error for parameter under measurement, transducer specifications, test condition and operating conditions.		
3	<p>Displacement Resistance potentiometer: (linear and logarithmic), piezo-resistive effect, ultrasonic transducer. LVDT, RVDT (transfer function, linearity, sensitivity, source, frequency dependence, phase null, and signal conditioning). Selection and properties of materials for LVDT, and general electromagnetic sensors.</p> <p>Capacitance type transducers: with applications, materials for capacitive, ultrasonic and elastic transducers.</p> <p>Digital transducer: translational and rotary encoders (absolute position and incremental position encoders), Optical and magnetic pickups.</p> <p>Pneumatic transducer: flapper- nozzle transducer.</p> <p>Comparative study for Displacement Transducers.</p>	10	CO3
4	<p>Temperature transducers: Modes of heat transfer, laws of conduction, convection and radiation, Temperature scales, classification of Temperature Sensors, Overview of Temperature Sensor Material.</p> <p>Thermometers: Classification of Thermometers, Construction and working of glass thermometers, liquid expansion thermometer, gas thermometer (filled system thermometer), bimetallic thermometer, solid state temperature sensor, Specifications of Thermometers.</p> <p>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, 3 wire and 4 wire RTD Element, Lead wire Compensation in RTD, self-heating effect, Specifications, advantages, disadvantages and applications of RTD.</p> <p>Thermistors: Principle, types (NTC and PTC), characteristics, Construction and working of Thermistor, Materials, specifications of Thermistor, applications.</p> <p>Thermocouples: Principle, thermoelectric effect, Seebeck effect, Peltier effect, laws of thermocouple, types of thermocouple with characteristic 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.</p> <p>Pyrometers: Principle, Construction and working of Radiation and optical pyrometers and its Applications.</p> <p>Comparative study for Temperature Transducers</p>	12	CO4
5	<p>Level Transducers Need for Level Measurement, Classification of Level Measurement Techniques. Construction and working of Dipstick, displacer, float system, bubbler, capacitive devices for level measurement, ultrasonic level gauge, DP cell, load cell, vibrating type, microwave, radar, radioactive type level gauges, LASER type transducers, fiber optic level sensors, solid level detectors,</p>	9	CO5

	Intelligent level measuring instruments. Comparative study for Level Transducers		
6	Miscellaneous Transducers Transducers for Position, speed, acceleration, vibration, sound, humidity, and moisture measurement, Hall effect Transducer, Optical sensors (LDR, Photo-diode, photo-transistor) leak detector, flame detector, smoke detector and Proximity sensors.	9	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. A. K. Sawhney, Puneet Sawhney, A course in Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai and Co. Rai, 1996 -
3. Rangan, Mani, Sharma. Instrumentation systems and Devices, 2nd Ed., Tata McGraw Hill.

Reference Books:

1. Doebelin 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
9. D. V. S. Murty, 'Transducers and Instrumentation', PHI, New Delhi, 2003

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

Subject Code	Subject Name	Credits
ISC304	Digital Electronics	4
Course objectives	<ol style="list-style-type: none"> To provide an understanding of the principles of digital electronics and use of number systems To give knowledge about combinational circuits, To describe working and design methods of sequential circuits. To familiarize with the basics of asynchronous sequential circuits and design techniques. To provide understanding of memory devices and state machines. To make the students understand basic logic families and their applications. 	
Course Outcomes	Students will be able to- <ol style="list-style-type: none"> Represent numerical values in various number systems and perform number conversions between different number systems. Explain operation of logic gates using IEEE/ANSI standard symbols. Analyze and design, digital combinational circuits. Analyze and design, sequential logic circuits. Analyze and design, asynchronous sequential logic circuits. Explain nomenclature and technology in memory devices. Analyze logic families and their application to design the digital system. 	

Details of Syllabus:

Prerequisite: Knowledge of number systems and boolean logic

Module	Topic	Hrs.	CO Mapping
1.	NUMBER SYSTEMS: Binary, Octal, Decimal, Hexadecimal-Number base conversions, complements, signed Binary numbers. Binary Arithmetic- Binary codes: Weighted, BCD, 8421, Gray code, Excess 3 code, ASCII, Error detecting code, code conversion from one code to another Boolean laws, De-Morgan's Theorem, Principle of Duality, Boolean expression, Boolean function, Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS), Minterm, Maxterm, Karnaugh map Minimization, Don't care conditions.	08	CO1

2.	COMBINATIONAL CIRCUITS: LOGIC GATES: AND, OR, NOT, NAND, NOR, Exclusive, OR and Exclusive NOR, Implementations of Logic Functions using gates, NAND, NOR implementations, Multi level gate implementations, Multi output gate implementations. Design of combinational circuits, Adders-Subtractors – Serial adder/ Subtractor - Parallel adder/ Subtractor, look ahead carry generator, BCD adder, Magnitude Comparator, Multiplexer/ Demultiplexer, encoder / decoder, parity checker, code converters. Implementation of combinational logic using MUX, DEMUX.	12	CO2
3.	SEQUENTIAL LOGIC CIRCUITS Flip flops- SR, D and Master slave JK, T, Characteristic table and equation, Edge triggering, Level Triggering, Realization of one flip flop using other flip flops, Asynchronous / Ripple counters, Synchronous counters, Modulo n counter, shift registers, Universal shift register and its applications, Serial to parallel and parallel to serial converter.	12	CO3
4.	ASYNCHRONOUS SEQUENTIAL CIRCUITS Design of fundamental mode and pulse mode circuits – primitive state / flow table, Minimization of primitive state table, state assignment, Excitation table, Excitation map, cycles, Races, Hazards: Static –Dynamic, Hazards elimination.	04	CO4
5.	MEMORY AND PROGRAMMABLE LOGIC DEVICES Classification of memories, RAM organization, Read/Write operation, Memory cycle, Timing waveforms, Memory decoding, memory expansion, Static RAM Cell, Bipolar RAM cell, MOSFET RAM cell, Dynamic RAM cell, ROM organization, 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). Introduction to state machine.	08	CO5
6.	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	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.

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, 3.ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2003/Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003
2. John .M Yarbrough, Digital Logic Applications and Design, Thomson- Vikas publishing house, New Delhi, 2002.

REFERENCES

1. S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 2nd ed., Vikas Publishing House Pvt. Ltd, New Delhi, 2004
2. Charles H. Roth. “Fundamentals of Logic Design”, Thomson Publication Company, 2003.
3. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 5 ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
4. R.P.Jain, Modern Digital Electronics, 3 ed., Tata McGraw–Hill publishing company limited, New Delhi, 2003.
5. Thomas L. Floyd, Digital Fundamentals, Pearson Education, Inc, New Delhi, 2003
6. Donald D. Givone, Digital Principles and Design, Tata Mc-Graw-Hill Publishing company limited, New Delhi, 2003.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC305	Electrical Networks and Measurement	4	-	1	4	-	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.					
ISC305	Electrical Networks and Measurement	20	20	20	80	25	-	-	125

Subject Code	Subject Name	Credits
ISC305	Electrical Networks and Measurement	5
Course objectives	<ol style="list-style-type: none"> To introduce the concept of circuit elements lumped circuits, circuit laws and reduction. To study the concept of coupled circuits. To study the transient response of series and parallel A.C. circuits. To study two port model of circuit and circuit elements. To introduce the concept of network synthesis. To study basic analog instruments as well as digital instruments To study the measurement of R-L-C 	
Course Outcomes	<p>Students will be able to -</p> <ol style="list-style-type: none"> Analyze AC and DC circuits using different theorems. Analyze transient and steady-state response of passive electrical networks. Analyze network using poles and zeros and find their parameters like Z, Y, and ABCD. Synthesize the networks using canonical forms. Discuss construction and working principle and applications of analog and digital instruments Measure electrical parameter like R, L, C using electrical bridges. 	

Details of Syllabus:

Prerequisite: Knowledge of DC and AC circuit analysis, Three-phase circuit and transformer.

Module	Contents	Hrs	CO Mapping
1	<p>Networks Theorems</p> <p>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.</p> <p>Solution of networks with AC sources, Analysis of coupled circuits (self-inductance, mutual inductance, and dot convention)</p>	12	CO1

2	<p>Time and Frequency response of circuits</p> <p>Voltage/current relations for R, L, C and their equations in time domain. Initial and final conditions, first and second order differential equations, steady state and transient response. Analysis of transient and steady state responses using Classical technique</p>	06	CO2
3	<p>Network Functions: poles and zeros</p> <p>Network functions for one port and two port networks, driving point and transfer functions, ladder network, general network, poles and zeros of network functions, restrictions on Pole and zero locations for driving point functions and Transfer functions, time domain behavior from pole-zero plot.</p> <p>Two-Port parameters</p> <p>Open circuit, Short circuit, transmission and hybrid parameters, relationship between parameter sets, reciprocity and symmetry conditions, parallel connections, parallel connection of two port networks.</p>	08	CO3
4	<p>Fundamentals of Network Synthesis.</p> <p>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 functions.</p>	08	CO4
5	<p>Analog & Digital Meters</p> <p>D'Arsonval 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, DSO</p>	08	CO5
6	<p>Measurement of R, L, C</p> <p>Measurement of medium, low and high resistance, Megger. AC bridges, measurement of self and mutual inductances. Measurement of capacitance. Derivations and numerical related to all bridges.</p>	06	CO6

Sr. No.	Tutorials	CO Mapping
1	Examples indicating concept of super mesh and super node.	CO1
2	Examples of indicating the application of Thevenin's and Norton's theorem for circuits with dependent sources.	CO1

3	Examples on evaluating the transient and steady-state conditions for a R-L-C series or parallel connections for different values of resistance.	CO2
4	Examples on evaluating the transient and steady-state conditions for a R-L, R-C circuits for DC conditions.	CO2
5	Examples for finding different parameters of two port networks	CO3
6	Examples on Hurwitz Polynomial. Necessary and sufficient condition for Positive real function.	CO4
7	Examples on realization of R-L, R-C, L-C functions.	CO4
8	Examples on synthesis of R-L-C function.	CO4
9	Testing /measurement of R-L-C using analog/digital multimeter	CO5
10	Applications of CRO (Measurements of phase and frequency).	CO5
511	Study of DVM.	CO5
12	Measurement of medium value resistance using bridge.	CO6
13	Measurement of Inductance using bridge.	CO6
14	Measurement of Capacitance using A.C. Bridges.	CO6

Term Work:

Term work shall consist of minimum three simulations and four tutorials from the above list.

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

Laboratory work (Tutorials) : 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.

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. Kuo Franklin F., Network analysis and synthesis, 1st ed., Wiley International, 1962.
2. Van Valkenburg M.E., Network analysis, 3rd ed., 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. Roy Chaudhary D., Network and systems, Wiley Eastern Limited, 1991.
2. Hayt William, Kemmerly Jr. Jack E., Engineering circuit Analysis, 6th ed., Tata McGraw Hill, New Delhi 2002.
3. Edminister Joseph A., Nahvi Mohmood, Electric Circuits, 3rd ed., Tata McGraw Hill New Delhi 1999.
4. Shyammohan Sudhakar, Circuits and Networks Analysis and Synthesis, 13th reprint, Tata McGraw Hill, 2000
5. Bruce Carsion A., Circuits, Brooks/Cole Thomson Learning, 2000.
6. Dav Artice M., Linear Circuits Analysis, PWS Publishing Company, 1998.
7. Alexander Charlesk, Mathew N.O., Sadlku, Fundamentals of Electric Circuits, McGraw Hill, 2000.
8. Cooper W.D., Helfrick A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall of India Limited, New Delhi.
9. Rathore-Narosa T. S., Digital Measurement Techniques.
10. Oliver and Cage, Modern Electronic Measurements and Instrumentation, MGH.
11. Bouwens A. J., Digital Instrumentation, MGH.
12. Technical Manuals of DSO: APLAB, Scientific, HP etc.
13. Technical Manuals for Virtual CRO.

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. and Oral	Oral	Total
ISL301	Object Oriented Programming and Methodology	-	-	-	-	50	-	25	75

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL301	Object Oriented Programming and Methodology	-	4#	-	-	2	-	2

out of four hours two hours theory shall be taught to entire class and two hours practical in batches

Subject Code	Subject Name	Credits
ISL301	Object Oriented Programming and Methodology	2
Course Objectives	<ol style="list-style-type: none"> To learn the object-oriented programming concepts To study various java programming constructs like multithreading, exception handling, packages etc. To explain components of GUI based programming 	
Course Outcomes	<p>The students will be able to:</p> <ol style="list-style-type: none"> Apply fundamental programming constructs. Illustrate the concept of packages, classes and objects. Elaborate the concept of strings arrays and vectors. Implement the concept of inheritance and interfaces. Implement the notion of exception handling and multithreading. Develop GUI based application 	

Details of Syllabus:

Prerequisite: Structured Programming Approach

Module	Contents	Hrs	CO Mapping
1	<p>Introduction to Object Oriented Programming</p> <p>OO Concepts: Object, Class, Encapsulation, Abstraction, Inheritance, Polymorphism.</p> <p>Features of Java, JVM</p> <p>Basic Constructs/Notions: Constants, variables and data types, Operators and Expressions, Revision of Branching and looping</p>	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.	05	CO2
3	Array, String and Vector Arrays, Strings, String Buffer, Wrapper classes, Vector	04	CO3
4	Inheritance and Interface Types of Inheritance, super keyword, Method Overriding, abstract class and abstract method, final keyword, Implementing interfaces, extending interfaces	03	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	04	CO5
6	GUI programming in JAVA Applet: Applet life cycle, Creating applets, Graphics class methods, Font and Color class, parameter passing. Event Handling: Event classes and event listener Introduction to AWT: Working with windows, Using AWT controls- push Buttons, Label, Text Fields, Text Area, Check Box and Radio Buttons.	06	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 Laboratory 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 on Applet to demonstrate Graphics, Font and Color class.	CO6
22.	Program on passing parameters to applets	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

Term Work:

Students will submit term work in the form of journal that will include:

1. At least 20 programs and mini project
2. Two assignments covering whole syllabus
3. Class test based on the above syllabus.

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

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

Total: 50 Marks (Total Marks) : 20 marks (Experiments),
10 marks (Mini Project),
05 marks (Assignments),
10 marks (Class Test),
05 marks (Attendance)

Practical and oral examination will be based on the suggested experiment list and the entire syllabus.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL302	Analog Electronics Lab Practice	-	02	-	-	1	-	1

Sub Code	Subject Name	Examination scheme								
		Internal Assessment				End sem exam	Term work	Pract. And oral	Oral	Total
		Test1	Test2	Avg.						
ISL302	Analog Electronics Lab Practice	-	-	-	-	25	25	-	50	

Subject Code	Subject Name	Credits
ISL302	Analog Electronics Lab Practice	1
Course objective	<ol style="list-style-type: none"> To familiarize the student with assembling circuits using basic electronic devices . To demonstrate operation of diodes, bipolar and MOS transistors, Demonstrate DC biasing circuits, Transistors as switching device, Power circuits and systems. To design and demonstrate Op-amp based circuits for linear and nonlinear applications 	
Course Outcome	Students will be able to <ol style="list-style-type: none"> Demonstrate operation of basic electronic devices such as Diode Demonstrate operation of basic electronic devices BJT, Assemble circuits using BJT AND find frequency response Demonstrate operation of MOSFET. Demonstrate linear applications of operational amplifier. Demonstrate non-linear applications of operational amplifier Design various circuits like regulator. 	

Syllabus: Same as that of Subject ISC302 Analog Electronics.

List of Laboratory Experiments:

Sr. No.	Detailed Content	CO Mapping
1	Clipping and clamping circuits using diode.	CO1
2	Plot input / output characteristics of BJT- CB, CE, and CC Configuration.	CO2
3	Design and analysis of biasing circuit and observing performance of BJT as a amplifier at various operating points.	CO2

4	BJT amplifier frequency response.	CO2
5	Demonstrate BJT as a switch and analysis of circuit	CO2
6	Study of input and transfer characteristics of FET.	CO3
7	FET amplifier frequency response.	CO3
8	Demonstrate use of Op-Amp as inverting and non-inverting amplifier	CO4
9	Clipper and Clamper circuits using Op-amp.	CO5
10	Precision rectifiers using Op-amp	CO5
11	Wein bridge oscillator using Op-amp	CO5
12	Demonstrate integrator and differentiator using Op-amp.	CO4
13	Adder and Subtractor using Op-amp	CO4
14	RC phase shift oscillator using Op-amp	CO5
15	Design and analysis of series regulator	CO6
16	Design and analysis of shunt regulator	CO6

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

Practical/Oral Examination:

Practical/Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum 10 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
ISL303	Transducer - I Lab Practice	-	02	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assesment			End sem exam	Term work	Pract. And oral	Oral	Total
		Test1	Test2	Avg.					
ISL303	Transducer - I Lab Practice	-	-	-	-	25	25	-	50

Subject Code	Subject Name	Credits
ISL303	Transducer –I Lab Practice	1
Course objective	<ol style="list-style-type: none"> To make students understand the Identification, construction, working principle of various transducers used for Displacement measurement, Temperature measurement, Level measurement and miscellaneous measurement. To experimentally verify the principle and characteristics of various transducers 	
Course Outcome	<p>The students will be able to</p> <ol style="list-style-type: none"> Explain measurement techniques and measuring instruments. Classify sensors, Transducers, and their brief Performance specifications. Examine characteristics of various temperature transducers. Examine characteristics of various level transducers To demonstrate the performance characteristics of displacement transducers. To demonstrate the performance characteristics of miscellaneous transducers. 	

Syllabus: Same as that of Subject ISC303 Transducers - I.

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO mapping
1.	Basic Measurements and Measuring Instruments.	CO1
2.	Temperature Measurement using various Thermometers.	CO2, CO3
3.	Plot characteristics of RTD	CO2, CO3
4.	Plot characteristics of various Thermocouples.	CO2, CO3
5.	Plot characteristics of Thermistors.	CO2, CO3
6.	Temperature Measurement with and without Thermo-well.	CO2, CO3
7.	Liquid Level Measurement using DP Cell.	CO2, CO4
8.	Liquid Level Measurement using Capacitance Type Level	CO2, CO4

	Sensor.	
9.	Liquid Level Measurement using Tubular Level Gauge and Ultrasonic Level Sensor.	CO2, CO4
10.	Displacement Transducer using LVDT.	CO2, CO5
11.	Plot Response curve for Flapper Nozzle system.	CO2, CO5
12.	Humidity measurement.	CO2, C06
13.	Application of Proximity sensor	CO2, C06
14	Application of optical sensors.	CO2, C06

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

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 (Practical) :	5 Marks

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

Practical/Oral Examination:

Practical/Oral examination will be based on entire syllabus.

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract	Tut.	Theory	Pract.	Tut.	Total
ISL304	Digital Electronics Lab Practice	-	2	-	-	1	-	1

Sub Code	Subject Name	Examination scheme							
		Internal Assessment			End Sem Exam	Term work	Pract. and Oral	Oral	Total
		Test1	Test2	Avg.					
ISL304	Digital Electronics Lab Practice	-	-	-		25	-	-	25

Subject Code	Subject Name	Credits
ISL304	Digital Electronics Lab Practice	1
Course objectives	<ol style="list-style-type: none"> To provide students basic experimental experiences in the operation of various gates, combinational circuit. To develop skills in the design of multiplexer, demultiplexer, counter, state machine design. 	
Course Outcomes	<p>Students will be able to –</p> <ol style="list-style-type: none"> Implement code converters. Verifying truth tables of all logic gates using NAND and NOR gates. Using gates for constructing half and full adder and subtractor and also realize with multiplexer. Understand the basics of types of flip-flops and design them to implement other flip-flops. Design and implement counters and shift registers. Learn how to convert BCD to seven segment and design finite state machine. 	

Syllabus: same as that of subject ISC304 Digital Electronics

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO mapping
1.	Implementation and conversion of gray/binary code.	CO1
2.	Implementation of all gates using NAND/NOR.	CO2
3.	Implementation of half/ full adder.	CO3
4.	Implementation of half/ full Subtractor	CO3
5.	Realise full adder using 2:1 Multiplexer	CO3

6.	Realise full Subtractor using 2:1 Multiplexer	C03
7.	Implementation of various flip-flops	C04
8.	Design and implement RS flip flop into other flip flops	C04
9.	Design and implement JK flip flop into other flip flops	C04
10.	Design and implement modulo-n counter	C05
11.	Design and implement ring counter	C05
12.	Design and implement universal shift register	C05
13.	Implement BCD to seven segments	C06
14.	Design finite state machine for a digital lock	C06

Note:

1. Any other experiments based on syllabus which will help students to understand topic/concept.
2. It is advised to implement one or two practicals with VHDL.

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.