UNIVERSITY OF MUMBAI

Bachelor of Engineering

Instrumentation Engineering (Second Year – Sem. III & IV),
Revised course

(REV- 2012) from Academic Year 2013 -14,

Under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

From Dean'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) and 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, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester 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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. 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 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

Dr. S. K. Ukarande
Dean,
Faculty of Technology,
Member - Management Council, Senate, 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 also 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 Chairman, Board of Studies in Electrical Engineering of University of Mumbai, happy to state here that, Program Educational Objectives (PEOs) were finalized for undergraduate program in Electrical Engineering, more than twenty senior faculty members from the different institutes affiliated to University of Mumbai were actively participated in this process. Few PEOs were finalized for undergraduate program in Electrical Engineering are listed below;

- To provide the overall strong technical foundation to formulate, solve and analyse engineering problems during undergraduate program.
- To prepare students to demonstrate an ability to identify, formulate and solve electrical based issues.
- To prepare students to demonstrate ability in the area of design, control, analyse and interpret the electrical and electronics systems.
- To prepare students for successful career in industry, research and development.
- To develop the ability among students for supervisory control and data acquisition for power system application.
- To provide opportunity for students to handle the multidisciplinary projects.
- To create the awareness of the life-long learning and to introduce them to professional ethics and codes of professional practice.

The affiliated institutes may include their own PEOs in addition to the above list to support the philosophy of outcome based education, in addition to stated PEOs, objectives and expected

outcomes are also included in the curriculum. I know, this is a small step taken to enhance and provide the quality education to the stake holders.

Dr. M. V. Bhatkar
Chairman,
Board of Studies in Electrical Engineering,
University of Mumbai

Semester III

Subject Code	Subject Name	Teaching Scheme (Hrs)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC301	Applied Mathematics-III *	4	-	1	4	-	1	5
ISC302	Electrical Network Analysis and Synthesis	4	2	-	4	1	-	5
ISC303	Analog Electronics	4	2	-	4	1	-	5
ISC304	Digital Electronics	4	2	-	4	1	-	5
ISC305	Transducers-I	4	2	-	4	1	-	5
ISC306	Object oriented programming and methodology *	-	4*	-	-	2	-	2
TOTAL		20	12	1	20	6	1	27

* Out of four hours, 2 hours theory shall be taught to entire class followed by 2 hrs. practical in batches.

Sub Code	Subject Name	Examination scheme							
		Theory Marks				Term work	Pract. and oral	Oral	Total
		Internal Assessment			End Sem exam				
		Test 1	Test 2	Avg.					
ISC301	Applied Mathematics-III *	20	20	20	80	25	-	-	125
ISC302	Electrical Network Analysis and Synthesis	20	20	20	80	25	-	-	125
ISC303	Analog Electronics	20	20	20	80	25	25	-	150
ISC304	Digital Electronics	20	20	20	80	25		-	125
ISC305	Transducers-I	20	20	20	80	25	25	-	150
ISC306	Object oriented programming and methodology *	-	-	-	-	25	50	-	75
TOTAL				100	400	150	100	-	750

*** Common for Electrical, Bio-medical Engineering, Instrumentation, Electronics and Electronics & Telecommunication branches.**

Sub code	Subject Name	Teaching Scheme (Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	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 (out of 20)			End sem Exam				
		Test 1	Test 2	Avg.					
ISC301	Applied Mathematics-III	20	20	20	80	25	-	-	125

Course pre-requisite:
FES 101: Applied Mathematics I
FES 201: Applied Mathematics II

Subject Code	Subject Name	Credits
ISC301	**Applied Mathematics-III**	**05**
Course Objectives	• To provide students with a sound foundation in Mathematics and prepare them for graduate studies in Instrumentation Engineering • To provide students with mathematics fundamental necessary to formulate, solve and analyze engineering problems. • To provide opportunity for students to work as part of teams on multi disciplinary projects.	
Course Outcomes	• Students will demonstrate basic knowledge of Laplace Transform. Fourier series, Bessel Functions, Vector Algebra and Complex Variable. • Students will demonstrate an ability to identify formulate and solve Instrumentation Engineering related problem using Applied Mathematics. • Students will show the understanding of impact of engineering mathematics on Instrumentation Engineering. • Students will be able to participate and succeed in competitive exams like GATE, GRE.	

Module No.	Unit No.	Topics	Hrs.
1. 0		**Laplace Transform**	**12**
	1.1	**Laplace Transform (LT) of Standard Functions:** Definition. unilateral and bilateral Laplace Transform, LT of *sin(at), cos(at),* e^{at}, t^n , *sinh(at), cosh(at), erf(t),* Heavi-side unit step, dirac-delta function, LT of periodic function	
	1.2	**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, initial and final value theorem, Parsavel's identity	
	1.3	**Inverse Laplace Transform:** Partial fraction method, long division method, residue method	
	1.4	**Applications of Laplace Transform:** Solution of ordinary differential equations	
2.0		**Fourier Series**	**10**
	2.1	**Introduction:** Definition, Dirichlet's conditions, Euler's formulae	
	2.2	**Fourier Series of Functions:** Exponential, trigonometric functions, even and odd functions, half range sine and cosine series	
	2.3	Complex form of Fourier series, orthogonal and orthonormal set of functions, Fourier integral representation	
3.0		**Bessel Functions**	**08**
	3.1	**Solution of Bessel Differential Equation:** Series method, recurrence relation, properties of Bessel function of order +1/2 and -1/2	
	3.2	Generating function, orthogonality property	

	3.3	Bessel Fourier series of functions	
4.0		**Vector Algebra**	**12**
	4.1	**Scalar and Vector Product**: Scalar and vector product of three and four vectors and their properties	
	4.2	**Vector Differentiation:** Gradient of scalar point function, divergence and curl of vector point function	
	4.3	**Properties:** Solenoidal and irrotational vector fields, conservative vector field	
	4.4	**Vector Integral:** Line integral, Green's theorem in a plane, Gauss' divergence theorem, Stokes' theorem	
5.0		**Complex Variable**	**10**
	5.1	**Analytic Function:** Necessary and sufficient conditions, Cauchy Reiman equation in polar form	
	5.2	Harmonic function, orthogonal trajectories	
	5.3	**Mapping:** Conformal mapping, bilinear transformations, cross ratio, fixed points, bilinear transformation of straight lines and circles	
		Total	**52**

Text books:

1. P. N. Wartikar and J. N. Wartikar, "A Text Book of Applied Mathematic", Vol. I & II, Vidyarthi Griha Prakashan
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

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the tests will be considered for final Internal Assessment.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. The students need to solve total 4 questions.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question (Q.2 to Q.6) will be selected from all the modules.

Term Work/ Tutorial:

At least 08 assignments covering entire syllabus must be given during the '**class wise tutorial'**. The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative.

Term work assessment must be based on the overall performance of the student with every assignment graded from time to time. The grades will be converted to marks as per '**credit and grading system'** manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Sub code	Subject Name	Teaching Scheme (Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC302	Electrical Network Analysis and Synthesis	4	-	1	4	-	1	5

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)							
		Internal Assessment (out of 20)			End sem Exam	Term Work	Pract. and oral	Oral	Total
		Test 1	Test 2	Avg.					
ISC302	Electrical Network Analysis and Synthesis	20	20	20	80	25	-	-	125

Subject Code	**Subject Name**	**Credits**
ISC302	**Electrical Network Analysis and Synthesis**	**5**
Course Objectives	• 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 the application of Laplace transforms to circuit analysis. • To study two port model of circuit and circuit elements. • To introduce the concept of network synthesis.	
Course Outcomes	• Analyze circuits with DC and AC sources. • Find Thevenin and Norton equivalents of circuits. • Analyze transient and steady-state responses response of passive electrical networks. • Analyze two port networks. • Analyze the structure and function of network synthesis.	

Module	Topics	Hrs.
1	**Networks Theorems** Analysis of networks with dependent sources, mesh analysis, nodal analysis, 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
2	**Graph Theory** Introductory definition – Graph of a network, trees, co-trees, loops. Incidence matrix, loop matrix and cutest matrix. Network equilibrium equations, Duality.	06
3	**Time and Frequency response of circuits** 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 as well as by Laplace transforms. Steady state response to step, ramp, impulse and sinusoidal input functions.	12
4	**Network Functions: poles and zeros** 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.	04
5	**Two-Port parameters** Open circuit, Short circuit, transmission and hybrid parameters, relationship between parameter sets, reciprocity and symmetry conditions, parallel connections, parallel connection of two port networks.	04
6	**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 functions. Properties of transfer functions, zeros of transmission, synthesis of Y_{21} and Z_{21} with a 1-Ohm termination, synthesis of constant – resistance networks.	10

List of suggested Tutorials/Simulations:

1. Examples indicating concept of super loop and super node.
2. Examples of indicating the application of thevenin's and Norton's theorem in presence of dependent sources.
3. The incidence, Cut-set, Tieset, F-Cutest and F-Tie-Set Matrices should be written for given graph.
4. Examples on evaluating the transient and steady-state conditions for a R-L-C series or parallel connections for different values of resistance. The concept of overdamped, critically damped, underdamped, oscillatory and unbounded response should become clear from this problems.
5. Examples on evaluating the transient and steady-state conditions for a R-L, R-C circuits for DC conditions.
6. Evaluating the above examples using Laplace Transform.
7. Examples on Hurwitz Polynomial. Necessary and sufficient condition for Positive real function.
8. Examples on realization of R-L, R-C, L-C functions.
9. Examples on synthesis of R-L-C function.
10. Examples on the synthesis of Y21 and Z21 with a 1 ohm termination.

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.

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 (Theory and 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.

Assessment:

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

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

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.

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.

Sub code	Subject Name	Teaching Scheme(Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	TW/Pract.	Tut.	Total
ISC303	Analog Electronics	4	2	-	4	1	-	5

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)				Term Work	Pract. and oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg.					
ISC303	Analog Electronics	20	20	20	80	25	25	-	150

Subject Code	**Subject Name**	**Credits**
ISC303	**Analog Electronics**	**5**
Course Objectives	• 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, Operational amplifier circuits, Power circuits and systems.	
Course Outcomes	• Students will be able to analyze, simulate, and design amplifiers using BJT and MOSFETs. • Students will be able to design various circuits using operational amplifiers. Students will be able to do analysis of biasing techniques, frequency response, feedback, stability, noise, and nonlinearities associated with various devices and circuits.	

Module	**Topics**	**Hrs.**
1	PN Junction diode small signal model, Zener diode and its applications, p-n junction under forward bias and reverse bias conditions, p-n junction breakdown region, Rectifier Circuits, Clipping and Clamping circuits	04
2	**Bipolar Junction Transistors (BJTs)** • Physical structure and operation modes • Active region operation of transistor • D.C. analysis of transistor circuits • Transistor as an amplifier	10

	• Biasing the BJT: Different type of biasing circuit and their analysis. Bias stability, Thermistor compensation, thermal runaway. • Basic BJT amplifier configuration: common emitter, common base and common collector amplifiers • Transistor as a switch: cut-off and saturation modes • High frequency model of BJT amplifier	
3	**Field Effect Transistor (FET)** • Junction FET its working and VI characteristic Enhancement-type MOSFET: structure and physical operation, current-voltage characteristics • Depletion-type MOSFET • D.C. operation of JFET and MOSFET circuits • 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.	10
4	**Operation Amplifier (Op-amps) and Oscillators** **Amplifiers with feedback .Gain and BW considerations.** • Ideal Op-amp • Differential amplifier: differential and common mode gains, common mode rejection ratio (CMRR) Oscillators: Introduction, Condition for Oscillation, RC phase shift, Weinbridge, Hartley, Colpitts and Crystal controlled oscillator.	06
5	**Applications of Op-amp** • Practical op-amp circuits: inverting amplifier, non -inverting amplifier, weighted Summation circuit, integrator, differentiator • Large signal operation of op-amps • Other applications of op-amps: instrumentation amplifier, active filters, controlled sources, logarithmic amplifiers, waveform generators, Schmitt triggers, comparators	10
6	**Power Circuits and Systems** • 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	8

List of Laboratory Experiments:

1. Study of input / output characteristics of BJT- CB, CE, and CC Configuration.
2. Study of input and transfer characteristics of FET.
3. BJT amplifier frequency response.
4. FET amplifier frequency response.
5. Measurement of operational amplifier parameters.
6. Clipper and Clamper circuits using Opamp.
7. Precision rectifiers using Opamp.
8. Adder and Subtrator using Opamp.
9. Wein bridge oscillator using Opamp.
10. RC phase shift oscillator using Opamp.

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.

Practical/Oral Examination:

Practical/Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum eight experiments.

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

Laboratory work (Experiments)	: 10 Marks
Laboratory work (programs / journal)	: 10 Marks
Attendance (Theory and 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.

Assessment:

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

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Books Recommended:

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

Sub code	Subject Name	Teaching Scheme(Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC304	Digital Electronics	4	2	-	4	1	-	5

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)							
		Internal Assessment (out of 20)			End sem Exam	Term Work	Pract. and oral.	Oral	Total
		Test 1	Test 2	Avg.					
ISC304	Digital Electronics	20	20	20	80	25	-	-	125

Subject Code	**Subject Name**	**Credits**
ISC304	**Digital Electronics**	**5**
Course Objectives	• To teach principles of digital electronics. • To teach topics including Boolean algebra, basic gates, logic circuits, flip-flops, registers, arithmetic circuits, counters, interfacing with analog devices, and computer memory	
Course Outcomes	• Students will be able to represent numerical values in various number systems and perform number conversions between different number systems. • Students will demonstrate the knowledge of: o operation of logic gates (AND, OR, NAND, NOR, XOR, XNOR) using IEEE/ANSI standard symbols o Boolean algebra including algebraic manipulation/simplification, and application of DeMorgan's theorems o Karnaugh map reduction method. • Students will demonstrate the knowledge of operation of basic types of flip-flops, registers, counters, decoders, encoders, multiplexers, and de-multiplexers. • Students will be able to analyze and design digital combinational circuits including arithmetic circuits (half adder, full adder, multiplier). • Students will be able to analyze sequential digital circuits. Students will demonstrate knowledge of the nomenclature and technology in the area of memory devices: ROM, RAM, PROM,	

	PLD, FPGAs, etc.

Module	Topics	Hrs.
1	**Introduction to number systems** Number systems, binary, octal, hexadecimal and others. Conversion from one system to another. Arithmetic, binary BCD and hexadecimal. **Binary codes** Weighted, reflective, sequential, gray, error detecting codes, odd, even parity, hamming codes, ASCII, EBCDIC codes, converting binary to gray and gray to binary and XS3.	08
2	**Boolean Algebra and combinational Circuits** AND, OR, NOT, XOR, XNOR, operations NAND, NOR use of universal gates for performing different operations. Laws of Boolean Algebra, De-Morgan's theorems. Relating a truth table to a Boolean expression. Multi level circuit. **Combinational Circuits** K-Maps and their use in simplifying Boolean expressions, minterm, maxterm SOP and POS implementation. Implementing a logic function using universal gates. Variable entered maps for five and six variable functions	12
3	**Combination Logic Circuit Design** Designing code converter circuits e.g. binary to gray, BCD to seven segment parity generator. Binary arithmetic circuits:- Adders, subtractors (half and full), BCD adder-subtractor, carry look head adder, serial adder, multiplier magnitude comparator, arithmetic logic units.	04
4	**Use of Multiplexers in logic design** Multiplexer, deMultiplexers, decoders, encoders, designing using multiplexer, demultiplexers, decoders. Ics of MUX, DEMUX, Decoders. Hazards in combinational circuits.	04
5	**Sequential Logic Circuits** Comparison of combinational and sequential circuits, , flip-flops, SR, T, D, JK. converting one flip-flop into another, use of debounce switch, counters modulus of a counter, ripple counters, up/down counter, designing sequential counters using gate IC and counter by drawing state transition diagram and state transition table. Ring counter, Johnson counter, twisted ring counter, pseudo random number generator, unused states and locked conditions. Registers: Serial input serial output, serial input parallel output, left shift, right shift register, sequence generators. Memories: RAM, ROM the basic cell IC bipolar, CMOS, RAM dynamic RAM cell. Magnetic core NVRAM, bubble memory, CCD, PAL, PLA. Introduction to PLD's.	16
6	**Logic Families:**	04

	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 E^2CMOS. Introduction to FPGA.	

List of Laboratory Experiments:

1. Implementing study of Gates and Logic Operations like, NOT, AND , OR, NR, XOR and XNOR using (i)all NAND Gates (ii)all NOR Gates.
2. Implementing a binary to gray, gray to binary or binary to XS3 code converter using gate ICs.
3. Simplifying 3, 4 variable logic functions and implementing them using gate ICs AND/OR, OR/AND, ALL NAND and ALL NOR.
4. Implementation of Half and Full Adder Circuit.
5. Study of Multiplexer and Demultiplexer using ICs.
6. Constructing flip flops like SR, D, JK and T using all NAND gates and a de-bounce switch.
7. Designing a mod N counter where N<14 using JK F/F and D F/F.
8. Design a ripple counter/or a two bit comparator using gate ICs.
9. Building a ring counter and a twisted ring counter using D f/f ICs.
10. Any one of the following:
    i. Full Adder using Gates and using Decoder or a multiplexer.
    ii. Using a counter ICs like 7490 or 7492 or 7493 as a BCD counter.
    iii. Using a shift register as a sequence generator.

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.

Term Work:

Term work shall consist of minimum eight experiments.

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

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End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Text Books:

1. Jain R.P., Modern Digital Electronics, Tata McGraw Hill, 1984.
2. Malvino Leach, Digital Principles and Applications, Tata McGraw Hill, 1991.

Reference Books:

1. Floyd Thomas L., Digital Fundamentals, 3rd ed., Belland Howell Company-1993.
2. Morris Mano M., Digital Design, Prentice Hall International-1984.
3. Almaini A.E., Electronic Logic Systems, 2nd ed., PHI-1986.
4. Malvino, Digital Electronics, Tata McGraw Hill, 1997.
5. Tocci, Digital Systems, PHI, 2000.
6. Dr. Jog Nandini K., Logic Circuits, 2nd ed., Nandu Publishers and printers Pvt, Ltd, 1998.
7. Floyd and Jain, Digital Fundamentals, Pearson Education.

Sub code	Subject Name	Teaching Scheme (Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC305	Transducers-I	4	2	-	4	1	-	5

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)				Term Work	Pract. and oral	Oral	Total
		Internal Assessment (out of 20)			End sem Exam				
		Test 1	Test 2	Avg.					
ISC305	Transducers-I	20	20	20	80	25	25	-	150

Subject Code	**Subject Name**	**Credits**
ISC305	**Transducers-I**	**5**
Course Objectives	• To make students understand the Identification, classification, construction, working principle and application of various transducers used for Displacement measurement, Temperature measurement, Level measurement,and Miscellaneous measurement.	
Course Outcomes	The students will be able to • Identify various sensors, Transducers and their brief Performance specifications. • Understand principle of working of various transducers used to measure Temperature, Displacement, Level, and various miscellaneous other sensors. • Make comparative study of various transducers. • Understand applications of various transducers in industry.	

Module	**Topics**	**Hrs.**
1	**Metrology** What is Metrology, Need of Inspection, Physical measurement, Measuring Instruments, Accuracy and Cost, Magnification, Selection of Instruments, Classification of Methods of Measurement, Measurement Problems,	06

	Objectives of Metrology, Standardization and Standardizing organization, Role of National Physical Laboratory in Metrology, Introduction to limit fits and gauges.	
2	**Instrumentation System** Units and standards of measurement, Introduction, block diagram, functional elements of measurement system, static and dynamic characteristics or performance characteristics of transducer, Measurement and calibration systems- Requirement. Error: definition, classification, statistical analysis of errors, Remedies for Errors. Sensor and Transducer : Definition, 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.	07
3	**Displacement** **a) 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. **b) Capacitance type transducers:** with applications, materials for capacitive, ultrasonic and elastic transducers. **c) Digital transducer:** translational and rotary encoders (absolute position and incremental position encoders), Optical and magnetic pickups. **d) Pneumatic transducer**: flapper- nozzle transducer. **e)** Comparative study for Displacement Transducers.	10
4	**Temperature transducers:** Modes of heat transfer, laws of conduction, convection and radiation, Temperature scales, classification of Temperature Sensors, Overview of Temperature Sensor Material. **a)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. **b)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. **c) Thermistors**: Principle, types (NTC and PTC), characteristics, Construction and working of Thermistor, Materials, specifications of Thermistor, applications.	12

	d) Thermocouples: Principle, thermoelectric effect, See beck 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. **e) Pyrometers:** Principle, Construction and working of Radiation and optical pyrometers and its Applications. f) Comparative study for Temperature Transducers.	
5	**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, Intelligent level measuring instruments. Comparative study for Level Transducers.	08
6	**Miscellaneous Transducers** Transducers for Position, speed, acceleration, vibration, sound, humidity, and moisture measurement.	05

List of Experiments:

1. Study Basic Measurements and Measuring Instruments.
2. Study Temperature Measurement using various Thermo meters.
3. Study and plot characteristics of RTD.
4. Study and plot characteristics of various Thermocouples.
5. Study and plot characteristics of Thermistors.
6. Study Temperature Measurement with and without Thermo well.
7. Study Liquid Level Measurement using DP Cell.
8. Study Liquid Level Measurement using Capacitance Type Level Sensor.
9. Study Liquid Level Measurement using Tubular Level Gauge and Ultrasonic Level Sensor.
10. Study Displacement Transducer using LVDT.
11. Study and Plot Response curve for Flapper Nozzle system.

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 Marks.
2. Total 4 question 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.

Practical/Oral Examination:

Practical/Oral examination will be based on entire syllabus.

Term Work:

Term work shall consist of minimum eight experiments.

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

Laboratory work (Experiments)	: 10 Marks
Laboratory work (programs / journal)	: 10 Marks
Attendance (Theory and 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.

Assessment:

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

End Semester Examination: Some guidelines for setting the question papers are as, six questions to be set each of 20 marks, out of these any four questions to be attempted by students. Minimum 80% syllabus should be covered in question papers of end semester examination.

Text Books:

1. B.C Nakra, K.K. Cahudhary, Instrumentation Measurement and Analysis, Tata Mc Graw Hill.
2. Sawney A.K., Electrical and Electronic Measurement and Instrumentation, Dhanpatrai And Co.

Reference Books:

1. Doeblin E.D., Measurement system, Tata Mc Graw Hill., 4th ed, 2003.
2. Liptak B.G., Process measurement and analysis.

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. Jain R.K., Engineering Metrology, Khana Publishers.
6. Rangan, Mani, Sharma. Instrumentation Systems and Devices, 2nd ed., Tata Mc Graw Hill.
7. S.P. Sukhatme, Heat Transfer, 3rd edition, University Press.
8. B.E. Jones, Instrument Technology.
9. Cheatle Keith R., Fundamentals of Test Measurement Instrument Instrumentation, ISA Publication.
10. Alan S Morris ; Measurement and Instrumentation Principles; 3rd Edition
11. D. V. S. Murty, 'Transducers and Instrumentation', PHI, New Delhi, 2003.

Sub code	Subject Name	Teaching Scheme(Hrs)			Credit Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC306	Object oriented programming and methodology		4*	-	-	2	-	2

*Out of four hours, 2 hours theory shall be taught to entire class followed by 2 hrs. practical in batches.

Sub code	Subject Name	Examination Scheme							
		Theory(out of 100)							
		Internal Assessment (out of 20)			End sem Exam	Term Work	Pract. and oral	Oral	Total
		Test 1	Test 2	Avg.					
ISC306	Object oriented programming and methodology	-	-	-	-	25	50	-	75

Subject Code	Subject Name	Credits
ISC306	**Object oriented programming and methodology**	**2**
Course Objectives	• To understand the concept of Object Oriented Programming • To help student to understand use of programming language such as JAVA to resolve problems. • To impart problems understanding, analyzing skills in order to formulate Algorithms. • To provide knowledge about JAVA fundamentals: data types, variables, keywords and control structures. • To understand methods, arrays, inheritance, Interface, package and multithreading and concept of Applet.	
Course Outcomes	• Students will be able to code a program using JAVA constructs. • Given an algorithm a student will be able to formulate a program that correctly implements the algorithm. • Students will be able to generate different patterns and flows using control structures and use recursion in their programs. • Students will be able to use thread methods, thread exceptions and thread priority. • Students will implement method overloading in their code.	

	• Students will be able to demonstrate reusability with the help of inheritance. • Students will be able to make more efficient programs.

Module No.	Unit No.	Topic	Hrs.
1		**Fundamental concepts of object oriented programming**	**4**
	1.1	Overview of programming	
	1.2	Introduction to the principles of object-oriented programming: classes, objects, messages, abstraction, encapsulation, inheritance, polymorphism, exception handling, and object-oriented containers	
	1.3	Differences and similarity between C++ and JAVA	
2		**Fundamental of Java programming**	**4**
	2.1	Features of Java	
	2.2	JDK Environment & tools	
	2.3	Structure of Java program	
	2.4	Keywords , data types, variables, operators, expressions	
	2.5	Decision making, looping, type casting	
	2.6	Input output using scanner class	
3		**Classes and objects**	**6**
	3.1	Creating classes and objects	
	3.2	Memory allocation for objects	
	3.3	Passing parameters to Methods	
	3.4	Returning parameters	
	3.5	Method overloading	
	3.6	Constructor and finalize ( )	
	3.7	Arrays: Creating an array	
	3.8	Types of array : One dimensional arrays ,Two Dimensional array, string	
4		**Inheritance, interface and package**	**6**

	4.1	Types of inheritance: Single, multilevel, hierarchical	
	4.2	Method overriding, super keyword, final keyword, abstract class	
	4.3	Interface	
	4.4	Packages	
5		**Multithreading**	**4**
	5.1	Life cycle of thread	
	5.2	Methods	
	5.3	Priority in multithreading	
6		**Applet**	**2**
	6.1	Applet life cycle	
	6.2	Creating applet	
	6.3	Applet tag	
		Total	**26**

Text Books:

1. Rajkumar Buyya, "Object-oriented programming with JAVA", Mcgraw Hill
2. E Balgurusamy, "Programming with JAVA", Tata McGraw Hill

Reference Books:

1. Herbert Schildt, "The Complete Reference JAVA", Tata McGraw Hill
2. Barry Holmes and Daniel T. Joyce, "Object Oriented Programming with Java", Jones & Bartlett Learning