University of Mumbai

No. AAMS(UG)/ 23 of 2022 -23

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular No. UG/55 of 2021 dated 21st January, 2021 relating to the Scheme and revised syllabus (Rev-2019 'C' Scheme) for the B.E. in Instrumentation Engineering (Sem. III & IV).

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Instrumentation Engineering at its meeting held on 18th November, 2021 and subsequently passed by the Board of Deans at its meeting held on 27th December 2021 vide item No. 6.13 have been accepted by the Academic Council at its meeting held on 28th December, 2021 **vide** item No. 6. 13 and that in accordance therewith, the reduced syllabus for B.E. (Instrumentation Engineering) (Rev-2019 'C' Scheme) for Direct Second Year (Sem.III) as Direct Second Year (DSE) students admission is delayed by the six months due to COVID-19 situation, has been brought into force with effect from the academic year 2021-22 only. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
4th May, 2022

(Sudhir S. Puranik)
REGISTRAR

To

The Principals of the Affiliated Colleges, and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.13/28/12/2021

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No. AAMS(UG)/ 21 -A of 2022-23

4th May, 2022

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies Instrumentation Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL.

(Sudhir S. Puranik)
REGISTRAR

Copy for information and necessary action :-

1. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
2. **College Teachers Approval Unit (CTA),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA)**
5. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
6. **The Deputy Registrar, Executive Authorities Section (EA)**
   He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
7. **The Deputy Registrar, PRO, Fort, (Publication Section),**
8. **The Deputy Registrar, Special Cell,**
9. **The Deputy Registrar, Fort Administration Department (FAD) Record Section,**
10. **The Deputy Registrar, Vidyanagari Administration Department (VAD),**

Copy for information :-

1. **The Director, Dept. of Information and Communication Technology (DICT), Vidyanagari,**
   He is requested to upload the Circular University Website
2. **The Director of Department of Student Development (DSD),**
3. **The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**
4. **All Deputy Registrar, Examination House,**
5. **The Deputy Registrars, Finance & Accounts Section,**
6. **The Assistant Registrar, Administrative sub-Campus Thane,**
7. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
8. **The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
9. **P.A to Hon'ble Vice-Chancellor,**
10. **P.A to Pro-Vice-Chancellor,**
11. **P.A to Registrar,**
12. **P.A to All Deans of all Faculties,**
13. **P.A to Finance & Account Officers, (F & A.O),**
14. **P.A to Director, Board of Examinations and Evaluation,**
15. **P.A to Director, Innovation, Incubation and Linkages,**
16. **P.A to Director, Department of Lifelong Learning and Extension (DLLE),**
17. **The Receptionist,**
18. **The Telephone Operator,**

Copy with compliments for information to :-

19. **The Secretary, MUASA**
20. **The Secretary, BUCTU.**

AC – 28/12/2021
Item No. - 6.13

UNIVERSITY OF MUMBAI

Bachelor of Engineering
(Instrumentation Engineering)

Direct Second Year (Sem. III) Admitted Students for the current Academic Year 2021-22 Only due to Covid Pandemic

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

Under
FACULTY OF SCIENCE & TECHNOLOGY

Program Structure for Second Year Instrumentation Engineering

Scheme for Semester- III

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

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

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

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

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

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

Module	Detailed Contents	Hrs.
01	**Module: Laplace Transform** 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform. 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and $t^n, n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. **Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	**CO-1** **7**
02	**Module: Inverse Laplace Transform** 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). **Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations.	CO-2 6
03	**Module: Fourier Series:** 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). 3.2 Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. **Self-learning Topics:** Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	CO-3 7
04	**Module: Complex Variables:** 4.1 Function *f*(z) of complex variable, limit, continuity and differentiability of *f*(z) Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function *f*(z)when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories **Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio,	CO-4 7

	fixed points and standard transformations.	
05	**Module: Linear Algebra: Matrix Theory** 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley- Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix **Self-learning Topics:** Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices**.**	CO-5 6
06	**Module: Vector Differentiation and Integra**l 6.1 **Vector differentiation**: Basics of Gradient, Divergence and Curl (Without Proof). 6.2 **Properties of vector field:** Solenoidal and irrotational (conservative) vector fields. 6.3 **Vector integral:** Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. **Self-learning Topics:** Gauss' divergence Theorem and applications of Vector calculus.	CO-6 6

Term Work:

General Instructions:

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

The distribution of Term Work marks will be as follows –

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

Assessment:

Internal Assessment Test:

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

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:-

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

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

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

Subject Code	Subject Name	Credits
ISC302	Transducers-I	4
Course objectives	1.To introduce the students for the purpose of explaining the measurement systems, errors of measurement. 2.To understand the sensors and transducers concept, operation and its applications in the various industry. 3.To familiarize the student with the Identification, classification, construction, working principle and application of various transducers used for Displacement, level, temperature, speed and vibration measurement.	
Course Outcomes	The students will be able to: 1.Explain the measurement systems, sources errors of measurement 2.List various standards used for selection of transducers/sensors. 3.To describe, draw, classify and produced sketches, drawings to explain working principles of various displacement sensors and transducers. 4.Interpret the characteristics of different temperature transducers/sensors also discuss working principle of transducers used for temperature measurement. 5. To create, design, formulate, generate and deliver the solutions for given applications using best applicable level sensors and transducer 6. To analyze the problem using basic principles for development of speed and vibration measurement project for Automobiles, Environmental, agriculture, biomedical, Petrochemical or other process industries.	

Details of Syllabus:

Module	Contents	Hours	CO mapping
1.	**Instrumentation System** Introduction, block diagram, functional elements of measurement system, static and dynamic characterstics of transducer, measurement and calibration systems.	2	**CO1**
2.	**Sensor and Transducer:** Definition, working principle, classification (active, passive, primary, secondary, mechanical, electrical, analog, digital), selection criteria.	2	**CO2**
3.	**Displacement transducers:** Resistive type transducers: potentiometer (linear and logarithmic), piezo-resistive effect. **Inductive type transducers:** LVDT, RVDT (transferfunction, linearity, sensitivity, source, frequency dependence, phase null, and signal conditioning). **Capacitive type transducers:** Linear and rotary (with change in distance between plates, change in dielectric constant and change in overlapping area).	6	**CO3**
4.	**Temperature transducers:** 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 and sums. Thermistors: Principle, types (NTC and PTC), characteristics, Construction and working of Thermistor, Materials, specifications of Thermistor, applications and sums. **Thermocouples:** Principle, thermoelectric effect, See beck effect, Peltier effect, laws of thermocouple, types of thermocouple with characteristic curve, thermocouple table, Sensitivity, constructional features of Thermocouples. Thermocouple specifications, cold junction Compensation method and sums. **Pyrometers:** Principle, Construction and working of Radiation and optical pyrometers and its applications. Comparative study for Temperature Transducers.	7	**CO4**
5.	**Level Transducers:** working principle, types, materials, design criterion: float, displacers, bubbler, and DP- cell, ultrasonic, capacitive types.	4	**CO5**
6.	**Speed and Vibration Measurement:** electromagnetic transducers (moving coil, moving magnet), AC and DC tachometers: Hall Effect proximity pickup, photoelectric, LVDT.	3	**CO6**

Internal Assessment:

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

Theory Examination:

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

Text Books:

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

Reference Books:

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

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL301	Transducers –I Lab Practice	-	02	-	-	1	-	1

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

Subject Code	Subject Name	Credits
ISL301	Transducer –I Lab Practice	1
Course objective	**1.** To make students understand the Identification, construction, working principle of various transducers used for Displacement measurement, Temperature measurement, Level measurement and miscellaneous measurement **2.** To experimentally verify the principle and characteristics of various transducers	
Course Outcome	**The students will be able to** 1. Demonstrate various measurement techniques and measuring instruments. 2. Classify sensors, Transducers, and their brief Performance specifications 3. Plot and validate the performance characteristics of displacement transducers 4. Validate the characteristics of various temperature transducers. 5. Describe the construction and operation of various level transducers 6. To demonstrate the performance characteristics of miscellaneous transducers.	

Syllabus: Same as that of Subject ISC302 Transducers - I.

List of Laboratory Experiments:

Sr. No.	Detailed Contents	CO mapping
1.	Demonstrate the basic measurements techniques and Measuring Instruments.	CO1
2.	Displacement measurement using Potentiometer.	CO3
3.	To determine characteristics of RTD	CO4
4.	To determine characteristics of various Thermocouples.	CO4
5.	To determine characteristics of Thermistors.	CO4
6.	To study Temperature Measurement with and without Thermo-well.	CO4
7.	Liquid Level Measurement using DP Cell.	CO5
8.	To evaluate performance characteristics capacitive level sensor.	CO5
9.	Liquid Level Measurement using Tubular Level Gauge and ultra-sonic sensor	CO5
10.	To determine the LVDT characteristics.	CO3

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

Term Work:
Term work shall consist of minimum **five 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
ISC303	Analog Electronics	3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC303	Analog Electronics	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC303	Analog Electronics	3
Course Objectives	1. To familiarize the student with basic electronic devices and circuits. 2. To provide understanding of applications of diodes, bipolar and MOSFET, DC biasing circuits, AC analysis and low and high Frequency response, 3. To introduce the students the basic construction of differential amplifier and its types. Different types of power amplifiers.	
Course Outcomes	Students will be able to: 1. Explain working of Diode and DC analysis of Transistor. 2. Analyze, simulate, and design amplifiers using BJT biasing techniques, frequency response. 3. Analyze circuits using FET characteristics and DC analysis. 4. Analyze circuits using MOSFET characteristics and analysis, Frequency response. 5. Differential amplifier configuration using transistor and frequency response. 6. Types of power amplifiers and power supply.	

Module	Contents	Hrs.	CO mapping
Pre-requisite Introduction of PN junction,			
1.	**Bipolar Junction Transistor:** Bipolar Junction Transistor, Device structure and physical operation, characteristics, the BJT as an amplifier and a switch, DC Analysis of BJT Circuits (Potential Divider Circuit only), Biasing BJT Amplifier Circuits,	05	CO1
2.	**BJT AC Analysis:** Amplification in AC domain, BJT transistor modelling, The r_e Transistor model, Single stage BJT amplifiers CE configuration (with and without feedback), Small Signal equivalent circuit, frequency response of a CE amplifier,	03	CO2
3.	**Field effect Transistors:** Introduction to JFET, Types, Construction, Operation, Static Characteristics, Pinch off voltage, FET Configurations (CS). Biasing of FET.	03	CO3
4.	**MOS Field effect Transistors:** Introduction to MOSFET as basic element in VLSI, Device structure and physical operation, current – voltage characteristics, the MOSFET as an amplifier and a switch, DC Analysis of MOSFET Circuits, Biasing MOSFET (No Numricals)	03	CO4
5.	**Differential and Multistage Amplifiers:** Preview, the Differential Amplifier, Basic BJT Differential Pair (SIBO, SIUO, DIBO, DIUO), Capacitive coupled and Direct coupled multistage amplifier.	02	CO5
6.	**Power Amplifier:** Definition and amplifier types, Series fed class A amplifier, Class B amplifier operation and circuits, Voltage regulation, Basic linear series and shunt Regulators, **Power supply design** using 78xx series, 79xx series and adjustable voltage IC regulators 317. Switched Mode Power Supply (SMPS) block Diagram.	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. Robert L. Boylestad, Louis Nashelsky, *"Electronic Devices and Circuit Theory",* PHI publishers, 2004
2. Thomas L. Floyd," Electronic Devices", Pearson 2015.
3. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar , "*Microelectronic Circuits,: Theory and Applications",* OUP, 2013
4. D. A. Neamen, "Micro *Electronic Circuit Analysis and Design*", McGraw-Hill, New Delhi, 2010.

Reference Books:

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

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL302	Analog Electronics Lab practice	--	2	--	--	1	--	1

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

Subject Code	Subject Name	Credits
ISL302	Analog Electronics	1
Course Objectives	1. To familiarize the student with basic electronic devices and circuits. 2. To provide understanding of applications of diodes, bipolar and MOSFET, DC biasing circuits, AC analysis and low and high Frequency response, 3. To introduce the students the basic construction of differential amplifier and its types. Different types of power amplifiers.	
Course Outcomes	Students will be able to: 1. Explain working of Diode and DC analysis of Transistor. 2. Analyze, simulate, and design amplifiers using BJT biasing techniques, frequency response. 3. Analyze circuits using FET characteristics and DC analysis.. 4. Analyze circuits using MOSFET characteristics and analysis, Frequency response. 5. Differential amplifier configuration using transistor and frequency response. 6. Types of power amplifiers and power supply.	

Syllabus: Same as that of Subject ISC303 Analog Electronics.

List of Experiments:

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

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

Practical and Oral Examination:

Practical and Oral examination will be based on entire syllabus of ISC303 Analog Electronics.

Term Work:

Term work shall consist of minimum 04 experiments and any one practical should be verified with software.

The distribution of marks for term work shall be as follows:
Laboratory work (Experiments) : 10 Marks
Laboratory work (programs / journal) : 10 Marks
Attendance : 05 Marks

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

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC304	Digital Electronics	3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC304	Digital Electronics	20	20	20	80	-	-	-	100

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

Module	Contents	Hours

Pre-requisite		
Knowledge of number systems and Boolean logic.		
1.	**Binary number system:** Binary Arithmetic, Binary codes, Gray code, Error detecting code. **Reduction methods:** De-Morgan's Theorem, Sum of Products (SOP), Product of Sums (POS), Karnaugh map Minimization, Don't care conditions.	03
2.	**Design of combinational logic circuits:** Adders, Subtractors, Parity checker, Multiplexer, De multiplexer (up to 16:1 and 1:16), Encoder and Decoder. Implementation of combinational logic circuits using Multiplexer and Demultiplexer.	06
3.	**Sequential logic circuits :** Flip flops- SR, D and Master slave JK, T, Asynchronous & Synchronous counters, shift registers.	03
4.	**Asynchronous sequential circuits:** Circuit Design – primitive state / flow table, Minimization of primitive state table, Excitation table,	02
5.	**Logic families:** Basics of digital integrated circuits, basic operational characteristics and parameters. TTL, tri-state gate ECL, CMOS, comparison of logic families (TTL/ECL/CMOS).	03
6.	**Memory and programmable logic devices:** PROM / EPROM / EEPROM / EAPROM Programmable Logic Devices –Programmable Logic Array (PLA), Programmable Array Logic (PAL),	03

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

Theory Examination:

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

Text Books

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

4. B. Ram,*"Fundamentals of Microprocessors and Microcontrollers",*Dhanpat Rai Publications, 2004.

References Books:

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

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISL303	Digital Electronics Lab practice	--	2	--	--	1	--	1

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

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

Syllabus: Same as that of Subject ISC304Digital Electronics.

List of Experiments:

Sr. No	Detailed Contents	CO Mapping
1	Implement conversion of Gray/Binary code.	**CO1**
2	Truth table verification and implementation of all gates using Universal gates.	**CO2**
3	Implementation of half/ full adder/ Subtractor.	**CO2**
4	Realise full adder using Multiplexer.	**CO3**
5	Realise full Subtractor using Multiplexer.	**CO3**
6	Implementation of various flip-flops.	**CO3**
7	Implement BCD to seven segments display.	**CO4**
8	Design and implement universal shift register.	**CO4**

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

Practical and Oral Examination:

Practical and Oral examination will be based on entire syllabus of ISC304Digital Electronics.

Term Work:

Term work shall consist of minimum 04 experiments and any ONE experiment should be verify using any software.

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

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

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

Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ISC305	Electrical Networks and Measurement	3	-	-	3	-	-	3

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		Test1	Test2	Avg.					
ISC305	Electrical Networks and Measurement	20	20	20	80	-	-	-	100

Subject Code	Subject Name	Credits
ISC305	Electrical Networks and Measurement	3
Course Objectives	1. To introduce the concept of circuit elements lumped circuits, circuit laws and reduction. 2. To introduce the concept of circuit elements and analyze DC circuits using various theorems. 3. To demonstrate basic analog and digital Instruments. 4. To identify the various techniques for measurement of R-L-C.	
Course Outcomes	**On successful completion of course learner/student will be able to:** 1. Analyze DC circuits using different theorems. 2. Demonstrate construction and working principle and applications of analog and digital instruments. 3. Formulate electrical bridges and evaluate electrical parameter like R, L, C.	

Details of Syllabus:

Prerequisite: Knowledge of Matrix algebra, Root-locus, Bode-plot and Nyquist stability criterion.

Module	Contents	Hrs.	CO mapping
1	**Network Theorems** Analysis of networks with dependent sources: mesh analysis, nodal analysis, super mesh and super node concept, source transformation technique, superposition theorem, Thevenin's theorem, Norton_s theorem, Maximum power transfer theorem	10	**CO1**
2	**Analog & Digital Meters** D_Arsonaval galvanometers, PMMC and PMMI instruments. Shunts and multipliers, Construction and working principle of: ammeters, voltmeters, ohmmeters, power factor meter, energy meter, Q meters, Analog multimeters. Electronic Voltmeters, Digital Voltmeter and digital multimeter. CRO, Measurement of phase and frequency.	05	**CO5**
3	**Measurement of R, L, C** Measurement of medium, low and high resistance, Megger AC bridges, measurement of self and mutual inductances (Maxwell). Measurement of capacitance (Schering Bridge). Derivations	05	**CO6**

Internal Assessment:

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

Theory Examination:

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

Text Books:

1. Kuo Franklin F., *"Network analysis and synthesis",* Wiley International, 1962.
2. Van Valkenburg M.E., *"Network analysis",* Eastern Economy Edition, 1983.

3. A. K. Sawhney, Puneet Sawhney, *"A course in Electrical and Electronic Measurement and Instrumentation",* Dhanpat Rai and Co. Rai, 1996.

Reference Books:

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

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

Subject Code	**Subject Name**	**Teaching Scheme**			**Credits Assigned**			
ISL304	**Object Oriented**	Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total

	Programming and Methodology	-	3	-	-	2	-	2

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

Details of Syllabus:

Prerequisite: Structured Programming Approach

Module	**Contents**	**Hrs**	**CO Mapping**
1	**Introduction to Object Oriented Programming** **OO Concepts:** Object, Class, Encapsulation, Abstraction, Inheritance, Polymorphism. **Features of Java, JVM** **Basic Constructs/Notions:** Constants, variables and data types, Operators and Expressions, Revision of Branching and looping	01	CO1
2	**Classes, Object and Packages** Class, Object, Method. Constructor, Static members and methods Passing and returning Objects Method Overloading, Packages in Java	02	CO2
3	**Array, String and Vector** Arrays, Strings, String Buffer	01	CO3
4	**Inheritance and Interface** Types of Inheritance, super keyword, Method Overriding	01	CO4
5	**Exception Handling and Multithreading** Error vs Exception, try, catch, finally, throw, throws	01	CO5
6	**GUI programming in JAVA** **Event Handling:** Event classes and event listener **Introduction to AWT:** Working with windows, Using AWT	01	CO6

	controls- push Buttons, Label, Text Fields, Text Area, Checkbox and Radio Buttons.		

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**
1.	Program on various ways to accept data through keyboard and unsigned right shift operator.
2.	Program on branching, looping, labelled break and labelled continue.
3.	Program to create class with members and methods, accept and display details for single object.
4.	Program on constructor and constructor overloading
5.	Program on method overloading
6.	Program on passing object as argument and returning object
7.	Program on 1D array
8.	Program on String
9.	Program on single and multilevel inheritance (Use super keyword)
11	Program to demonstrate try, catch, throw, throws and finally.
12	Program to create GUI application without event handling using AWT controls
13	Mini Project based on content of the syllabus. (Group of 2-3 students)

Term Work:

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

1. At least 11 programs and mini project
2. ONE assignments/MCQ 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.