AC 29/4/2013 Item no. 4.79

# UNIVERSITY OF MUMBAI

## Revised Syllabus

## Program -Bachelor of Engineering

**Course -Instrumentation Engineering**

**(Second Year – Sem. III & IV)**

**Under**

## FACULTY OF TECHNOLOGY

(As per Credit Based Semester and Grading System from 2013-14)

## 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.**

**Semester IV**

| Subject Code | Subject Name | Teaching Scheme(Hrs) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| ISC401 | Applied Mathematics-IV * | 4 | - | 1 | 4 | - | 1 | 5 |
| ISC402 | Feedback Control System | 4 | 2 | - | 4 | 1 | - | 5 |
| ISC403 | Electrical Technology and Instruments | 4 | 2 | - | 4 | 1 | - | 5 |
| ISC404 | Communication System | 4 | 2 | - | 4 | 1 | - | 5 |
| ISC405 | Transducers-II | 4 | 2 | - | 4 | 1 | - | 5 |
| ISC406 | Application Software Practices | - | 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. | | | | | |
| ISC401 | Applied Mathematics-IV * | 20 | 20 | 20 | 80 | 25 | - | - | 125 |
| ISC402 | Feedback Control System | 20 | 20 | 20 | 80 | 25 | - | 25 | 150 |
| ISC403 | Electrical Technology and Instruments | 20 | 20 | 20 | 80 | 25 | - | 25 | 150 |
| ISC404 | Communication System | 20 | 20 | 20 | 80 | 25 | - | - | 125 |
| ISC405 | Transducers-II | 20 | 20 | 20 | 80 | 25 | 25 | - | 150 |
| ISC406 | Application Software Practices | - | - | - | - | 25 | 25 | - | 50 |
| TOTAL | | | | 100 | 400 | 150 | 50 | 50 | 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<br>• To provide students with mathematics fundamental necessary to formulate, solve and analyze engineering problems.<br>• 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.<br>• Students will demonstrate an ability to identify formulate and solve Instrumentation Engineering related problem using Applied Mathematics.<br>• Students will show the understanding of impact of engineering mathematics on Instrumentation Engineering.<br>• 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.<br>• To study the concept of coupled circuits.<br>• To study the transient response of series and parallel A.C. circuits.<br>• To study the application of Laplace transforms to circuit analysis.<br>• To study two port model of circuit and circuit elements.<br>• To introduce the concept of network synthesis. | |
| **Course Outcomes** | • Analyze circuits with DC and AC sources.<br>• Find Thevenin and Norton equivalents of circuits.<br>• Analyze transient and steady-state responses response of passive electrical networks.<br>• Analyze two port networks.<br>• Analyze the structure and function of network synthesis. | |

| Module | Topics | Hrs. |
|---|---|---|
| 1 | **Networks Theorems**<br>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**<br>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**<br>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**<br>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**<br>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.**<br>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.<br>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.<br>• 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.<br>• 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)**<br>• Physical structure and operation modes<br>• Active region operation of transistor<br>• D.C. analysis of transistor circuits<br>• Transistor as an amplifier | 10 |

| | | |
|---|---|---|
| | • Biasing the BJT: Different type of biasing circuit and their analysis. Bias stability, Thermistor compensation, thermal runaway.<br>• Basic BJT amplifier configuration: common emitter, common base and common collector amplifiers<br>• Transistor as a switch: cut-off and saturation modes<br>• High frequency model of BJT amplifier | |
| 3 | **Field Effect Transistor (FET)**<br>• Junction FET its working and VI characteristic<br>Enhancement-type MOSFET: structure and physical operation, current-voltage characteristics<br>• Depletion-type MOSFET<br>• D.C. operation of JFET and MOSFET circuits<br>• JFET and MOSFET as an amplifier<br>• Biasing in JFET and MOSFET amplifiers<br>• Basic JFET and MOSFET amplifier configuration: common source, common gate and common drain types<br>• High frequency model of FET, Low and High frequency response of common source amplifier. | 10 |
| 4 | **Operation Amplifier (Op-amps) and Oscillators**<br>**Amplifiers with feedback .Gain and BW considerations.**<br>• Ideal Op-amp<br>• Differential amplifier: differential and common mode gains, common mode rejection ratio (CMRR)<br>Oscillators: Introduction, Condition for Oscillation, RC phase shift, Weinbridge, Hartley, Colpitts and Crystal controlled oscillator. | 06 |
| 5 | **Applications of Op-amp**<br>• Practical op-amp circuits: inverting amplifier, non -inverting amplifier, weighted Summation circuit, integrator, differentiator<br>• Large signal operation of op-amps<br>• Other applications of op-amps: instrumentation amplifier, active filters, controlled sources, logarithmic amplifiers, waveform generators, Schmitt triggers, comparators | 10 |
| 6 | **Power Circuits and Systems**<br>• Class A large signal amplifiers, Harmonic distortion<br>• Transformer coupled audio power amplifier<br>• Class B amplifier<br>• Class AB operation<br>• Power BJTs<br>• Regulated power supplies<br>• 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.<br>• 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.<br>• Students will demonstrate the knowledge of:<br>o operation of logic gates (AND, OR, NAND, NOR, XOR, XNOR) using IEEE/ANSI standard symbols<br>o Boolean algebra including algebraic manipulation/simplification, and application of DeMorgan's theorems<br>o Karnaugh map reduction method.<br>• Students will demonstrate the knowledge of operation of basic types of flip-flops, registers, counters, decoders, encoders, multiplexers, and de-multiplexers.<br>• Students will be able to analyze and design digital combinational circuits including arithmetic circuits (half adder, full adder, multiplier).<br>• Students will be able to analyze sequential digital circuits.<br>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**<br>Number systems, binary, octal, hexadecimal and others. Conversion from one system to another. Arithmetic, binary BCD and hexadecimal.<br>**Binary codes**<br>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**<br>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.<br>**Combinational Circuits**<br>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**<br>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**<br>Multiplexer, deMultiplexers, decoders, encoders, designing using multiplexer, demultiplexers, decoders. Ics of MUX, DEMUX, Decoders. Hazards in combinational circuits. | 04 |
| 5 | **Sequential Logic Circuits**<br>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.<br>Registers: Serial input serial output, serial input parallel output, left shift, right shift register, sequence generators.<br>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 $E^2$CMOS. 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:

| | |
|---|---|
| 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. 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<br>• Identify various sensors, Transducers and their brief Performance specifications.<br>• Understand principle of working of various transducers used to measure Temperature, Displacement, Level, and various miscellaneous other sensors.<br>• Make comparative study of various transducers.<br>• Understand applications of various transducers in industry. | |

| **Module** | **Topics** | **Hrs.** |
|---|---|---|
| 1 | **Metrology**<br>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**<br>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.<br>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**<br>**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.<br>**b) Capacitance type transducers:** with applications, materials for capacitive, ultrasonic and elastic transducers.<br>**c) Digital transducer:** translational and rotary encoders (absolute position and incremental position encoders), Optical and magnetic pickups.<br>**d) Pneumatic transducer**: flapper- nozzle transducer.<br>**e)** Comparative study for Displacement Transducers. | 10 |
| 4 | **Temperature transducers:**<br>Modes of heat transfer, laws of conduction, convection and radiation, Temperature scales, classification of Temperature Sensors, Overview of Temperature Sensor Material.<br>**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.<br>**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.<br>**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.<br>**e) Pyrometers:** Principle, Construction and working of Radiation and optical pyrometers and its Applications.<br>f) Comparative study for Temperature Transducers. | |
| 5 | **Level Transducers**<br>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.<br>Comparative study for Level Transducers. | 08 |
| 6 | **Miscellaneous Transducers**<br>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) | | | | Term Work | Pract. and oral | Oral | Total |
| | | Internal Assessment (out of 20) | | | End sem Exam | | | | |
| | | 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<br>• To help student to understand use of programming language such as JAVA to resolve problems.<br>• To impart problems understanding, analyzing skills in order to formulate Algorithms.<br>• To provide knowledge about JAVA fundamentals: data types, variables, keywords and control structures.<br>• 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.<br>• Given an algorithm a student will be able to formulate a program that correctly implements the algorithm.<br>• Students will be able to generate different patterns and flows using control structures and use recursion in their programs.<br>• Students will be able to use thread methods, thread exceptions and thread priority.<br>• Students will implement method overloading in their code. | |

| | |
|---|---|
| | • Students will be able to demonstrate reusability with the help of inheritance.<br>• 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

| Sub code | Subject Name | Teaching Scheme(Hrs) | | | Credit Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| ISC401 | Applied Mathematics-IV | 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. | | | | | |
| ISC401 | Applied Mathematics-IV | 20 | 20 | 20 | 80 | 25 | - | - | 125 |

**Course pre-requisite:**

FE C 101 : Applied Mathematics I

FE C 201 : Applied Mathematics II

SE S 301 : Applied Mathematics III

| Subject Code | Subject Name | Credits |
|---|---|---|
| **ISC401** | **Applied Mathematics-IV** | **5** |
| **Course Objectives** | This course will present the method of calculus of variations, basic concepts of probability, matrix theory, concept of ROC and residue theory with applications.<br>• To provide students with a sound foundation in Mathematics and prepare them for graduate studies in Instrumentation Engineering<br>• To provide students with mathematics fundamental necessary to formulate, solve and analyze engineering problems.<br>• To provide opportunity for students to work as part of teams on multi disciplinary projects. | |
| **Course Outcomes** | • Students will able to apply method of calculus of variations to specific systems, demonstrate ability to manipulate matrices and compute eigenvalues and eigenvectors, Identify and classify zeros, singular points, residues and their applications.<br>• Students will demonstrate an ability to identify formulate and solve Instrumentation Engineering related problem using Applied Mathematics.<br>• Students will show the understanding of impact of engineering | |

| | |
|---|---|
| | mathematics on Instrumentation Engineering.<br>• Students who can participate and succeed in competitive exams like GATE, GRE. |

| Module No. | Unit No. | Topics | Hrs. |
|---|---|---|---|
| **1. 0** | | **Calculus of variation** | **10** |
| | **1.1** | Euler Langrange equation, solution of Euler's Langrange equation (only results for different cases for function) independent of a variable, independent of another variable, independent of differentiation of a variable and independent of both variables | |
| | **1.2** | Isoperimetric problems, several dependent variables | |
| | **1.3** | **Functions involving higher order derivatives:** Rayleigh-Ritz method | |
| **2.0** | | **Linear algebra: vector spaces** | **12** |
| | **2.1** | **Vectors in n-dimensional vector space**: Properties, dot product, cross product, norm and distance properties in n-dimensional vector space. | |
| | **2.2** | Metric spaces, vector spaces over real field, properties of vector spaces over real field, subspaces. | |
| | **2.3** | Norms and normed vector spaces | |
| | **2.4** | Inner products and inner product spaces | |
| | **2.5** | The Cauchy-Schwarz inequality, orthogonal Subspaces, Gram-Schmidt process | |
| **3.0** | | **Linear Algebra: Matrix Theory** | **15** |
| | **3.1** | Characteristic equation, Eigenvalues and Eigenvectors, properties of Eigenvalues and Eigenvectors | |
| | **3.2** | Cayley-Hamilton theorem, examples based on verification of Cayley-Hamilton theorem | |
| | **3.3** | Similarity of matrices, Diagonalisation of matrix | |

| | | | |
|---|---|---|---|
| | **3.4** | Functions of square matrix, derogatory and non-derogatory matrices | |
| | **3.5** | Quadratic forms over real field, reduction of quadratic form to a diagonal canonical form, rank, index, signature of quadratic form, Sylvester's law of inertia, value-class of a quadratic form of definite, semi- definite and indefinite | |
| | **3.6** | Singular Value Decomposition | |
| **4.0** | | **Complex variables: Integration** | **15** |
| | **4.1** | **Complex Integration:** Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula | |
| | **4.2** | Taylor's and Laurent's series | |
| | **4.3** | Zeros, singularities, poles of f(z), residues, Cauchy's Residue theorem | |
| | **4.4** | Applications of Residue theorem to evaluate real Integrals of different types | |
| | | **Total** | **52** |

**Text books:**


1) A Text Book of Applied Mathematics Vol. I & II by P.N.Wartilar & J.N.Wartikar, Pune, Vidyarthi Griha Prakashan., Pune

2) Mathematical Methods in science and Engineering, A Datta (2012)

3) Higher Engg. Mathematics by Dr. B.S. Grewal, Khanna Publication


**Reference Books:**


1) Todd K.Moon and Wynn C. Stirling, Mathematical Methods and algorithms for Signal Processing, Pearson Education.
2) Kreyszig E., Advanced Engineering Mathematics, 9th edition, John Wiley, 2006.
3) Linear Algebra- Hoffman & Kunze (Indian editions) 2002
4) Linear Algebra- Anton & Torres (2012) 9th Indian Edition.
5) Complex Analysis – Schaum Series.

**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 |
| ISC402 | Feedback Control System | 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. | | | | | |
| ISC402 | Feedback Control System | 20 | 20 | 20 | 80 | 25 | - | 25 | 150 |

| Subject Code | Subject Name | Credits |
|---|---|---|
| **ISC402** | **Feedback Control System** | **5** |
| **Course Objectives** | • To familiarize students with concepts of control systems and mathematical modeling of the System.<br>• To understand the concept of transient and steady-state response analysis for control systems and to assess the stability of control systems through the root-locus method and the frequency-response method. | |
| **Course Outcomes** | • Students will able to represent the mathematical model of a system and determine the response of different order systems.<br>• Students will have the ability to analyse the stability of the system. | |

| Module | Topics | Hrs. |
|---|---|---|
| 1 | **Introduction**<br>Definition of control system and related terms, open loop and closed loop system, examples. Development of automatic control systems, classification of control system, examples | 02 |
| 2 | **Mathematical Models of Physical Systems**<br>Definition of physical systems, principle of superposition and homogeneity, linear/non-linear, time variant/time invariant systems. Types of dynamic model, linear elements of electrical and mechanical systems, differential equations of physical systems-mechanical systems, electrical systems, thermal systems, fluid systems, pneumatic systems. Analogous systems. | 08 |

| | | |
|---|---|---|
| 3 | **Transfer Function and Feedback Characteristics**<br>Definition of transfer function, sinusoidal transfer function,<br>transfer functions of physical systems, block diagram algebra, reduction rules, signal flow graphs-definition, construction, properties, and Mason's gain formula ,sensitivity of closed loop and open loop system, effect of feedback, effect of disturbances signals, regenerative feedback with examples | 14 |
| 4 | **Time Response Analysis**<br>Standard test signals, pulse and impulse function, step function, ramp function, parabolic function, sinusoidal function, dynamic response, time response of first order system, time response of second order system, specifications, steady - state error, system types and error constants, effect of adding zeros and poles to a system, design specifications of second order system- desired close loop pole location and the dominant condition. | 08 |
| 5 | **Stability Analysis and Root Locus**<br>Concept of stability, definitions, bounded input-bounded<br>output stability, relative stability, necessary and sufficient<br>conditions for stability, Routh stability criterion, relative<br>stability analysis, root locus technique, applications, concept, construction of root loci, root loci of different systems. | 08 |
| 6 | **Frequency Response and Stability Analysis**<br>Correlation between time and frequency response, polar plots, Bode plots, log magnitude versus phase plots, Nyquist stability criterion, frequency response specifications, stability analysis using-bode, polar, log-magnitude versus phase plots, definitions and significance of gain margin and phase margin, sensitivity analysis in frequency domain | 08 |

**List of Laboratory Experiments:**

1. To study time response of Type 0, 1, 2 systems.
2. To study the effect of time constant on performance of 1st order system.
3. To study the effect of damping factor on the performance of second order system.
4. To study time response of Second order under damped systems. Calculate time response specifications.
5. To study the frequency response of First and Second order systems.
6. Atleast four experiments should be performed using simulation software like MATH CAD/MATLAB/SCILAB/OCTAVE or equivalent.

**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.

**Oral Examination**:

Oral examination will be based on entire syllabus.

**Term Work:**

Term work shall consist of 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. Nagrath I. G., Gopal M., "Control System Engineering", New Age International (P) Ltd. Publishers 2000.
2. Kuo Benjamin C., "Automatic Control Systems", 6th ed., Prentice Hall of India, New Delhi, 1993.


**Reference Books:**


1. Gopal M., "Control Systems Principles and Design", Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1998.
2. Nise Norman S., "Control Systems Engineering", 3rd ed., John Wiley and Sons, Inc. -2000.
3. Lewis Paul H., Chang Yang, "Basic Control Systems Engineering", Prentice Hall International, Inc. 1997.

4. Raymond T. Stefani, Bahram Shahian, late Clement J. Savant and late Gene H. Hostetter, "Design of Feedback Control Systems", 4th ed., Oxford University Press, New Delhi, 2001.
5. Dhanesh N. Manik, "Control System", Cengage Lerning India, 1st edition, 2012.

| Sub code | Subject Name | Teaching Scheme(Hrs) | | | Credit Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| ISC403 | Electrical Technology and Instruments | 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. | | | | | |
| ISC403 | Electrical Technology and Instruments | 20 | 20 | 20 | 80 | 25 | - | 25 | 150 |

| Subject Code | Subject Name | Credits |
|---|---|---|
| **ISC403** | **Electrical Network Analysis and Synthesis** | **5** |
| **Course Objectives** | • To introduce the basic concept of machines and measuring instruments<br>• To study the construction, types, characteristics, starting methods, speed control methods and applications of DC and AC machines.<br>• To study the basic analog instruments as well as sophisticated digital instruments like digital voltmeters. | |
| **Course Outcomes** | • The students get well versed with construction, characteristics, and applications of DC machines as well as AC machines.<br>• Students also get thorough knowledge of construction, working principle, limitations and applications of Analog and Digital Instruments. | |

.

| Module | Topics | Hrs. |
|---|---|---|
| 1 | **D.C. Machines**<br>Constructional details, types (shunt, series and compound), generator action. emf equation, motoring action, significance of back emf, torque and speed equations, torque-armature current, speed-armature current and torque-speed characteristics of different types of motors, speed control, starter, applications. General specifications of D.C. Machine and their significance. | 12 |
| 2 | **Induction Motor**<br>Rotating magnetic field, construction and principle of operation, slip, rotor | 12 |

| | | |
|---|---|---|
| | frequency, torque-slip characteristic, relationship between slip and rotor copper loss, speed control, starting methods, motor ratings. General specifications of induction motor and their significance. | |
| 3 | **Fractional Horse Power Motors**<br>Construction and principle of operation of single phase induction motortypes of single phase induction motor (resistance split phase, capacitance split phase) and their applications. Shaded pole induction motor. Introduction to Variable frequency drives and its application. | 08 |
| 4 | **Analog Meters**<br>Construction and working principle of: ammeters, voltmeters, ohmmeters, power factor meter, energy meter, Q meters, D'Arsonaval galvanometers-PMMC and PMMI instruments.<br>Shunts and multipliers-Measurement of phase and frequency, analog multimeters. | 04 |
| 5 | **Measurement of R, L, C**<br>Measurement of medium, low and high resistance, megger.<br>A.C. and D.C. potentiometers: A.C. Bridges, measurement of self and mutual inductances. Measurement of capacitance. Derivations and numericals related to all bridges. | 04 |
| 6 | **Electronic Measuring Instruments**<br>Electronic voltmeters, Principle of A/D and D/A converters and their types, DVM and DMM, automation in voltmeters (ranging, zeroing, polarity indication). | 08 |

**List of Laboratory Experiments:**

1. Speed control of DC shunt motor by armature voltage and flux control method.
2. Load test on DC shunt motor.
3. Load test on DC series motor.
4. Speed control of 3 phase slip ring induction motor by adding the external resistance in the rotor circuit.
5. Starting of induction motor by D.O.L., autotransformer, star/delta and rotor resistance starter.
6. Study of different types of fractional horse power motors.
7. Study of D.C. machine starter.
8. Study of Multi-meterand CRO: front panel controls and specifications.
9. Introduction, identification and testing of various components like resistors, capacitors, inductor, transistor, diode, various ICs.
10. Measurement of medium value resistance using bridge.
11. Measurement of small value resistance using bridge.
12. Measurement of Inductance by using bridge.

13. Study of D.C. Potentiometer.
14. Study of Megger.
15. Measurement of Capacitance using A.C. Bridges.
16. Measurement of phase and frequency using frequency meters and Synchroscope.
17. Applications of CRO (Measurements of phase and frequency and component testing).
18. Study of DVM.

**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.

**Oral Examination**:

Oral examination will be based on entire syllabus.

**Term Work:**

Term work shall consist of minimum eight experiments.

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

| | |
|---|---|
| Laboratory work (Experiments) | : 10 Marks |
| Laboratory work (programs/ journal) | : 10 Marks |
| Attendance (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. Sawhney A. K., Electrical and Electronics Measurement and Instrumentation, Dhanpat Rai and Co.Pvt Ltd.
2. Nagrath I. J., Kothari D. P., Electrical Machines, 2nd ed., Tata McGraw Hill, New Delhi 1997.


**Reference Books:**


1. Guru Bhag S., Hiziroglu Huseyin R., Electric Machinery and Transformers, 3rd ed., Oxford University Press, New Delhi 2007.
2. Say M. G., The performance and Design of Alternating Current Machines, 3rd ed., CBS Publisher and Distributor, Delhi, 1983.
3. Taylor Openshaw, FHP Motors, Addison Wesley 1976.
4. Kalsi H. S., Electronics Instrumentation, Tata McGraw Hill, New Delhi 1997.
5. Khandpur R. S., Preventive Maintenance and Troubleshooting, Tata McGraw Hill, New Delhi 1997.
6. Cooper W.D., Helfrick A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall of India Limited, New Delhi.
7. Rangan C. S., Sharma G. R., Mani V. S., Instrumentation Devices and Systems, 2nd ed., Tata McGraw Hill, New Delhi 1997.
8. Rathore-Narosa T. S., Digital Measurement Techniques.
9. Oliver and Cage, Modern Electronic Measurements and Instrumentation, MGH.
10. Bouwens A. J., Digital Instrumentation, MGH.
11. Technical Manuals of DSO: APLAB, Scientific, HP etc.
12. Technical Manuals for Virtual CRO.

| Sub code | Subject Name | Teaching Scheme(Hrs) | | | Credit Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| ISC404 | Communication System | 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. | | | | | |
| ISC404 | Communication System | 20 | 20 | 20 | 80 | 25 | - | - | 125 |

| Subject Code | Subject Name | Credits |
|---|---|---|
| **ISC404** | **Communication System** | **5** |
| **Course Objectives** | • To teach students about the basic principles underlying the operation and design of a communication system.<br>• To introduce the students to analog and digital communication as well as to telemetry principle<br>• To introduce the students to network model of communication in brief. | |
| **Course Outcomes** | • Students will be able to understand the basic operating principles of current communication systems or standards.<br>• Students will be equipped with the ability to analyze and design a communication system. | |

| Module | Topics | Hrs. |
|---|---|---|
| 1 | **Introduction to communication system**: Elements of a communication system, noise in communication systems, Amplitude Modulation: Introduction, time and frequency domain analysis, power relations, basic requirements and description of various modulators, comparison of DSB, SSB, VSB, ISB modulation and detection. | 08 |
| 2 | **Angle Modulation:** Introduction to frequency modulation, phase modulation, spectrum or FM, effect of noise in FM, generation of FM and detection. | 08 |
| 3 | **Pulse and Digital Modulation**: pulse modulation methods, pulse amplitude | 08 |

| | | |
|---|---|---|
| | (PAM) pulse position (PPM), pulse duration/width (PWM) modulation methods for digital signals over analogue: amplitude shift keying (ASK), frequency shift keying (FSK), and phase shift keying (PSK) Quaternary Phase Shift Keying (QPSK). | |
| 4 | **Pulse and Digital Modulation II:** Quaternary Amplitude Modulation (QAM), DPSK, M-ary PSK, M-ary FSK, OQPSK, MSK, Modulation, demodulation, signal space diagram, spectrum, bandwidth efficiency, power efficiency, probability of error, applications, Digital Pulse Code Modulation, Delta modulation; Adaptive Della modulation. Multiplexing techniques: space division; frequency division; time division; wavelength division. | 08 |
| 5 | **Telemetry:** Methods of data transmission, general telemetry land line telemetering voltage telemetry current telemetry different types force balance impulse and position telemetry land line, Feedback telemetry systems, FM telemetry systems PAM telemetry, PAM telemetry. | 08 |
| 6 | **Introduction to Networks:**<br>OSI reference model, System Engineering approach, Evolution of Industrial Control Process, Communication Interface-Serial and parallel, Communication Modes-Simplex, Half Duplex, Duplex ,Synchronization and timing.Protocols-Rs232 interface, PC-Parallel port interface, GPIB | 08 |

**List of Laboratory Experiments:**

1. To analyze the signals in frequency domain.
2. To analyze the AM generation and detection and calculate the modulation index.
3. To analyze the SSB generation and detection.
4. To observe the FM generation and detection and frequency deviation and modulation index of FM.
5. To generate and detect phase modulation.
6. To analyze PAM generation and detection.
7. To analyze PWM generation and detection.
8. To analyze PPM generation and detection.
9. To analyze PAM generation and detection.
10. To analyze delta modulation and demodulation.
11. To observe time division multiplexing.
12. To observe frequency division multiplexing
13. To analyze FSK modulation.
14. To analyze PSK modulation.
15. Study of RS-232 protocol
16. Study of PC parallel port.

**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:

| | |
|---|---|
| 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. Blake, Electronic Communication Systems, 2nd Edition, Thomson Learning. IlJ89.
2. Hayk in, Simon S., Communication Systems, John Wiley.


**Reference Books:**


1. Taub and Schilling, Principles 0/ Communication Engineering, 2nd Edition, 1993.
2. Bruce Carlson, Communication Systems, 2nd Edition, McGraw Hill, 1994.
3. Kennedy and Davis, Electronic Communication Systems. McGraw hill. 1985.
4. Lathi Ghagwandas Pannalal, Signals. Systems and Communications, John Wile\New York, 2000.
5. Dennis Roddy and John Coolen, Electronic Communications, 3rd Edition. Prentice Hall of India (P) Ltd., New Delhi, 1986.
6. A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Co., 1997.
7. Perry A. Borden and W.J. Mayo, Telemetering Systems, Wells Reinhold publishing Corporation, New York, 1959.

| Sub code | Subject Name | Teaching Scheme(Hrs) | | | Credit Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| ISC405 | Transducers-II | 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. | | | | | |
| ISC405 | Transducers-II | 20 | 20 | 20 | 80 | 25 | 25 | - | 150 |

| **Subject Code** | **Subject Name** | **Credits** |
|---|---|---|
| **ISC405** | **Transducers-II** | **5** |
| **Course Objectives** | • To make students understand the construction, working principle and application of various transducers used for flow measurement, strain measurement, pressure and vacuum measurement, force, torque and power measurement.<br>• To study electro-chemical sensors and transducers used for density and viscosity measurement. | |
| **Course Outcomes** | The course would enable the students to:<br>• Understand principle of working of various transducers used to measure flow, pressure, strain, force, power and torque etc.<br>• Make comparative study of various transducers.<br>• Understand applications of various transducers in industry. | |

| **Module** | **Topics** | **Hrs.** |
|---|---|---|
| 1 | **Strain Measurement**<br>Introduction, types of strain gauge, gauge factor calculation, materials for strain gauge, resistance strain gauge bridges, temperature compensation and applications of strain gauges. | 06 |
| 2 | **Pressure Measurement**<br>Pressure scales, units and relations, classification<br>**a)Primary pressure sensors** - elastic elements like bourdon tube, diaphragm, bellows, properties and selection of elastic materials, Calibration using dead weight tester. | 12 |

| | | |
|---|---|---|
| | **b) Electrical/Secondary Pressure Transducers**: Capacitive, piezo-electric and its material, variable reluctance, LVDT, strain gauge.<br>**c) High Pressure Measurement**: Bulk modulus cell, Bridgeman type, capsule.<br>**d) Differential pressure measurement**: Force balance, motion balance, DP Cell, semiconductor strain gauges.<br>**e) Pressure measurement using manometer**: U-tube types, well type, inclined type, micro manometer | |
| 3 | **Vacuum Measurement**<br>Units and relations, McLeod gauge, Pirani gauge, thermocouple gauge, hot cathode ionization gauge, Knudsen gauge, Calibration using dead weight tester | 04 |
| 4 | **Flow Measurement**<br>**Introduction to fluid flow**: properties of fluid, types of fluid, dimensionless numbers, types of fluid flow, continuity equation, Bernoulli's equation, hydrostatic law, Pascal's law, flow through pipes – major and minor losses, flow measurement through open channel-weirs and notches. Materials used for flow sensors, performance of materials, corrosion resistors, erosion, effect of vapour pressure<br>**Head Type**: orifice, venturi, nozzle, pitot tube, annubar, characteristics of head type flow meters.<br>**Variable Area Type**: Rotameter and its type.<br>Other flow meters: Turbine, electromagnetic, ultrasonic, positive displacement, anemometers, mass flow meters, solid flow measurements. | 14 |
| 5 | **Electro-chemical Sensors**<br>Terminology, equations, units.<br>pH measurement-electrodes, measuring circuits, maintenance, temperature compensation, calibration.<br>Conductivity measurement-probes and measuring circuits.<br>ORP(Oxidation Reduction Potential) Measurement. | 05 |
| 6 | **Miscellaneous Measurement**<br>Force Measurement: strain gauge, LVDT, piezoelectric.<br>Torque: Torsion bar, strain gauge.<br>Power: Dynamometer, instantaneous power measurement, alternator power measurement.<br>Density Measurement – Displacement and float type densitometers, Hydrometers, Radiation and Ultrasonic densitometers<br>Viscosity Measurement – Capillary tube viscometer, Efflux type viscometer, Variable area viscometer | 07 |

**List of Laboratory Experiments**:

1. Strain gauge characteristics and weight measurement.
2. Measurement of pressure using bellows, diaphragm, bourdon tube, manometer.
3. Test and calibration of pressure gauges using dead weight tester.
4. Measurement of flow using orifice/venturi tube/nozzle/pitot tube.
5. Measurement of flow using rotameter.
6. Measurement of flow using electromagnetic flow meter.
7. Study and characterization of pH meter.
8. Study and characterization of conductivity meter.
9. Humidity measurement.
10. Viscosity measurement.

**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.

**Text Books**:


1. Nakra B.C., Chaudhary K.K., Instrumentation Measurement and Analysis, Tata Mc Graw Hill.
2. Sawhney 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., "Instrument engineer's handbook – Process measurement and analysis".
3. Douglas M. Considine, "Process Instruments and controls", Handbook, Mc Graw Hill.
4. Curtis Johnson, "Process Control Instrumentation Technology", 8th ed, 2005.
5. Rangan, Mani, Sarma, "Instrumentation Systems and Devices", 2nd ed., Tata Mc Graw Hill.
6. Andrew Williams, "Applied Instrumentation in process industry", Vol-I, Gulf publishing company.
7. Bansal R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi publications.
8. David W. Spitzer, "Industrial Flow Measurement", ISA Publication.

| Sub code | Subject Name | Teaching Scheme(Hrs) | | | Credit Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| ISC406 | Application Software Practices | - | 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 --) | | | | Term Work | Pract. and oral | Oral | Total |
| | | Internal Assessment (out of --) | | | End sem Exam | | | | |
| | | Test 1 | Test 2 | Avg. | | | | | |
| ISC406 | Application Software Practices | - | - | - | - | 25 | 25 | - | 50 |

| Subject Code | Subject Name | Credits |
|---|---|---|
| **ISC406** | **Application Software Practices** | **2** |
| **Course Objectives** | • To study LabVIEW software for creating custom applications that interact with real-world data or signals in fields of science and engineering. | |
| **Course Outcomes** | • The course would enable the students to develop customized virtual instruments and represent them in the required format with user friendly graphical user interface in the field of Engineering. | |

| Module | Topics | Hrs. |
|---|---|---|
| 1 | LabVIEW Programing: Components of virtual instrument, creating VI and sub-VI, LabVIEW data types, debugging techniques. | 04 |
| 2 | Structures- case structure, sequence structures, formula nodes and mathscript loops- shift registers and feedback node, Arrays and clusters. | 06 |
| 3 | Arrays and clusters, strings and file I/O | 06 |
| 4 | Plotting data -- graphs and charts, local and global variables, Express VI | 04 |
| 5 | Introduction to terms: Measurement system, sampling, calibration, measurement hardware- configuration. | 02 |
| 6 | Data Acquisition cards, LabVIEW modules and toolsets, general applications of LabVIEW. | 02 |

**List of Suggested Programs**

1) To develop a VI to calculate speed, convert degree Celsius to degree Fahrenheit, compute the given equations etc.
2) To develop a VI to calculate factorial of a given number, addition of first 10 numbers etc. using loops
3) To develop a Sub VI to calculate average of given numbers, solve the given series etc.
4) Build a VI to plot circle in XY graph, generate and plot random numbers on chart, different colors in an intensity graph etc with graph, chart properties and options.
5) To create VI student database, library database etc. using array and cluster functions.
6) To create VI to find roots of quadratic equation, user defied unit conversions etc using case structure.
7) To create VI to simulate traffic light control, stirred tank heater etc. using Sequence structure.
8) Develop a VI to storing all the points of simulated signal, storing all iterations from experiment 2 etc. using File I/Os.
9) Applications of LabVIEW in analog electronics—simulation of RC circuit characteristics, diode characteristics etc.
10) Applications of LabVIEW in digital electronics—half adder, full adder, binary to decimal conversion etc.
11) Applications of LabVIEW in process —tank level/temperature control, alarm annunciator, batch process control etc.
12) Applications of LabVIEW in control —simulate first and second order system response, effect of damping factor etc,
13) Write a VI to compute Matrices calculations like transpose, rank, inverse, determinant, eigen values etc.
14) Write a VI to carry out Signal analysis like spectral measurements, statistics, filtering, curve fitting etc using express VIs.
15) To design VI for simulation of To create VI for controlling multiple parameters ( Sub VI and main VI)
16) Measurement of AC/ DC voltage and current using DAQ cards.

**Practical/Oral Examination**:

Practical/Oral examination will be based on entire syllabus.

**Term Work:**

Term work shall consist of minimum 12 programs out of which minimum 6 Programs from 1 to 6 and any 6 from the remaining list of suggested programs.

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

| | |
|---|---|
| Laboratory work (Programs) | : 10 Marks |
| Laboratory work (Journal/Test) | : 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.

**Reference Books:**


1. Robert Bishop, "Learning with LabVIEW ™ 7 express", Pearson Education, 2005.
2. Jovitha Jerome, "Virtual Instrumentation", PHI, 2010.
3. Gupta S, "Virtual Instrumentation Using LabVIEW", Tata McGraw Hill Publishing Company Limited.
4. LabVIEW users manual.
5. National instruments Product catalog.

**Website**: www.ni.com