NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Syllabus for

Second Year Instrumentation Engineering

Faculty of Engineering and Technology

COURSE OUTLINE

SEMESTER – III and IV

W.E.F 2013 – 2014

North Maharashtra University, Jalgaon

Syllabus structure for second year Instrumentation Engineering w.e.f 2013-2014.

SEM III

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs /wk	Tutorial Hrs/wk	Practical Hrs/wk	Total	ISE	ESE	ICA	ESE		
	Engineering Mathematics-III(TH)	A	3	1	---	4	20	80	---	---	100	4
	Electrical Machines & Networks(TH)	B	3	---	---	3	20	80	---	---	100	3
	Analog Circuits & Analysis(TH)	D	3	1	---	4	20	80	---	---	100	4
	Measurement Fundamentals(TH)	D	3	---	---	3	20	80	---	---	100	3
	Computational Methods & Programming(TH)	D	3	---	---	3	20	80	---	---	100	3
	Soft skill – III(LAB)	C	1	---	2	3	---	---	50	---	50	2
	Electrical Machines & Networks(LAB)	B	---	---	2	2	---	---	50	---	50	1
	Analog Circuits & Analysis (LAB)	D	---	---	2	2	---	---	25	25 (PR)	50	1
	Measurement Fundamentals(LAB)	D	---	---	2	2	---	---	25	25 (PR)	50	1
	Computational Methods & Programming(LAB)	D	---	---	2	2	---	---	25	25 (OR)	50	1
Total			**16**	**2**	**10**	**28**	**100**	**400**	**175**	**75**	**750**	**23**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA : Internal Continuous Assessment

North Maharashtra University, Jalgaon

Syllabus Structure for second year Instrumentation Engineering w.e.f 2013-14.

SEM IV

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs /wk	Tutorial Hrs/wk	Practical Hrs/wk	Total	ISE	ESE	ICA	ESE		
	Electronic Instrumentation (TH)	D	3	--	---	3	20	80	---	---	100	3
	Signals & Systems (TH)	D	3	1	---	4	20	80	---	---	100	4
	Automatic Control Systems (TH)	D	3	1	---	4	20	80	---	---	100	4
	Sensors & Transducers (TH)	D	3	---	---	3	20	80	---	---	100	3
	Digital Circuits Design (TH)	D	3	---	---	3	20	80	---	---	100	3
	Programming in MATLAB (LAB)	B	1	---	2	3	---	---	50	-	50	2
	Electronic Instrumentation (LAB)	D	---	---	2	2	---	---	50		50	1
	Automatic Control Systems (LAB)	D	---	---	2	2	---	---	25	25 (OR)	50	1
	Sensors & Transducers (LAB)	D	---	---	2	2	---	---	25	25 (PR)	50	1
	Digital Circuits Design (LAB)	D	---	---	2	2	---	---	25	25 (PR)	50	1
Total			**16**	2	**10**	**28**	**100**	**400**	**175**	**75**	**750**	**23**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA : Internal Continuous Assessment**

Course Title	Short Title	Course Code
Engineering Mathematics-III	**EM-III**	

Course Description:

This course is an advanced level Engineering Mathematics which will further strengthen the knowledge of the students who have completed Engineering Mathematics I and II in their first year which were elementary in nature. The course coverage explores Liner Differential Equation**,** function of a complex variable, Integral transforms like Laplace, Fourier, and Z-transform and vector integration. The goal of this course is to understand various differential equations and their solutions with various Integral Transform techniques, together with vector integration and their applications in engineering field.

Lectures	**Hours/Week**	**No. of Weeks**	**Total Hours**	**Credits**
	03	**14**	**42**	**04**
Tutorial	**01**	**14**	**14**	

Prerequisite Course(s): knowledge of HSC , Engineering Mathematics –I & Engineering Mathematics –I subject of first year of engineering.

Objectives of the subject:

1. Students will understand second and higher order differential equations and their solutions by general method as well as some short cut methods. Also application of differential equations to electrical engineering problems are discussed which will allow them to apply to engineering problems.
2. Students will understand function of a complex variable, definition of analytic function and its use in solving real or complex integration. Cauchy Integral theorem and Cauchy residue theorem are very important tools in solving many problems. They will learn these techniques.
3. Students will understand integral transforms such as Laplace transform (L.T.) of a function in t-domain. They will learn L.T. and their inverses of various standard functions as well as special functions such as Heaviside function, Dirac delta function, error function etc. Also they will learn the techniques to solve Initial Value Problems through Laplace transform techniques.
4. Students will understand Fourier transforms, Fourier Sine Transforms, Fourier Cosine transforms and their Inverses which are again very useful in solving Initial Value Problems.
5. Students will also learn Z-Transform and their inverses.
6. Students will understand vector integration such as line integral, surface integral etc which is very much essential in various problems.

7. Students will also learn the important theorems of vector integration like Green's, Gauss' and Stokes' theorems.
8. Students will learn Maxwell's equations which are very important for them.

Course Outcomes:

Upon successful completion this course a students will be

1. Able to apply methods of solving differential equations to the engineering problems they face in industry.
2. Able to understand analytic function of a complex variable. Able to apply Cauchy Integral theorem and Cauchy residue theorem to solve contour integrations
3. Able to apply Laplace Transform and Inverse Laplace Transform which are very useful in solving Initial Value Problems.
4. Able to apply Laplace Transform in solving problems related to their engineering field and other future courses.
5. Able to use Fourier transforms, Fourier Sine Transforms, Fourier Cosine transforms, Z transforms and their Inverses to solve various integration problems.
6. Able to use mathematics in higher studies for analysis and optimal design of system.

Engineering Mathematics – III

(Course Contents)

Semester-III **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

Tutorials : 1 Hr/Week **(ESE) End Semester Exam duration: 03 Hours**

UNIT-I: Linear Differential Equations: 09 Hours, 16 Marks

a. Solution of LDE of order n with constant coefficients.
b. Method of variation of parameters (Only Second Order).
c. Cauchy's linear equation.
d. Legendre's linear equation.
e. Applications of Linear differential equations to electrical circuits.

UNIT-II: Function of Complex Variable 09 Hours, 16 Marks

a. Analytic Functions, Cauchy-Riemann equations.
b. Cauchy's Residue theorem (Without proof)
c. Cauchy's Integral theorem and Cauchy's Integral Formula (without proof).
d. Conformal mapping, Bilinear transformations.

UNIT-III: Laplace Transform 08 Hours, 16 Marks

a. Definition and Existence of Laplace transforms.
b. Laplace Transform of elementary/standard functions.
c. LT of some special Functions viz., error, Periodic, Unit step, unit Impulse.
d. Theorems & Properties of Laplace Transform (without proof).
e. Inverse Laplace Transform.
f. Applications of LT for Network Analysis.
g. Applications of LT to solution of linear differential equation.

UNIT –IV: Fourier Transform and Z-Transform 08 Hours, 16 Marks

F) Fourier Transform:

a. Introduction to Fourier Integral theorem.
b. Fourier Transforms, Fourier Cosine Transforms, Fourier Sine Transform and their inverse.

G) Z-Transform:

a. Definition and standard properties (without proof)
b. Region of Convergence.
c. Z-Transform of standard /elementary sequences.
d. Inverse Z-transform.

UNIT-V: Vector Calculus and its applications **08 Hours, 16 Marks**

a. Introduction to Gradient, Divergence, Curl, Solenoid and Irrotational vector fields.
b. Vector integration: Line Integral, Surface and Volume integrals.
c. Gauss's Stokes and Green's Theorems (without proof).
d. Applications to Maxwell's equation.

Reference Books:

1. H.K. Dass "Advanced Engineering Mathematics" S. Chand Publication, New Delhi.
2. Erwin Kreyszig "Advanced Engineering Mathematics" Wiley Eastern Ltd.
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi
4. Wylie C.R. & Barrett , "Advanced Engineering Mathematics," Mc Graw Hill
5. B.V. Raman "Engineering Mathematics"Tata Mc- Graw – Hill.
6. N. P. Bali, "A Text Book of Engineering Mathematics", Laxmi Publication
7. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Electrical Machines and Networks	**EMN**	

Course Description:

The course considers the basic principles of electrical machines. In this course comprises of the basic concepts and terminology that are used in modern electrical engineering. The students can use this knowledge to analyze electrical networks, D.C. machines, A.C. machine & transformer etc.

Lecture	Hours / Week	No. o f Weeks	Total Hours	Semester Credits
	03	14	42	03

Prerequisite Course(s): knowledge of Elements of Electrical and Electronics Engineering.

General Objectives:

The objective of the course is to provide students with a firm grasp of the essential principles of d c machines and their classifications. The course aimed at acquiring an understanding of basic principles, operation, performance and control of electrical machine and transformer. The subject is helpful in the study of technological aspects such as utilization of electrical energy, switch gear & protection, manufacturing processes, testing, automation & maintenance of electrical machines. The subject provides scope of higher study and able to use updated software and tools.

Course Outcomes: Upon successful completion of this course the students will be able to:

1. Apply basic Knowledge of science and mathematics for understanding the subject electrical machines and network.
2. Understand the working principles, classifications of dc and ac electrical machines.
3. Analyze the characteristics, Controls, power stages and applications of dc machine and ac machines.
4. Find the application of electrical machine and their control in manufacturing fields.
5. Understand the concept, construction and working of transformer.
6. Discharge the professional duties in automation field for economical development.

Electrical Machines and Networks

(Course Contents)

Semester-III **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit-I: Three phase circuits & A.C. circuits **09 Hours, 16 Marks**

a. Thevenin's, Norton's theorem's application for AC network.
b. Three phase circuit power measurement (Star and Delta load).
c. Single watt meter, two Watt meter method.
d. Active, reactive, apparent power and power factor.

Unit-II: DC Machines **09 Hours, 16 Marks**

a. DC machine construction.
b. EMF equation of Generator, working principle (series & shunt).
c. Motor working principle; back EMF (series & shunt).
d. Torque equation and speed equation of motor.
e. Characteristics, losses and power stages of generator & motor.
f. Necessity of starter (3-point starter).

Unit-III: Single phase & three – phase transformers **08 Hours, 16 Marks**

a. Transformers construction, EMF equation, working Principle: 1ϕ and 3ϕ.
b. Transformer phasor diagram no load & on load.
c. C.T, P.T. & Auto-transformer.
d. Open circuit and short circuit tests, Efficiency and regulation.

Unit-IV: Synchronous Machines **08 Hours, 16 Marks**

a. Alternator construction, principle of operation and EMF equation.
b. Principle of operation of synchronous motor.
c. Synchronous Motors on load with different excitation.
d. Explain hunting in synchronous motor.

Unit-V: Induction Motors **08 Hours, 16 Marks**

a. Three phase I.M. construction.
b. Principle of working of three-phase I.M.
c. Slip, torque equation (T_{st} & T_{max}) & torque - slip characteristics.
d. Types of starters (DOL, star-delta, auto-transformer).
e. Special machines working, data analysis and application.

Reference Books:

1. B. Theraja, A. Theraja, "A Text book of Electrical Technology- Vol-I",S. Chand, 1st Edition, 2010.
2. B. Theraja, A. Theraja, "A Text book of Electrical Technology- Vol-II", S. Chand, 1st Edition, 2010.
3. P. S Bimbhra, "Electrical Machinery" 2/E, Khanna Publishers
4. Ashfaq Husain, "Electrical Machines", Dhanpat Rai & Co.
5. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Analog Circuits and Analysis	**ACA**	

Course Description:
This course provides knowledge about basic analog electronics components to familiarize students with construction, their working, operation, performance and applications.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**3**	**14**	**42**	**4**
Tutorial	**1**	**14**	**14**	

Prerequisite Course(s): Knowledge of HSC & FE level.

General Objectives:
Understand the operating principles of major electronic devices, circuit models and connection to the physical operation of device. Be able to apply this knowledge to the analysis and design of basic circuits. Have the ability to analyze and design discrete electronic circuits. Get some practical knowledge about the design and analysis of basic electronic circuits. Learn how to design, analyze and test multi-stage amplifiers, feedback amplifiers.

Course Outcomes:
Upon successful completion of this course the students will be able to:

1. Apply basic Knowledge of science and engineering subject to understand the working principles, classifications of analog electronics components.
2. Understanding construction and working principal of BJT and Field Effect Transistor and its applications.
3. Analyze the characteristics and applications of transistors.
4. Understanding construction and design of multi-vibrators and oscillators.
5. Understanding the basic theorems of network circuits required for circuit analysis.
6. Do higher studies in advance electronic component for reliable automation system for economical developments.

Analog Circuits and Analysis

(Course Contents)

Semester-III **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

Tutorials : 1 Hr/Week **(ESE) End Semester Exam duration: 03 Hours**

Unit – I: **Diode Theory** **09 Hours,16 Marks**

a. Basic review of diode theory & Types of diode & their applications.
b. Rectifiers.
c. Filters.
d. Clippers, clampers.
e. Voltage Multipliers-Doubler, Trippler, quadrupler.
f. Voltage regulator.
g. Diode current equation.

Unit – II: **Basic Review of Transistor Configuration** **09 Hours,16 Marks**

a. Transistor biasing & Thermal stabilization.
b. Bias compensation, Thermal runaway, Load line, Q -point.
c. Transistor at low frequencies (h-parameter).
d. Transistor at high frequencies (h-parameter).
e. Transistor amplifier class A, B &AB.
f. Darlington circuits, Frequency response of amplifier.
g. Oscillators, Multivibrators.

Unit – III: **Basic Review Of Field Effect Transistor** **08 Hours,16 Marks**

a. Small signal FET analysis & FET applications.
b. Single stage amplifier.
c. Analog switches.
d. Voltage variable resistance.
e. UJT & its application.
f. MOSFET & its application.
g. IGBT & its application.

Unit – IV: **Development of Circuits** **08 Hours,16 Marks**

a. Charge & Energy, Relationship of field & Circuit concepts.
b. The Capacitance Parameter, The Inductance Parameter.
c. The resistance Parameter, Units & Scaling.
d. Approximation of a physical system as a circuit.
e. Topological Description of Network.
f. Steady state & Transient Response.
g. DC response of an RL, RC & RLC Circuits ,Sinusoidal response of RL, RC & RLC circuits.

Unit – V: **Network Analysis** **08 Hours,16 Marks**

a. Network Definition , Network Equations ,Kirchhoff's laws.
b. The Number of Network Equation , Source Transformation , Examples of the formulation of Network equation .
c. Loop & Node Variable analysis, Determinants-Minors & Gauss Method.
d. Duality, State Variable analysis.
e. Impedance functions & Network Theorems –The concept of complex frequency.
f. Transform Impedance & Transform Circuits, Series & parallel combination of elements
g. Superposition & Reciprocity, Thevenin's Theorem.
h. Norton's Theorem, Reduction of complicated networks.

Reference Books:

1. A. Mottershead , "Electronic Devices & Circuits", Prentice Hall of India.
2. A. P. Malvino, "Electronic Principles", Tata McGraw-Hill Publishing Company Limited India.
3. J. Millman & C. Halkis, "Electronic Devices and Circuits", Tata McGraw Hill Publication Company Limited India.
4. Donald A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw-Hill.
5. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", Eighth edition, PHI publishers, 2004.
6. N. C. Goyal and R. K. Khetan, "A Monograph on Electronic Design Principles", Khanna Publishers.
7. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Measurement Fundamentals	**MF**	

Course Description:
This course provides knowledge about measuring instruments and standards. It also gives introduction to recorders, oscilloscopes, errors in measurements. It will give knowledge about ac and dc bridges.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**3**	**14**	**42**	**3**

Prerequisite Course(s): Knowledge of HSC & FE level.

General Objectives: To expose the students to a broad knowledge of experimental methods and measurement techniques. To train the students in the skill of operation of instruments in the electrical & electronic engineering applications. To understand the basic working of instruments. To understand the errors in measurements and their rectification. To gain proficiency in the use of common measuring instruments. To compare theoretical predictions with experimental results and to resolve any apparent differences.

Course Outcomes:
Upon successful completion of this course the students will be able to:

1. Understand the basic concepts in measurement and measuring instruments.
2. Understand the working principles of measuring instruments and their applications with extension of ranges.
3. Understand the need and process of standardization, calibration of instruments, their significance in process and manufacturing industries for international acceptance.
4. Select instruments on basis of accuracy, sensitivity and response time in generation transmission, manufacturing, power system, testing and energy auditing purposes.
5. Perform technical and professional duties in any type of industries.
6. Do higher studies and able to use of modern instruments for techno-economical developments.

Measurement Fundamentals

(Course Contents)

Semester-III **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit – I: **Introduction to Measurement and Standards** **09 Hours,16 Marks**

a. Definition of instrumentation, Static &dynamic characteristics of instruments, types of error & their remedies.
b. Data types. Statistical treatment of experimental data, system accuracy calculation.
c. Comparison of analog & digital instruments, instrument specifications.
d. Terminology as per ISA standards.
e. Standards for time, current, voltage, frequency etc.
f. ANSI, ASME, ASA, BS, DIN, FCI, API, ISI, BIS, NEMA standards.

Unit – II: **Measuring instruments & their responses** **09 Hours,16 Marks**

a. DC instruments- Galvanometer, ammeter, voltmeter, ohmmeter, multimeter.
b. Design and operation of multi-range ammeter, voltmeter & ohmmeter.
c. Megger, design & operation..
d. Shunt meters & multipliers, design & operation. Calibration of meters.
e. AC instruments: ammeter, voltmeter, electrodynamometer.
f. Phase & line frequency meter, energy meter, testing & calibration of meters.

Unit – III: **DC and AC Bridges** **08 Hours,16 Marks**

a. Wheatstone bridge design. Bridge sensitivity.
b. Analysis of thevenin's theorem, Errors in measurement, null type & deflection type-their comparison.
c. Current & voltage sensitive bridge, Kelvin bridge.
d. Maxwell bridge.
e. Hay bridge.
f. Wein bridge.
g. Anderson bridge
h. Schering bridge
i. Storage factor, dissipation factor, their measurement. Phaser diagram.

Unit – IV: **Potentiometers and Recorders** **08 Hours,16 Marks**

a. Potentiometers: principle, calibration, sensitivity of potentiometer.
b. Self balancing potentiometer.
c. Multi-range potentiometer
d. Recorders: Rectilinear recorder, inject, ink pen.
e. Thermal galvanometric recording, magnetic, paperless, oscilographic, hybrid recording,

f. Y-T, X-T single, multichannel recorders.
g. Driving systems for pen & chart, chart speed & their applications.

Unit – V: **Cathode Ray Oscilloscope(CRO)** **08 Hours,16 Marks**

a. General purpose CRO, CRT block diagram.
b. Controls on CRO panel.
c. Measurement of amplitude, phase, frequency, time, duration, rise & fall time.
d. Z-modulation, X-Y mode.
e. Dual trace oscilloscope
f. Dual beam CRO.
g. Sampling oscilloscope.
h. Details of DSO, Per-trigger, CRO probe,
i. Analog storage oscilloscope.

Reference Books:

1. A.K. Sawhney, "A course in Electrical & Electronic Measurements & Instrumentation", Publication Dhanpat Rai & Sons.
2. Helfrick and Cooper, "Modern Electronic Instrumentation & Measurement Techniques", Publisher- Pearson.
3. V. Popov, "Electrical Measurements", Publication – Mir, Moscow.
4. Jones and Chin, "Electronics Instruments & Measurements", Tata McGraw Hill.
5. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Computational Methods and Programming	**CMP**	

Course Description:
This course provides knowledge about numerical methods and their use in engineering.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**3**	**14**	**42**	**3**

Prerequisite Course(s) : Knowledge of mathematics and sciences at HSC & First Year Engineering.

General Objectives:
To familiarize with number system in computations, polynomial equations, concept of roots of an equation & methods to find the same. To study various differentiation & integration methods. To understand the tradeoff between programming ease, computation time, data storage, truncation and round off errors.

Course Outcomes: Upon successful completion of this course the student will be able to:

1. Solve polynomial and transcendental equations,
2. Solve linear algebraic equations, simultaneous equations.
3. Solve Interpolate by Lagrange's & Newton methods.
4. Solve by different differentiation & integration methods.
5. Solve ordinary differential equations by using Euler's method, Runge-Kutta method, Taylor's Method, Predictor - Corrector method etc.
6. Develop computer program for higher studies in system optimizations.

Computational Methods and Programming

(Course Contents)

Semester-III **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit – I: **Computer Arithmetic** **09 Hours,16 Marks**

a. Floating point representation.
b. Arithmetic operation with normalized floating point numbers.
c. Inherent error. absolute & relative error solution of simultaneous algebraic equation
d. Gauss elimination method,
e. Iterative methods their convergence. Three Conditions equation.
f. Decompositions methods

Unit – II: **Interpolation** **09 Hours,16 Marks**

a. Lagrange's interpolation.
b. Difference table.
c. Newton's interpolation.
d. Interpolation, iterated linear interpolation technique.
e. Solution of non linear equations
f. Bisection method.
g. False position method.
h. Newton Raphson method.
i. Method of successive approximation.

Unit – III: **Numerical Integration** **08 Hours,16 Marks**

a. Trapezoidal mile.
b. Simpson's 1/3& 3/8 rule.
c. Romberg integration.
d. Newton's cote's integration formula, error in these formulae,
e. Simplex Method (Graphical & Numerical)

Unit – IV: **Solution of Ordinary Differential Equation** **08 Hours,16 Marks**

a. Taylor series method.
b. Picard's method.
c. Euler method.
d. Runga-Kutta second order method.
e. Runga-Kutta fourth order method.
f. Predictor Corrector method Numerical solution of partial differential equation
g. Finite difference, approximation to derivative.
h. Laplace equation.
i. Iterative methods for the solution of equation.

Unit – V: **Least Square Approximation of Function** **08 Hours,16 Marks**

a. Linear regression, polynomial regression.
b. Fitting exponential& trigonometric function.
c. Data fitting with cubic splines.
d. Approximation of function.

Numerical Solution of Integral Equation

e. Finite difference methods.
f. Chebyshev series method.
g. Method using Generalized Quadrature.
h. Method for degenerate kernels.
i. Method of Invariant embedding.

Reference Books:

1. V. Rajaraman, "Computer Oriented Numerical Method"- Prentice Hall of India.
2. S.S. Shastry, "Introductory Methods of Numerical Analysis"., Prentice Hall of India
3. Thomas Richard Mecalla "Introduction to Numerical Methods and FORTRAN programming", Willey International Edition.
4. Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers", Mc-Graw-Hill Publications.
5. B.S. Grewal, "Numerical Methods in Engineering & Science", Khanna Publishers.

Course Title	Short Title	Course Code
Soft Skills – III	**SK-III**	

Course Description: Through this course we have tried to prepare the students for the industry. Most companies test mathematical and logical ability through an aptitude test. This subject aims at working on these skills of a student through strategies formulae and practice exercises.

Lecture	Hours per Week	No. of Weeks	Total Hours	Semester Credits
	1	14	14	2
Practical	2	14	28	

Prerequisite Course(s): Fundamental knowledge of High School Mathematics.

COURSE CONTENT

Semester-III **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 50 Marks**
Lectures : 1 Hrs/Week
Practical : 2 Hrs/Week

Unit-I: Arithmetic-1 **04 Hours, 10Marks**

a. Basic Formulae

i. Divisibility Rules
ii. Speed Maths
iii. Remainder Theorem
iv. Different Types of Numbers
v. Applications

b. HCF, LCM and Linear Equations

i. HCF – Successive Division and Prime Factorization Methods
ii. LCM – Successive Division and Prime Factorization Methods
iii. Applications
iv. Linear Equations – Elimination Method
v. Substitution Method
vi. Applications

c. Averages and Mixtures

i. Concept of Average

ii. Faster Ways of Finding It
iii. The Allegation Method
iv. Applications

Unit-II: Arithmetic–II **04 Hours, 10Marks**

a. Percentages

i. Concept of Percentage
ii. Working with Percentages
iii. Applications

b. Profit and Loss

i. Difference between Cost and Selling Price
ii. Concept of Profit Percentage and Loss Percentage
iii. Applications

c. Time and Work

i. Basic Time and Work Formula
ii. Relation between Time and Work
iii. Applications

Unit-III: Arithmetic–III **03 Hours, 10Marks**

a. Permutations and Combinations

i. Sum Rule of Disjoint Counting
ii. Product Rule of Counting
iii. Concept of Factorial
iv. Permutations
v. Linear Permutations
vi. Combinations
vii. Circular Permutations
viii. Applications

b. Probability

i. Definition and Laws of Probability
ii. Mutually Exclusive Events
iii. Independent Events
iv. Equally Likely Events
v. Exhaustive Events
vi. Cards
vii. Dice
viii. Applications

c. Time and Distance

i. Speed
ii. Conversion Factors for Speed
iii. Average Speed
iv. Moving Bodies – Passing, Crossing and Overtaking
v. Relative Speed
vi. Boats and Streams
vii. Applications

Unit-IV: Non-Verbal Reasoning **03 Hours, 10Marks**

a. Analogies

i. Examples
ii. Applications

b. Classification

i. Examples
ii. Applications

c. Sequences

i. Examples
ii. Applications

Unit-V: Analytical Reasoning **03 Hours, 10Marks**

a. Analytical Puzzles

i. Classification Puzzles
ii. Ordering Puzzles
iii. Assignment Puzzles
iv. Applications

b. Letter and Number Series

i. Different Types of Letter Series
ii. Different Types of Number Series
iii. Mixed Series

c. Coding and Decoding

i. Letter Coding
ii. Number Coding
iii. Mixed Coding
iv. Odd Man Out
v. Applications

Guide lines for ICA:

ICA will be based on credit tests and assignments submitted by the student in the form of journal.

Reference Books:

1. R. S. Aggarwal, "Quantitative Aptitude", S. Chand Publication, New Delhi, 2012.
2. R. S. Aggarwal, "A Modern Approach to Verbal Reasoning", S. Chand Publication, New Delhi, 2012.
3. R. S. Aggarwal, "A Modern Approach to Non-Verbal Reasoning", S. Chand Publication, New Delhi, 2012.

Course Title | Short Title | Course Code

Electrical Machines and Network Lab | **EMN Lab**

Course Description:

In this laboratory, course emphasis on imparting the practical knowledge and understanding of basic principles, characteristic , performance and testing of DC and AC Machines, Speed control DC Motor and use of other measuring equipment their class of accuracy. It also give the platform to understand construction, working , performance , testing and selection of transformer.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Practical	**2**	**14**	**28**	**1**

Prerequisite Course(s): Knowledge of HSC and First year Engineering.

General Objectives:

The objective of the laboratory is to impart the fundamental knowledge of Machines and transformers. Students develops their ability to apply the specific procedures to analyze the experimental results. The students will able to understand the characteristic of DC machines and application in process and manufacturing. In this lab course, students will be familiar with the use of different equipments, safety precautions on work place. This makes bridge on theoretical knowledge and practical practices.

Course Outcomes: After successful completion of this lab students will be able to:

1. Understand the methods of measurement of power.
2. Understand constructional details, specification of electrical machines.
3. Understand characteristic of different type of generator& motors.
4. Able to analyze the test data for practical applications, design and manufacturing processes.
5. Understand methods of speed control, starters for dc motors, precautions and safety while handling of machines.
6. Conduct various tests on transformer for determination of performance.
7. Do professional duties in technical field for economical development.

Electrical Machines and Network Lab

(Lab Course Contents)

Semester-III **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 50 Marks**

Practical : 2 Hrs/Week

1. **Two Wattmeter method of power measurement in three phase balanced load.**
    a. Measure the line Voltage for star / delta inductive load.
    b. Measure the line current for star / delta inductive load.
    c. Measure the power of wattmeter's.
    d. Draw the phasor diagram for the star / delta inductive load.
    e. Calculate total power.
2. **Speed control of D.C. shunt motor by armature voltage and flux control method**.
    a. Measure armature voltages of D.C. shunt motor.
    b. Measure the field current of D.C. shunt motor.
    c. Plot graph for measure values voltages and field current.
    d. Verification of characteristics of motor.
3. **Load test on three phase induction motor.**
    a. Measure input Voltage and current of motor.
    b. Measure output speed of motor.
    c. Measure output torque of motor.
    d. Calculate the input power of motor.
    e. Calculate the output power of motor.
    f. Calculate the efficiency of motor.
    g. Verification of performance characteristics of motor.
4. **O.C. and S.C. test of single phase transformer to determine regulation and efficiency.**
    a. Measure the reading of ammeter.
    b. Measure the reading of voltmeter.
    c. Measure the reading of wattmeter.
    d. Calculate no load resistance & reactance.
    e. Calculate equivalent resistance, reactance and impedance.
5. **Load test on D.C. series motor**
    a. Measure load current IL.
    b. Measure armature current Ia.
    c. Verification of performance characteristics of motor.
6. **Study of specification & application single phase motors.**
    a. Describe working and construction.

b. Selection criteria for application.
c. Use of datasheet for same.
d. Assembly & dissembling.

7. **Study of specification & application of stepper motor.**
    a. Describe working and construction.
    b. Selection criteria for application.
    c. Use of datasheet for same.
    d. Assembly & dissembling.
8. **Study of specification & application of servo motor.**
    a. Describe working and construction.
    b. Selection criteria for application.
    c. Use of datasheet for same.
    d. Assembly & dissembling
9. **Study of specification & application of universal motors.**
    a. Describe working and construction.
    b. Selection criteria for application.
    c. Use of datasheet for same.
    d. Assembly & dissembling.
10. **Study of starter of three-point starter.**
    a. Identify and explain different parts of starter.
    b. Assembly & dissembling of starter.
    c. Connection of starter according to wiring diagram.
11. **Study of starter of star-delta starter.**
    a. Identify and explain different parts of starter.
    b. Assembly & dissembling of starter.
    c. Connection of starter according to wiring diagram.
12. **Study of starter of DOL starter.**
    a. Identify and explain different parts of starter.
    b. Assembly & dissembling of starter.
    c. Connection of starter according to wiring diagram.

Note: Lab file should consist of minimum **Eight** experiments

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Reference Books:

1. B. Theraja, A. Theraja, "A Text book of Electrical Technology- Vol-I",S. Chand, 1st Edition, 2010.
2. B. Theraja, A. Theraja, "A Text book of Electrical Technology- Vol-II", S. Chand, 1st Edition, 2010.
3. P. S Bimbhra, "Electrical Machinery"2/E, Khanna Publishers
4. Ashfaq Husain, "Electrical Machines", Dhanpat Rai & Co.

Course Title	Short Title	Course Code
Analog Circuits and Analysis Lab	**ACA Lab**	

Course Description:
In this laboratory, course emphasis on imparting the practical knowledge and understanding of basic principles, characteristic, performance of Electronic Components such as diodes, transistors and their applications is studied. It also give the platform to understand construction, working, performance, and testing of networks.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Practical	**2**	**14**	**28**	**1**

Prerequisite Course(s): Knowledge of HSC and First year Engineering.

General Objectives:
The objectives of the laboratory is to impart the fundamental knowledge of basic electronic components such as resistors, capacitors etc and other analog electronic components such as diodes and transistors. Students develop their ability to apply the specific procedures to analyze the experimental results. The students will able to understand the characteristic of transistors and applications in process. In this lab course, students will be familiar with the use of different analog electronic components.

Course Outcomes:
Upon successful completion of this course the students will be able to:

1. Apply basic knowledge of science and engineering to understand electronic circuits.
2. Conduct practical and able to analyze the data for determination of circuit parameters and response of electronic devices.
3. Understand the characteristics of different electronic component and their applications
4. Understand and implement simple digital electronic circuits, able to use updated software and tools for continuous updating of knowledge.

Analog Circuits and Analysis Lab

(Lab Course Contents)

Semester-III **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. To study characteristics of JFET and MOSFET.
2. To study clipping circuits.
3. To study clamping circuits.
4. To study voltage multiplier circuits.
5. To study half wave rectifier.
6. To study full wave rectifier.
7. To study frequency response of two-stage RC coupled amplifier.
8. To study Hartley oscillator. And Colpitt's oscillator
9. Design and implementation of Astable multivibrator and Monostable multivibrator
10. To study class AB push-pull power amplifier.
11. To study performance of emitter follower/Darlington emitter follower.
12. To study Thevenin's Theorem.

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work and performance in the practical.

Reference Books:

1. A. Mottershead , "Electronic Devices & Circuits", Prentice Hall of India.
2. A. P. Malvino, "Electronic Principles", Tata McGraw-Hill Publishing Company Limited India.
3. J. Millman & C. Halkis, "Electronic Devices and Circuits", Tata McGraw Hill Publication Company Limited India.
4. Donald A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw-Hill.
5. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", Eighth edition, PHI publishers, 2004.
6. N. C. Goyal and R. K. Khetan, "A Monograph on Electronic Design Principles", Khanna

Course Title	Short Title	Course Code
Measurement Fundamentals Lab	**MF Lab**	

Course Description:
In this laboratory, course emphasis on imparting the practical knowledge and understanding of measuring instruments, design of meters, recorders and oscilloscope.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Practical	**2**	**14**	**28**	**1**

Prerequisite Course(s): Knowledge of HSC and First year Engineering.

General Objectives:
The objective of the laboratory is to impart the fundamental knowledge of measuring instruments and students develop their ability to apply the specific procedures to analyze the experimental results. In this lab course, students will be familiar with the use of different instruments (ammeter, voltmeter, ohmmeter, recorders and oscilloscope etc). This makes bridge on theoretical knowledge and practical practices.

Course Outcomes:
Upon successful completion of this lab students will be able to:

1. Conduct practical and able to analyze the practical data for various purposes.
2. Measure various electrical quantities, non electrical quantities and circuit parameters.
3. Able to select the measuring instrument with proper range and type for practical uses.
4. Calibrate various types of instruments as per IS .
5. Do professional duties in technical field and able to use advance measuring instruments.

Measurement Fundamentals Lab

(Lab Course Contents)

Semester-III **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Design of multi-range ammeter.
2. Design of multi-range voltmeter.
3. Design of series type ohmmeter.
4. Design of shunt type ohmmeter.
5. Design of Wheatstones bridge.
6. Design and calibration of energy meter.
7. Design and calibration of wattmeter.
8. Voltage and frequency measurement on CRO using Lissajous pattern.
9. Study of digital voltmeter, digital multimeter.
10. Study of recorders.
11. Digital measurement of phase and frequency.
12. Study of AC and DC meters.

Note: Lab file should consist of minimum **Eight** experiments**.**

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work and performance in the practical.

Reference Books:

1. A.K. Sawhney, "A course in Electrical & Electronic Measurements & Instrumentation", Publication Dhanpat Rai & Sons.
2. Helfrick and Cooper, "Modern Electronic Instrumentation & Measurement Techniques", Publisher- Pearson.
3. V. Popov, "Electrical Measurements, Publication" – Mir, Moscow.
4. Jones and Chin, "Electronics Instruments & Measurements", Tata McGraw Hill.

Course Title | Short Title | Course Code

Computational Methods and Programming Lab | **CMP Lab**

Course Description:

In this laboratory, course emphasis on imparting the practical knowledge and understanding of numerical methods and simulate the methods.

Practical	Hours per Week	No. of Weeks	Total Hours	Semester Credits
	2	**14**	**28**	**1**

Prerequisite Course(s): Knowledge of HSC and First year Engineering.

General Objectives:

The objective of the laboratory is to impart the basic concept of numerical methods and their use in engineering applications. Further students have to implement the methods using softwares like C++, Matlab.

Course Outcomes: After successful completion of this lab students will be able to:

1. Use of method for solving the problems in engineering
2. Developing algorithm, flow-chart and computer program in any language.
3. Find out Integration using Trapezoidal method.
4. Find out roots of nonlinear equations.
5. To obtain solution of nonlinear differential equations.

Computational Methods and Programming Lab

(Lab Course Contents)

Semester-III **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(OR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. To find out the roots of the given polynomial by using Bisection method.
2. To find out the roots of the given polynomial by using false position method.
3. To find out the integration by using Trapezoidal method.
4. To solve the differential equation by using Runga kutta second order and forth order method.
5. To solve the differential equation by using Euler's method.
6. To find out the roots by using Newton-Raphson method.
7. To find out the integral by using Simpson's 1/3 rule and 3/8 rule.
8. To plot the straight line to the given data by using Simplex method.
9. To find out the optimal solution by using Least squares method.
10. To solve the differential equation by using Adam's Bashforth predictor and corrector method.

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked questions on practical. Evaluation will be based answers given by students in oral examination.

Reference Books:

1. V. Rajaraman , "Computer Oriented Numerical Method" Prentice Hall of India.
2. S.S. Shastry " Introductory Methods of Numerical Analysis"., Prentice Hall of India
3. Thomas Richard Mecalla "Introduction to Numerical Methods and FORTRAN Programming",Willey International Edition.
4. Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers", Mc-Graw-Hill Publication, 2007.
5. B.S. Grewal, "Numerical Methods in Engineering & Science", Khanna Publishers.
6. Steve Otto and James P. Denier "An Introduction to Programming and Numerical Methods in MATLAB" Springer
7. Rudra Pratap - Getting Started With Matlab 7 - Oxford University publications

NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Syllabus for

Second Year Instrumentation Engineering

Faculty of Engineering and Technology

COURSE OUTLINE

SEMESTER – IV

W.E.F 2013 – 2014

Course Title	Short Title	Course Code
Electronics Instrumentation	**EI**	

Course Description:
This course provides knowledge about Operational Amplifiers and their applications. Also the subject deals with signal sources and analysis. Design of voltage regulators and power supplies.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**3**	**14**	**42**	**3**

Prerequisite Course(s): Knowledge of HSC & First year Engineering.

General Objective:
The objective of the course is to provide students with a firm grasp of the essential principles of Operational Amplifiers and its applications as well as signal sources and signal analysis.

Course Outcomes:
Upon successful completion of this course the students will be able to:

1. Apply basic Knowledge of science and engineering subject to understand the concept, working and application of Operational Amplifier.
2. Understand concept of negative and positive feedback applications using Operational Amplifiers.
3. Understand the characteristics of operational amplifiers.
4. Understand fundamentals and design of different signal sources and voltage regulators.
5. Do higher studies in electronics instrumentation for modern automation and economical developments
6. Discharge the professional duties in field of instrumentation and automation.

Electronics Instrumentation

(Course Contents)

Semester-IV **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit – I: **Differential Amplifiers** **09 Hours , 16 Marks**

a. Dual input-balanced output ; single input-balanced output; their analysis,
b. Constant current bias, current mirror, level translators,
c. Basic Operational amplifier; equivalent circuit,
d. IC Operational amplifiers-characteristics, specification
e. Parameter measurements,
f. Frequency response, types (741,308,356,OP07) and their properties

Unit – II: **Applications of Operational Amplifier** **09 Hours , 16 Marks**

Negative feedback applications:

a. Voltage amplifier, current amplifier,
b. Voltage to current and current to voltage converter,
c. Op-amp as integrator and differentiator,
d. Instrumentation amplifier.

Positive feedback applications:

e. Crystal oscillator
f. Function generator.

Unit – III: **Comparators, Converters and Multivibrators** **08 Hours , 16 Marks**

a. Basic comparator, zero-crossing detector, Schmitt trigger.
b. Precision AC/DC converters, analog-to-digital and digital-to –analog converters.
c. Logarithmic amplifier, Clippers and clampers using op-amp.
d. Timer ICs.-Timer 555, its block diagram
e. Applications- astable , monostable multivibrater,
f. Timers- 7555 and XR2240, their block diagram and applications.
g. Phase locked loop (PLL)- operating principle, IC 565 applications,
h. Voltage controlled oscillator (VCO) and its applications.
i. Voltage to time, voltage to frequency converter.

Unit – IV: **Signal Sources and Analysis** **08 Hours , 16 Marks**

a. Sinusoidal signal sources, pulse generators, frequency synthesis, square wave generators, function generators.
b. Analog switches and multiplexers,
c. Sample and hold circuits, programmable amplifiers, lock in amplifiers.
d. distortion analyzer, wave analyzer,
e. spectrum analyzer, FFT analyzer,

f. logic analyzer, network analyzer,
g. optical spectrum analyzer and optical time domain reflectometer (OTDR)

Unit – V: Voltage Regulators and Power Supplies 08 Hours , 16 Marks

a. 3 terminal positive and negative voltage regulators, variable voltage regulators (3085,723), tracking regulators.
b. Active filters: Butterworth & Chebychev filter, design and evaluation of second order filters-low pass, high pass filter.
c. band pass, band reject and all pass filter.
d. Introduction to the unregulated power supply, DC voltage regulation, AC Ripple voltage.
e. Design procedure for a full-Wave Bridge unregulated supply.
f. Bipolar and two valve unregulated power supply, Need for voltage regulation, Linear IC voltage regulators, +/- 15V power supplies.
g. Adjustable three terminal positive voltage regulators (LM 317 HV) and negative voltage regulator (LM 337 HV).
h. Introduction to UPS and SMPS.

Reference Books:

1. Ramakant A. Gayakwad, "Op-Amp and Linear Integrated Circuits', Third edition, Prentice-Hall of India
2. Graeme,Tobey and Huelsman, "Operational Amplifiers: Design and Application", McGraw-Hill International edition.
3. D.Roy Choudhury and Shail Jaon, "Linear Integrated Circuits" New Age International
4. Albert Paul Malvino, "Electronic Principles" 6th edition, Tata McGraw-Hill.
5. Cooper and Helfric, "Electronic Instrumentation and Measurement Techniques", third edition, Prentice – Hall of India.
6. Chin and Jones, "Electronic Instrumentation and Measurement", wiley.
7. J.J.Carr, "Elements of Electronic Instrumentation and Measurement", second Edition, Reston.
8. Oliver and Cage, "Electronic Instrumentation and Measurement", McGraw-Hill.
9. Rangan, Sarma, Mani, "Instrumentation Devices and Systems", Tata Mcgraw Hill.
10. S.Soclof, "Application of Analog integrated circuits", prentice Hall.
11. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Signals and Systems	**SS**	

Course Description:
This course provides knowledge about basic analog electronics components to familiarize students with construction, their working, operation, performance and applications.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**3**	**14**	**42**	**4**
Tutorial	**1**	**14**	**14**	

Prerequisite Course(s): Knowledge of HSC & FE level.

General Objective:
The course is designed to provide the fundamental concepts in signals and systems. To obtain solid foundation in fundamentals of signals and systems. To gain an understanding of some of the very important and basic applications of these fundamentals to problems in filtering, sampling, communications and feedback systems analysis.To develop some appreciation for an extremely powerful and broadly applicable approach to formulating and solving complex problems.

Course Outcomes: Upon successful completion of this course the students will be able to:

1. Understand the different type of signal and mathematical treatments on signal.
2. Represent signals in deferent ways, and know properties of signals.
3. Analyze systems characteristics: homogeneity, time-invariance, linearity and superposition, stability, etc.
4. Apply knowledge of mathematics like Laplace transform, Z- transform and fourier transform on signal to analyze for higher studies and advancement in field of instrumentation.
5. Find transfer function (continuous and discrete-time systems) frequency response (continuous and discrete-time systems) of the systems

Signals and Systems

(Course Contents)

Semester-IV **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

Tutorials : 1 Hr/Week **(ESE) End Semester Exam duration: 03 Hours**

Unit – I: **Introduction to Signals and Systems** **09 Hours, 16 Marks**

a. Continuous Time and Discrete Time Signals: Various classifications; Mathematical representation; Signal Energy and Power.
b. Transformations of the Independent Variable; Periodic Signals; Even and Odd Signals.
c. Arithmetic Operations on Sequences; Continuous-Time and Discrete-Time Complex Exponential. The continuous-Time Unit Step and Unit Impulse Functions.
d. The Discrete-Time Unit Impulse and Unit Step Sequences.
e. Representation of Direct-Time Signals in Terms of impulse.
f. Continuous-Time and Discrete-Time Systems: Interconnections of Systems.
g. Basic System Properties (Causality, Stability, Time-Invariance, Linearity, Invertibility, systems with and without, memory).

Unit – II: **Linear Time Invariant systems and Properties** **09 Hours, 16 Marks**

a. Linear Time Invariant systems: The Discrete–Time and Continuous-Time LTI Systems; Unit Impulse Response.
b. Convolution Sum and Convolution Integral Representation. Properties of LTI Systems (Commutative, Distributive, Associative Properties, Invertibility, Causality, Stability).
c. The Unit Step Response of an LTI System; LTI Systems Described by Differential and the Difference Equations.
d. Block Diagram Representations; Singularity Functions.
e. Fourier Series Representation of Periodic Signals: The Response of LTI Systems to Complex Exponential.
f. Fourier Series Representation of Continuous-Time and Discrete–Time periodic Signals; Convergence of the Fourier Series.
g. Properties of Discrete-Time and Continuous-Time Fourier Series; Fourier Series and LTI Systems.

Unit – III: **Fourier Transform** **08 Hours, 16 Marks 16**

a. The Continuous-Time Fourier Transform: Representation of Continuous-Time Aperiodic Signals and Continuous-Time Fourier Transform.
b. The Fourier Transform for Periodic Signals.
c. Properties of Continuous-Time Fourier Transform; Fourier Transform and LTI Systems.

d. The Discrete- Time Fourier Transform: Representation of Discrete-Time Aperiodic signals and the Discrete-Time Fourier Transform.
e. Properties of the Discrete-Time Fourier Transform.
f. Discrete-Time LTI Systems and Discrete-Time Fourier Transform.

Unit – IV: **Analysis of Signals and Systems** **08 Hours, 16 Marks**

a. Time and Frequency Characterization of Signals and Systems: The Magnitude and Phase Representation of the Fourier Transform.
b. The Magnitude and Phase Representation of the Frequency Response of LTI systems.
c. Time Domain Properties of Frequency Selective Filters; First Order and Second Order Continuous-Time and Discrete Time Systems.
d. Time and Frequency Domain Analysis of Systems.
e. Sampling: Representation of a continuous–Time Signal by its Samples.
f. The Sampling Theorem; Reconstruction of Signals form its Samples using Interpolation; Effect of Under Sampling (Frequency Domain Aliasing).
g. Discrete Time processing of Continuous–Time Signals.

Unit – V: **Tools for analysis of Signal and Systems** **08 Hours, 16 Marks**

a. The Laplace Transform: The Laplace Transform; Region of Convergence for Laplace Transform.
b. Properties of Laplace Transform; Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot.
c. Analysis and Characterization of LTI Systems using the Laplace Transform.
d. System Transfer Function; Block Diagram Representations; The Unilateral Laplace Transform; Solution of Differential Equations using the Unilateral Laplace Transform.
e. The Z Transform; The Region of Convergence for the Z- Transform.
f. Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot.
g. Properties of Z-Transform; Analysis and Characterization of Discrete-Time LTI Systems using Z-Transform.
h. System Transfer Function; Block Diagram Representation; The Unilateral Z-Transform; Solution of Difference Equation using the Unilateral Z-Transform.

Reference Books:

1. A. V. Oppenheim, A. S. Willsky with S. H. Nawab, "Signals and Systems", Prentice- Hall of India Private Limited, Second Edition, 1997.
2. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, Inc., Second Edition, 1999.
3. M. J. Roberts, Signals and Systems: Analysis using , Transform Methods and MATLAB, Tata McGraw-Hill Publishing Company Limited, Second Edition, 2003.
4. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Automatic Control Systems	**ACS**	

Course Description:
This course provides knowledge about control systems, their stability analysis, Time domain analysis and frequency domain analysis of control systems.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**3**	**14**	**42**	**4**
Tutorial	**1**	**14**	**14**	

Prerequisite Course(s): Knowledge of HSC & FE level.

General Objective:
The objective of the course is to provide students with a firm grasp of the essential principles of control systems and their classifications. This course will help student to understand the concepts and terminologies that are used in control systems. A course aimed at acquiring an understanding of basic principles, operation, performance feedback control systems. The subject is helpful in the study of technological aspects such as stability of control systems, frequency domain analysis and time domain analysis.

Course Outcomes:
Upon successful completion of this course the students will be able to:

1. Understand Control system concept, basic control configurations and types of control systems.
2. Review of Laplace Transform and learn how to find mathematical model called transfer function.
3. Perform Time domain analysis of control systems and able to get Knowledge about stability of control systems.
4. Understanding frequency response analysis of control systems.
5. Understanding the concept of compensators and their design.
6. Do higher studies in design of control systems and advanced process automation.

Automatic Control Systems

(Course Contents)

Semester-IV **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

Tutorials : 1 Hr/Week **(ESE) End Semester Exam duration: 03 Hours**

Unit – I: **Introduction to Linear Control System** **09 Hours, 16 Marks**

a. Introduction to Laplace transform & its inverse.
b. Open loop & closed loop control system. Types of feedback control systems-linear v/s non linear systems. Time invariant v/s time varying.
c. Effect of feedback on gain, sensitivity, noise.
d. Continuous Data sampled & data control systems,
e. MIMO & SISO writing differential equations electrical, mechanical systems & to determine Transfer function.
f. Transfer function by block diagram reduction technique
g. Transfer function by signal flow graph analysis using mason's Gain formula.

Unit – II: **Time Domain Analysis of Control Systems** **09 Hours, 16 Marks**

a. Different test signals-step, ramp & parabolic.
b. Steady state response of various types (0, 1, 2, 3) of systems.
c. Steady state Performance specifications.
d. Time response of first order system.
e. Transient response of second order systems. Performance specifications.
f. Dominant poles of transfer function.
g. Stability of control systems. Absolute & relative

Unit – III: **Stability Of Control Systems** **08 Hours, 16 Marks**

a. Methods of determining stability of linear control systems.
b. Hurwitz criterion.
c. Routh-Hurwitz criterion.
d. Root locus technique,
e. Effect of adding pole zero on stability.
f. Root sensitivity-robustness of system.

Unit – IV: **Frequency Domain Analysis Of Control Systems** **08 Hours, 16 Marks**

a. Mapping theorem.
b. Stability analysis with Nyquist stability criterion.
c. Frequency domain characteristics.
d. Peak overshoot & Resonant frequency & the bandwidth of second order system,
e. Relative stability-gain margin, phase margin & peak overshoot.

Unit – V: **Graphical Methods For Stability Analysis** **09 Hours, 16 Marks**

a. Bode plot
b. Calculation of gain margin & phase margin
c. Importance of control system using Lead, Lag & Lead-Lag compensators
d. Constant M & N loci in magnitude v/s phase plane-Nichols chart.
e. Design of Lead, Lag, Lead-Lag Compensator using Root Locus and Bode Diagrams

Reference Books:

1. Benjamin C. Kuo, "Automatic Control Systems", Fifth Edition, Prentice-Hall of India.
2. M. Gopal, "Control Systems: Principles & Design". Tata MC-Graw-Hill.
3. K. Ogata, "Modern control Engineering".(1997 edition)
4. Norman S. Nise- "Control systems Engineering", Third Edition, John Wiley and Sons.Inc, Singapore, 2001.
5. R. C. Dorf and R.H. Bishop, "Modern Control Systems", Eighth edition, Addison-Wesley, 1999.
6. I.J. Nagrath and M. Gopal, "Control systems Engineering", Third Edition, New age International Publishers, India, 2001.
7. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Sensors and Transducers	**ST**	

Course Description:
This course provides knowledge about transducers for measurement of different parameters such as pressure, temperature, level, flow, humidity etc .

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**3**	**14**	**42**	**3**

Prerequisite Course(s): Knowledge of HSC & FE level.

General Objective:
The objective of the course is to provide students with a firm grasp of the essential principles of sensor and transducers.

Learning Outcomes:
Upon successful completion of this course the students will be able to:

1. Apply knowledge of material science and engineering for construction of sensor and transducers.
2. Analyze the characteristics of sensor and transducers for different applications.
3. Measure non electrical quantities like temperature, pressure and flow by transducers in manufacturing and process industries.
4. Develop the ladder diagram with combinations of sensor and transducers for reliable automation task.
5. Discharge professional duties in the field of automation.
6. Do higher studies in field of sensors and transducers for technical advancement in the field of automation and economical developments.

Sensors and Transducers

(Course Contents)

Semester-IV **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit – I: **Introduction to Transducers** **9 Hours, 16 Marks**

a. Transducer: Definition, classification, selection criteria.
b. Errors, loading effects, basic configuration of control system.
c. Transducer specifications.
d. Displacement, force and torque transducers.
e. Force measuring transducers, electrical load cell, LVDT.
f. Piezoelectric, vibrating type.
g. Torque-strain gauge and other suitable transducers.

Unit – II: **Speed, Vibration and Temperature Transducers** **9 Hours, 16 Marks**

a. Tachometers, toothed rotor tachometers,
b. Photoelectric, stroboscopic principal,
c. Theory of acceleration pick- ups, their calibration,
d. Type of accelerometer, Jerk meter.
e. Temperature Transducers : fills system thermometers,
f. semiconductor temperature detector(thermostat and p-n junction)
g. resistance thermometer,
h. thermometer ultrasonic, crystal , infrared thermometer

Unit – III: **Level and Flow Measurement** **8 Hours, 16 Marks**

a. Level transducers for liquid and solids- float type displacer.
b. Air plug method, diaphragm box level gauge.
c. DP cell, Load cell, bicolor direct reading.
d. Vibrating, Ultrasonic, radioactive transducers, Reed switches, microwave sensors.
e. Flow transducer: Basic measurement principle, Bernoulli's theorem.
f. Differential pressure type (orifice, venturi, pitot type).
g. Variable area type, target type, magnetic.
h. Ultrasonic vortex shedding, cross co-relation, positive displacement type.
i. Mass flow meter, anemometer, total flow meter.

Unit – IV: **Pressure, Viscosity Transducers** **08 Hours, 16 Marks**

a. Pressure transducer: Pressure scale and standards, manometer, elastic (Bellows, bourdon tube, diaphragm) type.
b. Dead weight and vaccum gauge, testers, electrical pressure sensors (LVDT, strain gauge, load cell, piezo- electric, capacitive).

c. Tuning fork type, differential sensors (capacitive, force balance and vibrating cylinder type).
d. Vacuum pressure measurement- McLeod gauge, thermal conducting and ionization type,
e. Transducers for very high pressure measurement.
f. Viscosity and density sensing and measurement: capillary type, Shearle's rotating cylinder, cone and plate, falling and rolling ball type viscometers.
g. Gravity meters, buoyancy type, DP cell type and electrical density sensors.

Unit – V: P^H, Conductivity, Humidity Sensors and Transducers 08 Hours, 16 Marks

a. PH and conductivity sensors: pH scale and standards, principle of pH measurement.
b. Different type of reference and measuring electrodes, ion selective electrodes.
c. Principle of conductivity measurement, conductivity cells and bridges-their application.
d. Effect of temperature on pH and conductivity sensors.
e. Humidity and misc. transducers: Pyrometer, Hygrometer (Hair, wire and Electrolysis type).
f. Dew point meter, piezoelectric humidity meter.
g. Infrared conductance and capacitive type probes for moisture measurement.
h. Flow detectors, leak detectors
i. Acoustic transducers and sound level measurement.

Reference Books:

1. Bentley J.P., "Principles of Measurement Systems", Third Edition, Pearson Education Asia pvt.ltd.
2. Doebelin, E.O., "Measurement Systems", McGraw Hill Book Co.
3. Patranabis D, "Sensors and Transducers", Wheeler Publishing Co., Ltd. New Delhi.
4. Murthy, D.V.S., "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd., New Delhi.
5. Neubert, H.K.P., "Instrument Transducers", Clarenden Press, Oxford.
6. R. K. Jain, "Mechanical and Industrial Measurement".
7. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Digital Circuits Design	**DCD**	

Course Description:

This course provides knowledge about number systems, digital circuits, combination logic design, sequential logic design, different converter circuits and different digital storage device such as ROM,RAM, EPROM,EEPROM,CAM.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**3**	**14**	**42**	**3**

Prerequisite Course(s): Knowledge of HSC & FE level.

General Objective:

The objective of the course is to provide students with a firm grasp of the essential principles of design of combinational and sequentional logic circuits.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Understand the conversion of different number system.
2. Analyze digital signals and different digital circuits.
3. Analyze the characteristics of different digital ICs.
4. Understand the different types of codes and code convertor circuit.
5. Comparison of digital logic families such as RTL, TTL, DCTL, DTL, PMOS & CMOS.
6. Understand DAC and ADC operations and digital storage devices.
7. Do higher studies in VLSI design.

Digital Circuits Design

(Course Contents)

Semester-IV **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit – I:

Number system and fundamental concepts of digital circuits. 09 Hours, 16 Marks

a. Number system –different types of number system like binary Octal.
b. Decimal and hexadecimal, Signed binary numbers.
c. Conversion methods of one type number system to another type.
d. Fundamental concepts: Digital circuits.(AND,OR,NOT,NOR,NAND and Exclusive-OR operation).
e. Different types of codes – binary code, Gray code, BCD code.
f. Excess- 3 code, Hamming code, ASCII code.
g. Comparison of digital logic families such as RTL, DCTL, DTL, HTL, TTL.
h. PMOS and CMOS Causes.
i. Boolean algebra laws.

Unit – II: **Combinational logic design** **09 Hours, 16 Marks**

a. Standard representation for logical function, SOP & POS form.
b. Min-term & Max-term.
c. Simplification of logical function specified in min-term & max-term or along with don't care condition using K- MAP.
d. Design examples such as half and Full adder ,half and full Subtractor.
e. BCD to Seven segment decoder.

Unit – III: **Combinational logic design using MSI circuit**s **08 Hours, 16 Marks**

a. Multiplexer and Demultiplexer operations.
b. Adder and Digital comparator circuits.
c. Parity generator /chekers.
d. Code convertors BCD to binary , Binary to BCD
e. BCD to Excess-3 ,Binary to gray.

Unit – IV: **Sequential Logic Design** **08 Hours, 16 Marks**

a. 1 Bit memory cell, clocked S-R flip-flop, master slave J-K flip flop, D and T types of flip flops
b. Excitation tables of flip flop
c. Conversion of one type of flip flop into another type
d. Registers, classifications, shift registers, counters, synchronous, asynchronous

e. Analysis of clocked sequential circuits, state table, state diagram, next state equation and state reduction.

Unit – V: **Convertor circuits and digital storage devices. 08 Hours, 16 Marks**

a. Digital to analog converter, weighted register D/A converter, R/2R ladder D/A converter
b. Analog to digital conveter, parallel comparator, A/D converter, successive approximation A/D converter, dual slope A/D converter.
c. Digital storage devices such as ROM, RAM, EPROM, EEPROM, CAM (content addressable memory), CCD, ROM as PLD and PLA, PAL, field programmable gate arrays (FPGA), ERA (Electrically reconfigurable arrays) (5 Hrs)

Reference Books:

1. R. P. Jain, "Modern Digital Elecronics", 2nd edition, TMH.
2. Hill and Peterson, "Digital Logic and Microprocessor", John Wiley and Sons.
3. Malvino and Leach, "Digital Principles and Applications",
4. Morris Mano, "Digital Logic and Computer Design", PHI.
5. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Programming in MATLAB	**PIM**	

Course Description:
This course provides knowledge about MATLAB Software.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**1**	**14**	**15**	**2**
Practical	**2**	**14**	**28**	

Prerequisite Course(s): Knowledge of HSC & FE level.

General Objective:
The objective of the course is to provide students with a firm grasp of the MATLAB software which is being used by the scientific and engineering community all over the world. It provides an integrated development environment (IDE) for programming with numerous predefined functions for technical computations and visualization.

Course Outcomes: Upon successful completion of this course the students will be able to:

1. Understand detailed insight of MATLAB environment and elaborate the basic features of MATLAB as programming language.
2. Understands MATLAB operations on Vectors and Matrices.
3. Understand different methods of data input and output in MATLAB and analysis.
4. Understand 2D and 3D Graphics in MATLAB.
5. Develop MATLAB Functions and subprograms.
6. Do higher studies and able to use updated software and tools for analysis of control systems and other process control applications.

Programming in MATLAB

(Course Contents)

Semester-IV **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 50 Marks**

Lectures : 1 Hrs/Week

Practical : 2 Hrs/Week

Unit – I: **Introduction to Matlab** **03 Hours**

a. Introduction, Starting and Ending Matlab Session
b. Matlab Environment, Command Window, Command History Window, Workspace, Current Directory, Edit Window, Figure Window, Help Feature, Help Browser, help command, look for command
c. Types of files, m-files, script files, function files, MAT files, Mex files, Platform, search path, Some basic matlab commands such as cd, dir, mkdir etc.
d. Data Types, constants, variables, Operators, Hirarchy of operations
e. Built in functions.
f. some basic programs e.g conversion to convert temperature from ^{0}C to ^{0}F and vice versa, sum of series.

Unit – II: **Vectors, Matrices and Polynomials** **03 Hours**

a. Scalars and vectors, assigning data to elements of a vector and scalar, vector product, vector transpose, creation of evenly spaced row vectors some useful commands
b. Entering data in matrices, line continuation, matrix subscripts, indices, sub-matrices, sub-arrays, multi-dimensional matrices and arrays
c. Matrix manipulations, Generation of special matrices, some useful commands related to matrices, matrix and array operations, Structure arrays, Cell arrays.
d. Polynomials, Entering a polynomial, polynomial evaluation, arithmetic operations on polynomial, Formulation of polynomial equation
e. Characteristic polynomial of a matrix, polynomial differentiation, polynomial integration, polynomial curve fitting.

Unit – III: **Input- Output Statements and MATLAB Graphics** **03 Hours**

a. Data Input, Interactive Inputs, Reading and sorting file data, Output commands
b. Low level input output functions, file opening and closing functions, formatted Input Output functions, Binary Input Output Functions.
c. MATLAB Graphics, Two dimensional Plots, Multiple Plots, Style Options, Legend Command
d. Subplots, Specialized Two Dimensional Plots, Three Dimensional Plots

Unit – IV: **Control Structures, Writing Programs and Functions** **03 Hours**

a. Loops, for loop, nested for loop, while loop
b. Branches control structures, if control structure, switch statement, break statement, continue statement, error statement, try-catch structure
c. MATLAB editor, MATLAB programming, function sub programs, some illustrative examples
d. Types of functions, function handles, Errors and warnings, MATLAB debugger

Unit – V: **Ordinary differential Equations and Simulink basics** **02 Hours**

a. Ordinary differential equations solver, symbolic mathematics, study of ode solvers, study of commands.
b. Starting simulink, opening simulink model, simulink modeling, collecting blocks to create model, modifying block parameters, labeling blocks, collecting blocks, labeling single lines, saving the model.
c. Solvers, Fixed step solvers, variable step solvers
d. Simulating a model, Using variables from matlab, Data Import/ Export, creating subsystem, creating masked subsystem
e. Getting Help for Simulink.

Reference Books:

1. K. V. Krishnamurthy and S. K. Sen, "Programming in MATLAB", East West Press.
2. M. E. Herniter, "Programming in MATLAB", Thomson Brooks.
3. R. Pratap, "Getting Started with MATLAB 7", A quick introduction for scientists and engineers, Oxford University Press.
4. R. K. Bansal, A. K. Goel, M. K. Sharma, "Matlab and its Applications in Engineering", Pearson Education.

Programming in MATLAB Lab
(Lab Course Contents)

Teacher should facilitate learning following lab experiments:

1. For given matrix write MATLAB statements to obtain all elements of all rows but first column, all elements of first row but all columns, elements in the second row and third column.
2. Create a n × n matrix of random numbers, multiply all elements by 10 and then round off all the elements to integers using appropriate commands.
3. Write a program to fit the polynomial of degree 2 and degree 3.
4. Write a MATLAB program to copy the data from one file to another file.
5. Write a program to illustrate how menu can be created using Matlab.
6. Write a program to plot the curve for equation.
7. Assume suitable data and draw the following 2-D plots:
   a. Semilogx
   b. Loglog
   c. Bar
   d. Stem
8. Write a function that returns 1 if its argument is a prime number and returns 0 otherwise. Test for the numbers less than 100.
9. Obtain the solution of the following differential equation for the interval t=0 to 2 using Matlab.
   $\frac{dy}{dt} = y\,(e^t - 1)$ with y(0)=1.
10. Consider a third order system described by $\frac{d^3x}{dt^3} + 4\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 2x = u(t)$
    Draw the block diagram and obtain the system response using Simulink.
11. Write Matlab Program using While loop.
12. Write Matlab Program using nested for loop.

Note: The list of programs is for illustration. Similar kind of programs based on Matlab Course Syllabus can be included. Lab file should consist of minimum EIGHT experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Reference Books:

1. K. V. Krishnamurthy and S. K. Sen, “Programming in Matlab”, East West Press.
2. M. E. Herniter, “Programming in Matlab”, Thomson Brooks.
3. R. Pratap, “Getting Started with Matlab” 7, A quick introduction for scientists and engineers, oxford university press.
4. R. K. Bansal, A. K. Goel, M. K. Sharma, Matlab and its applications in Engineering, Pearson Education.

Course Title	Short Title	Course Code
Electronics Instrumentation Lab	**EI Lab**	

Course Description:
In this laboratory, course emphasis on imparting the practical knowledge and understanding of Operational Amplifiers and its applications. Also it gives knowledge of voltage regulator and power supply design.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Practical	**2**	**14**	**28**	**1**

Prerequisite Course(s): Knowledge of HSC and First year Engineering.

General Objective:
The objective of the laboratory is to impart the fundamental knowledge of operational amplifiers and its applications such as clippers, clampers, Instrumentation Amplifier, low pass , high pass, band pass and band reject filter etc.

Course Outcomes:
After successful completion of this lab students will be able to:

1. Apply basic Knowledge engineering and analyze the practical data for Operational Amplifier.
2. Understand concept of negative and positive feedback applications using Operational Amplifiers.
3. Understand the characteristics of operational amplifiers, precaution and safety during handling of instruments.
4. Understand fundamentals and design of different signal sources and voltage regulators.
5. Do higher studies in electronics instrumentation for modern automation and economical developments
6. Discharge the professional duties in field of instrumentation , automation, testing and maintenance.

Electronics Instrumentation Lab

(Lab Course Content)

Semester-IV **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 50 Marks**

Practical : 2 Hrs/Week

Teacher should facilitate learning following lab experiments:

1. Measurement of different Op-Amp parameters.
2. Design and implement Instrumentation Amplifier
3. Design and implement Function Generator using Op-amp.
4. Design and implement Half-wave precision rectifier.
5. Design and implement Zero-crossing detector
6. Design and implement Schmitt trigger.
7. Design and implement Clipper / Clamper circuits using op-amp
8. Design and implement A/D and D/A converter
9. Design and implement Butterworth second order low-pass / high-pass filter.
10. Design and implement Astable multivibrator using IC555.
11. Design and implement Monostable multivibrator using IC555.
12. Design and implement application of Phase locked loop PLL-565.
13. Design Wein bridge Oscillator as a sine wave generator.
14. Design function generator using IC 8038 and study its outputs.
15. Design Q-meter circuit.
16. Study of RLC meter.

Note: Lab file should consist of minimum **Ten experiments**.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Reference Books:

1. Ramakant A. Gayakwad, “Op-Amp and Linear Integrated Circuits’, Third edition, Prentice-Hall of India
2. Graeme,Tobey and Huelsman, “Operational Amplifiers: Design and Application”, McGraw-Hill International edition.
3. D.Roy Choudhury and Shail Jaon, “Linear Integrated Circuits” New Age International
4. Albert Paul Malvino, “Electronic Principles” 6th edition, Tata McGraw-Hill.
5. Cooper and Helfric, “Electronic Instrumentation and Measurement Techniques”, third edition, Prentice – Hall of India.
6. Chin and Jones, “Electronic Instrumentation and Measurement”, wiley.

7. J.J.Carr, “Elements of Electronic Instrumentation and Measurement”, second Edition, Reston.
8. Oliver and Cage, “Electronic Instrumentation and Measurement”, McGraw-Hill.
9. Rangan, Sarma, Mani, “Instrumentation Devices and Systems”, Tata Mcgraw Hill.
10. S.Soclof, “Application of Analog integrated circuits”, prentice Hall.

Course Title	Short Title	Course Code
Automatic Control Systems Lab	**ACS LAB**	

Course Description:
In this laboratory, course emphasis on imparting the practical knowledge and understanding of control systems and their analysis. It also give the platform to understand effect of parameters on the performance of control systems.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Practical	**2**	**14**	**28**	**1**

Prerequisite Course(s): Knowledge of HSC and First year Engineering.

General Objective:
The objective of the laboratory is to impart the knowledge of control systems. Students develops their ability to apply the specific procedures to analyze the experimental results. The students will able to understand the concept of time and frequency response characteristics of control systems.

Course Outcomes: After successful completion of this lab students will be able to:

1. Define basic control configurations and types of control systems.
2. Review of Laplace Transform and learn how to find mathematical model.
3. Analyze practical data for stability of control systems.
4. Understanding frequency response analysis of control systems.
5. Understanding the concept of compensators.

Automatic Control Systems Lab

(Lab Course Contents)

Semester-IV **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(OR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Determination of transfer function of an armature controlled d. c. motor.
2. Time response of first order system.
3. Transient response of second order system.
4. Frequency response of first order system.
5. Frequency response of second order system.
6. Design of Lag Compensator.
7. Design of Lead Compensator.
8. Design of Lead-Lag Compensator.

Experiments based on Software (Programs)

1. Compare and plot the unit-step responses of the unity-feedback closed loop systems with the given forward path transfer function. Assume zero initial conditions. Use any computer simulation program.
2. Study of effect of damping factor on system performance by obtaining unit step response and unit impulse response for a prototype standard second order system. Consider five different values for ξ = 0.1, 0.3, 0.5, 0.7 and 1.0. Also study the effect of varying undamped natural frequency by taking three different values. Comment on the simulations obtained.
3. Write a program that will compute the step response characteristics of a second order system i.e. percent overshoot, rise time, peak time and settling time. Generalize it for accepting different values of undamped natural frequency and damping factor.
4. Study and plot the unit step responses of addition of a pole and a zero to the forward path transfer function for a unity feedback system. Plot the responses for four different values of poles and zeros. Comment on the simulations obtained.
5. Program for compensator design using Bode plot.
6. Program for Compensator design using Root Locus Analysis.
7. Plot and comment on various properties of any three systems (Problems) using

- Routh-Hurwitz criterion
- Root locus technique
- Bode plots
- Nyquist plots.

Use any software package.

Note: Lab file should consist of minimum **Eight (Four based on Hardware and four based on software)** experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked questions on practical. Evaluation will be based answers given by students in oral examination.

Reference Books:

1. Benjamin C. Kuo, "Automatic Control Systems", Fifth Edition, Prentice-Hall of India.
2. M. Gopal, "Control Systems: Principles & Design". Tata MC-Graw-Hill.
3. K. Ogata, "Modern control Engineering".(1997 edition)
4. Norman S. Nise- "Control systems Engineering", Third Edition, John Wiley and Sons.Inc, Singapore, 2001.
5. R. C. Dorf and R.H. Bishop, "Modern Control Systems", Eighth edition, Addison-Wesley, 1999.
6. I.J. Nagrath and M. Gopal, "Control systems Engineering", Third Edition, New age International Publishers, India, 2001.

Course Title	Short Title	Course Code
Sensors And Transducers Lab	**ST Lab**	

Course Description:
In this laboratory, course emphasis on imparting the practical knowledge and understanding of sensors and transducers for different parameters such as temperature, level, flow, pressure and other parameters.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Practical	**2**	**15**	**30**	**1**

Prerequisite Course(s): Knowledge of HSC and First year Engineering.

General Objective:
The objective of the laboratory is to impart the fundamental knowledge of different types of sensors and transducers. It gives students the practical knowledge of temperature, flow, pressure, level, humidity, conductivity measurement.

Course Outcomes:
After successful completion of this lab students will be able to:

1. Apply knowledge of material science and engineering for construction of sensor and transducers.
2. Analyze the practical data for determination of characteristics of sensor and transducers for different applications.
3. Measure non electrical quantities like temperature, pressure and flow by transducers in manufacturing and process industries.
4. Develop the ladder diagram with combinations of sensor and transducers for reliable automation task.
5. Discharge professional duties in the field of automation.
6. Do higher studies in field of sensors and transducers for technical advance in the field of automation and economical developments.

Sensors and Transducers Lab

(Lab Course Contents)

Semester-IV **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. To determine the LVDT characteristics.
2. To determine the characteristics of capacitive displacement transducer.
3. To determine Strain gauge characteristics.
4. To determine Thermocouple characteristics.
5. To determine RTD characteristics.
6. To determine thermistor characteristics.
7. To determine Rotameter characteristics.
8. To determine level transducer characteristics.
9. To determine DP Cell characteristics.
10. To determine flow using orifice or venturimeter or rotameter and compare the accuracy.
11. Study of conductivity measurement.
12. Pressure measurement using dead weight tester.
13. Vacuum measurement using vacuum gauge.
14. Humidity Measurement.
15. Vibration Measurement.
16. Speed Measurement using Stroboscope and Tachometer.

Note: Lab file should consist of minimum **Ten** experiments**.**

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work and performance in the practical.

Reference Books:

1. Bentley J.P., “Principles of Measurement Systems”, Third Edition, Pearson Education Asia pvt.ltd.
2. Doebelin, E.O., “Measurement Systems”, McGraw Hill Book Co.
3. Patranabis D, “Sensors and Transducers”, Wheeler Publishing Co., Ltd. New Delhi.
4. Murthy, D.V.S., “Transducers and Instrumentation”, Prentice Hall of India Pvt. Ltd., New Delhi.
5. Neubert, H.K.P., “Instrument Transducers”, Clarenden Press, Oxford.
6. R. K. Jain, “Mechanical and Industrial Measurement”.

Course Title	Short Title	Course Code
Digital Circuits Design Lab	**DCD Lab**	

Course Description:
In this laboratory, course emphasis on imparting the practical knowledge and understanding of basic digital circuits (logic gates), design and implementation of combinational logic circuits as well as sequential logic circuits.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Practical	**2**	**14**	**28**	**1**

Prerequisite Course(s): Knowledge of HSC and First year Engineering.

General Objective:
The objective of the laboratory is to impart the fundamental knowledge of integrated circuits(IC-adder, subtractor, multiplexer, counters), Students develops their ability to apply the specific procedures to analyze the experimental results. In this lab course, students will be familiar with the use of different equipments(IC Tester, bread board , power supply etc) safety precautions on work place. This makes bridge on theoretical knowledge and practical practices.

Course Outcomes: After successful completion of this lab students will be able to:

1. Analyze the practical data and able to test different ICs using IC tester.
2. Implementation of digital circuits on experimental trainer kit.
3. Minimization of given logical problem and implement it using universal logic.
4. Design Counter operation using IC 7493.
5. Design Multiplexer and De-multiplexer operation.
6. Design 7-segment display and LED operation.

Digital Circuits Design Lab

(Lab Course Contents)

Semester-IV **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1) Verification of truth table of various TTL logic gates.
2) Verification of Boolean algebra laws.
3) Verification of given logical expression using universal gates.
4) To Design and test adder circuits (half and full adder) using K-map.
5) To Design and test binary to gray code converter circuits and test using IC7486.
6) To Design and test BCD to Exess-3 code converter circuit.
7) To Design and test one bit comparator circuit using K-map.
8) Verification of truth table of multiplexer using IC74153.
9) Verification of truth table of De-multiplexer using IC74155.
10) Verification of BCD to 7-segment display using IC7447.
11) Verification of ring counter using IC7493.
12) To study and test D/A converter (R/2R ladder network).

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

ESE will be based on practical assignment submitted by the student in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work and performance in the practical.

Reference Books:

1. R. P. Jain, "Modern Digital Elecronics", 2nd edition, TMH.
2. Hill and Peterson, "Digital Logic and Microprocessor", John Wiley and Sons.
3. Malvino and Leach, "Digital Principles and Applications",
4. Morris Mano, "Digital Logic and Computer Design", PHI.