Second Year Curriculum

Admission Year 2026-27

Bachelor of Technology
Robotics and Automation

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Semester 3

a. Course Name: Control Theory

b. Course Code: 03012303PC01

c. Prerequisite: Basics of circuit theory, differentiation and complex numbers, and Laplace transform**.**

d. Rationale: The course explores the fundamentals of control systems, understanding and predicting system behaviour and design and analysis of closed loop control systems.

e. Course Learning Objective:

1. Apply systems theory to solve complex real-world engineering problems by developing mathematical models using differential equations, transfer functions, and state-space representations.
2. Predict and interpret system behavior using mathematical models represented in time-domain and frequency-domain forms.
3. Analyze the stability and performance of linear control systems using time-domain and frequency-domain techniques.
4. Develop dynamic system models and represent them in transfer function and state-space forms for analysis and design purposes.
5. Design and evaluate PID controllers using frequency-response methods to achieve desired system performance specifications.

f. Course Learning Outcomes:

1. Apply the systems theory to complex real-world problems in order to obtain models that are expressed using differential equations, transfer functions, and state space equations.
2. Predict system behavior based on the mathema cal model of that system where the model may be expressed in time or frequency domain.
3. Analyse the stability of linear control system in time and frequency domain.
4. Obtain models of dynamic systems in transfer function and state space forms.
5. Design of PID Controllers with Frequency-Response Approach.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					**Examination Scheme**					**Total**
Lecture Hrs/Week	**Tutorial Hrs/Week**	**Lab Hrs/Week**	**Seminar Hrs/Week**	**Credit**	**Internal Marks**			**External Marks**		
					T	**CE**	**P**	**T**	**P**	
3	0	0	0	3	20	20	-	60	-	100

h. Course Content:

Course Content	**W** - Weightage (%) , **T** - Teaching hours		
Sr.	**Topics**	**W**	**T**
1	**Introduction to Control Systems** Motivation, Concept of control systems, classification of control systems, Transfer function and block diagram representation for electrical systems, block diagram algebra, signal flow graph representation	**20**	**10**
2	**Time Response Analysis and Stability** Time response analysis for first and second order system. Time domain specifica ons, Steady state response, Steady state errors, Characteris c equa on of feedback control systems and Concept of stability, Routh-Hurwitz test.	**25**	**8**
3	**Control Systems Analysis and Design by the Root-Locus Method** Introduction, Root-Locus Plots, Plo ng Root Loci with MATLAB, Root- Locus Plots of Posi ve Feedback Systems, Root-Locus Approach to Control-Systems Design. P, PI, PD, PID controllers. Ziegler´Nichols Rules for Tuning PID Controllers. Design of controllers using root- locus.	**20**	**10**
4	**Control Systems Analysis and Design by the Frequency- Response Method** Introduction, Correlation between me and frequency response, Bode plots, Polar plots, Nyquist plot and Nyquist stability criterion, Log magnitude versus Phase plots, Rela ve stability, concepts of gain and phase margins.	**20**	**11**
5	**State Space Analysis** Concepts of state, State variables and state models, State space equations, transfer function, Transfer model, State space representation of dynamic systems, State transition matrix, Decomposi on of transfer function, Controllability and observability	**15**	**6**
	Total	**100**	**45**

i. Text Book and Reference Book:

Reference Books	
1.	**CONTROL SYSTEMS ENGINEERING (TextBook)** By I J Nagrath, M Gopal | New Age International Publishers Ltd.
2.	**Control Systems: Principles and Design** By M. Gopal | McGraw Hill Education, Pub. Year 1997
3.	**Automatic control systems** By Farid Golnaraghi, Benjamin C Kuo | John Wiley & Sons, Inc., Ninth edition
4.	**Modern Control Engineering, (TextBook)** By Katsuhiko Ogata, | PHI Publication.
5.	**Modern control systems** By Richard C. Dorf, Robert H Bishop | Pearson Education International, Twelfth edition.

j. List of Practical:

List of Practical	
1.	Introduction to MATLAB for Control System.

2.	Introduction to simulink and various block sets.
3.	Analysis different input signals to control system.
4.	Analysis of linear me-invariant systems and representation.
5.	Write a MATLAB program for reduction of block diagram.
6.	Plotting response of first order circuit and second order circuits with the help of MATLAB programming.
7.	Obtain the root locus plot for the system using MATLAB.
8.	Obtain the bode plot for the system using MATLAB.
9.	Obtain the Nyquist plot for the system using MATLAB.
10.	Basic concept of state space and its conversion using MATLAB.

a. Course Name: Control Theory Laboratory

b. Course Code: 03012303PC02

c. Prerequisite: Basics of circuit theory, differentiation and complex numbers and Laplace transform.

d. Rationale: The course explores the fundamentals of control systems, understanding and predicting system behaviour and design and analysis of closed loop control systems.

e. Course Learning Objective:

1. Apply systems theory to solve complex real-world engineering problems by developing mathematical models using differential equations, transfer functions, and state-space representations.
2. Predict and interpret system behavior using mathematical models represented in time-domain and frequency-domain forms.
3. Analyze the stability and performance of linear control systems using time-domain and frequency-domain techniques.
4. Develop dynamic system models and represent them in transfer function and state-space forms for analysis and design purposes.
5. Design and evaluate PID controllers using frequency-response methods to achieve desired system performance specifications.

f. Course Learning Outcomes:

1. Apply the systems theory to complex real-world problems in order to obtain models that are expressed using differential equations, transfer functions, and state space equations.
2. Predict system behavior based on the mathema cal model of that system where the model may be expressed in time or frequency domain.
3. Analyse the stability of linear control system in time and frequency domain.
4. Obtain models of dynamic systems in transfer function and state space forms.
5. Design of PID Controllers with Frequency-Response Approach.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
0	0	2	0	1	-	-	20	-	30	50

h. Course Content:

List of Practical	
1.	Introduction to MATLAB for Control System.
2.	Introduction to simulink and various block sets.
3.	Analysis different input signals to control system.
4.	Analysis of linear me-invariant systems and representation.
5.	Write a MATLAB program for reduction of block diagram.
6.	Plotting response of first order circuit and second order circuits with the help of MATLAB programming.
7.	Obtain the root locus plot for the system using MATLAB.
8.	Obtain the bode plot for the system using MATLAB.
9.	Obtain the Nyquist plot for the system using MATLAB.
10.	Basic concept of state space and its conversion using MATLAB.

i. Text Book and Reference Book:

Reference Books	
1.	**CONTROL SYSTEMS ENGINEERING (TextBook)** By I J Nagrath, M Gopal | New Age International Publishers Ltd.
2.	**Control Systems: Principles and Design** By M. Gopal | McGraw Hill Education, Pub. Year 1997
3.	**Automatic control systems** By Farid Golnaraghi, Benjamin C Kuo | John Wiley & Sons, Inc., Ninth edition
4.	**Modern Control Engineering, (TextBook)** By Katsuhiko Ogata, | PHI Publication.
5.	**Modern control systems** By Richard C. Dorf, Robert H Bishop | Pearson Education International, Twelfth edition.

j. List of Practical:

List of Practical	
1.	Introduction to MATLAB for Control System.
2.	Introduction to simulink and various block sets.
3.	Analysis different input signals to control system.
4.	Analysis of linear me-invariant systems and representation.
5.	Write a MATLAB program for reduction of block diagram.
6.	Plotting response of first order circuit and second order circuits with the help of MATLAB programming.
7.	Obtain the root locus plot for the system using MATLAB.

8.	Obtain the bode plot for the system using MATLAB.
9.	Obtain the Nyquist plot for the system using MATLAB.
10.	Basic concept of state space and its conversion using MATLAB.

a. Course Name: Sensors and Transducers

b. Course Code: 03012303PC03

c. Prerequisite: : Basic knowledge of Physics, Electrical and Electronics Engineering

d. Rationale: Knowledge of sensors and transducers is essential for understanding and designing the modern systems and equipment used in industry as well as in daily life.

e. Course Learning Objective:

1. Understand the principles of converting physical parameters into electrical quantities and select appropriate sensors based on standards and guidelines for accurate measurement of parameters such as pressure, flow, and acceleration.
2. Analyze and identify various sensors used in real-life applications for the measurement of strain, motion, position, temperature, and light.
3. Classify and explain different types of transducers with suitable examples, including transducers used for pressure, temperature, and flow measurement.
4. Implement sensor-based measurement systems and predict the performance characteristics of various sensors and transducers accurately.

f. Course Learning Outcomes:

1. Understand the concepts for converting a physical parameter into an electrical quantity. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.
2. Analyze and locate different type of sensors used in real life applications for measurement of strain, motion, position, temperature, and light.
3. Classify and explain with examples of transducers, including those for measurement of pressure, temperature, and Flow.
4. Implement and predict correctly the expected performance of various sensors.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
2	0	0	0	2	20	20	-	60	-	100

h. Course Content:

Course Content		W - Weightage (%) , T - Teaching hours	
Sr.	Topics	W	T

1	**Introduction and Characteristics** Definition of Sensors and Transducers, Need for Sensors, Classification: Active/Passive, Analog/Digital, Primary/Secondary. Static Characteristics: Accuracy and Precision, Sensitivity and Repeatability, Linearity, Resolution, Threshold, Hysteresis, Range. Dynamic Characteristics: response time. **Measurement:** Definition, Methods of measurement, Significance of Measurement, Errors in Measurements-Systematic and Random error, calibration.	**25**	**8**
2	**Force, Motion, Resistive and Magnetic Sensors** Strain Gauges: Theory, gauge factor, types (metal, semiconductor), bridge circuits. Potentiometers: Linear and rotary types. Encoders, Resistive Sensors: Thermistors, RTDs (Resistance Temperature Detectors), LDRs (Light Dependent Resistors). Magnetic Sensors: Hall effect sensors, magneto-resistive sensors.	**20**	**6**
3	**Transducers** Capacitive Transducers: Diaphragm-based, variable dielectric/distance, proximity sensors. Inductive Transducers: Variable reluctance, LVDT (Linear Variable Differential Transformer), eddy current type. Piezoelectric Transducers: Piezoelectric effect, piezoelectric materials, charge and voltage coefficients, accelerometers.	**20**	**6**
4	**Thermal and Flow Sensors** Temperature Sensors: Thermocouples, IC-based sensors. Flow Sensors: Bernoulli's principle, Orifice plate, Venturi tube, Rotameter, Electromagnetic flow meter. Pressure Sensors: Manometers, Bourdon tubes, Bellows, Diaphragm pressure gauges.	**20**	**6**
5	**Signal Conditioning and Smart Sensors** Signal Conditioning: Bridge circuits, amplifiers, filters, impedance matching. Smart Sensors: Basic architecture, digital output and MEMS (Micro-Electro-Mechanical Systems). Applications: Data acquisition systems and introduction to IoT-based sensing.	**15**	**4**
	Total	**100**	**30**

i. Text Book and Reference Book:

Reference Books	
1.	**Sensors and Transducers (TextBook)** By Patranabis.D | Wheeler publisher
2.	**A course in electrical & Electronic measurement and instrumentation (TextBook)** By A.K.Sawhney | Dhanpat Rai
3.	**Measurement systems, Application and Design** By E O Doebelin | McGraw-Hill
4.	**Sensors and Transducers** By Ronald K. Jurgen | SAE

j. List of Practical:

List of Practical	
1.	**To study and perform ohmmeter, voltmeter, watt-hour meter.**
2.	**To study and perform galvanometer.**
3.	**To study and perform strain gauge.**
4.	**To study and perform working of RTD.**

5.	**To study and perform Hall Effect sensor.**
6.	**To study and perform pressure transducers.**
7.	**To study and perform input-output characteristics of LVDT.**
8.	**To study and perform speed transducer.**
9.	**To study and perform Thermocouple.**
10.	**To study and perform flow sensor.**

a. **Course Name:** Sensors and Transducers Laboratory

b. **Course Code:** 03012303PC04

c. **Prerequisite: :** Basic knowledge of Physics, Electrical and Electronics Engineering

d. **Rationale:** Knowledge of sensors and transducers is essential for understanding and designing the modern systems and equipment used in industry as well as in daily life.

e. **Course Learning Objective:**

1. Understand the principles of converting physical parameters into electrical quantities and select appropriate sensors based on standards and guidelines for accurate measurement of parameters such as pressure, flow, and acceleration.
2. Analyze and identify various sensors used in real-life applications for the measurement of strain, motion, position, temperature, and light.
3. Classify and explain different types of transducers with suitable examples, including transducers used for pressure, temperature, and flow measurement.
4. Implement sensor-based measurement systems and predict the performance characteristics of various sensors and transducers accurately.

f. **Course Learning Outcomes:**

1. Understand the concepts for converting a physical parameter into an electrical quantity. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.
2. Analyze and locate different type of sensors used in real life applications for measurement of strain, motion, position, temperature, and light.
3. Classify and explain with examples of transducers, including those for measurement of pressure, temperature, and Flow.
4. Implement and predict correctly the expected performance of various sensors.

g. **Teaching & Examination Scheme:**

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		Total
					T	CE	P	T	P	
0	0	2	0	1	-	-	20	-	30	50

h. **Course Content:**

List of Practical

1.	To study and perform ohmmeter, voltmeter, watt-hour meter.
2.	To study and perform galvanometer.
3.	To study and perform strain gauge.

4.	**To study and perform working of RTD.**
5.	**To study and perform Hall Effect sensor.**
6.	**To study and perform pressure transducers.**
7.	**To study and perform input-output characteristics of LVDT.**
8.	**To study and perform speed transducer.**
9.	**To study and perform Thermocouple.**
10.	**To study and perform flow sensor.**

i. Text Book and Reference Book:

Reference Books	
1.	**Sensors and Transducers (TextBook)** By Patranabis.D | Wheeler publisher
2.	**A course in electrical & Electronic measurement and instrumentation (TextBook)** By A.K.Sawhney | Dhanpat Rai
3.	**Measurement systems, Application and Design** By E O Doebelin | McGraw-Hill
4.	**Sensors and Transducers** By Ronald K. Jurgen | SAE

j. List of Practical: as same point h

a. Course Name: Network Analysis and Synthesis

b. Course Code: 03012303PC05

c. Prerequisite: Basic Electrical Engineering.

d. Rationale: Network Analysis and Synthesis form a core foundation in electrical and electronics engineering, enabling students to understand, analyse, and design electrical networks systematically. The subject equips learners with essential theoretical tools to model real-world electrical systems using network theorems, graph theory concepts, and mathematical techniques.

e. Course Learning Objective:

1. Understand and analyze basic electrical circuits using nodal analysis and mesh analysis techniques.
2. Apply and analyze electrical circuits using various network theorems for solving complex networks.
3. Analyze electrical networks in the Laplace domain for circuit response evaluation.
4. Compute and evaluate the parameters of two-port networks for electrical system analysis.
5. Determine the transient and steady-state responses of electrical networks under different operating conditions.

f. Course Learning Outcomes:

1. Understand basic electrical circuits with nodal and mesh analysis.
2. Analyse the circuit using network theorems.
3. Analyse electrical networks in the Laplace domain.
4. Compute the parameters of a two-port network.
5. Find Transient response and Steady state response of a network.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	0	0	0	3	20	20	-	60	-	100

h. Course Content:

Course Content		**W** - Weightage (%) , **T** - Teaching hours	
Sr.	**Topics**	**W**	**T**
1	**Introduction** Types of circuit components, Types of Sources and Source Transformations, Mesh analysis and Nodal analysis, problem solving with resistances only including dependent sources, Principal of Duality with examples.	**20**	**8**
2	**Network Theorems** Thevenin's, Norton's, Milliman's, Reciprocity, Compensation, Substitution, Superposition, Max Power Transfer, Tellegens - problem solving using dependent sources	**25**	**11**

3	**Laplace transform & Transients** **Laplace transform:** Introduction, Laplace transformation, basic theorems, problem solving using Laplace transform, partial fraction expansion, Heaviside's expansions, problem solving using Laplace transform. **Transients:** First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, homogeneous, nonhomogenous, problem-solving using R-L-C elements with DC excitation and AC excitation, Response as related to s-plane rotation of roots.	**25**	**13**
4	**Resonance** Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, general case- resistance present in both branches, anti-resonance at all frequencies. Coupled Circuits: Self-inductance, Mutual inductance, Coefficient of coupling, analysis of coupled circuits, Natural current, Dot rule of coupled circuits, conductively coupled equivalent circuits- problem solving.	**15**	**7**
5	**Two-port Networks** Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h- parameters, Relationships Between parameter Sets, Parallel & series connection of two port networks, cascading of two port networks, problem solving using dependent sources also.	**15**	**6**
	Total	**100**	**45**

i. Text Book and Reference Book:

Reference Books	
1.	**Engineering Circuit Analysis (TextBook)** By W H Hayt, S M Durbin | Tata McGraw-Hill Education
2.	**Network Analysis (TextBook)** By By M. E. Van Valkenburg | PHI Learning
3.	**Fundamentals of Electric Circuits** By C. K. Alexander and M. N. O. Sadiku | McGraw Hill Education | 5th edition, Pub. Year 2013
4.	**Networks and Systems** By D. Roy Choudhury | New Age Science | 2nd Edition
5.	**Network Analysis and synthesis** By F. F. Kuo | John Wiley and sons

j. List of Practical:

List of Practical	
1.	Familiarization with the Electrical Equipment.
2.	To study and verify the Kirchhoff's law.
3.	Verification of Loop and Node Analysis.
4.	Verification of Thevenin Theorem.
5.	Verification of Norton Theorem.
6.	Verification of Superposition and Thevenin's Theorem.
7.	R-L-C Circuit Analysis.
8.	Determination of different parameters of Two-port network and verification of their interrelations.
9.	To Determine the Resonance Frequency in a series RLC circuit.
10.	Frequency response of R-L-C series Circuit.

a. Course Name: Network Analysis and Synthesis Laboratory

b. Course Code: 03012303PC06

c. Prerequisite: Basic Electrical Engineering.

d. Rationale: Network Analysis and Synthesis form a core foundation in electrical and electronics engineering, enabling students to understand, analyse, and design electrical networks systematically. The subject equips learners with essential theoretical tools to model real-world electrical systems using network theorems, graph theory concepts, and mathematical techniques.

e. Course Learning Objective:

1. Understand and analyze basic electrical circuits using nodal analysis and mesh analysis techniques.
2. Apply and analyze electrical circuits using various network theorems for solving complex networks.
3. Analyze electrical networks in the Laplace domain for circuit response evaluation.
4. Compute and evaluate the parameters of two-port networks for electrical system analysis.
5. Determine the transient and steady-state responses of electrical networks under different operating conditions.

f. Course Learning Outcomes:

1. Understand basic electrical circuits with nodal and mesh analysis.
2. Analyse the circuit using network theorems.
3. Analyse electrical networks in the Laplace domain.
4. Compute the parameters of a two-port network.
5. Find Transient response and Steady state response of a network.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
0	0	2	0	1	-	-	20	-	30	50

h. Course Content:

List of Practical

1.	Familiarization with the Electrical Equipment.
2.	To study and verify the Kirchhoff's law.
3.	Verification of Loop and Node Analysis.
4.	Verification of Thevenin Theorem.
5.	Verification of Norton Theorem.
6.	Verification of Superposition and Thevenin's Theorem.
7.	R-L-C Circuit Analysis.
8.	Determination of different parameters of Two-port network and verification of their interrelations.
9.	To Determine the Resonance Frequency in a series RLC circuit.

10.	Frequency response of R-L-C series Circuit.

i. Text Book and Reference Book:

Reference Books	
1.	**Engineering Circuit Analysis (TextBook)** By W H Hayt, S M Durbin | Tata McGraw-Hill Education
2.	**Network Analysis (TextBook)** By By M. E. Van Valkenburg | PHI Learning
3.	**Fundamentals of Electric Circuits** By C. K. Alexander and M. N. O. Sadiku | McGraw Hill Education | 5th edition, Pub. Year 2013
4.	**Networks and Systems** By D. Roy Choudhury | New Age Science | 2nd Edition
5.	**Network Analysis and synthesis** By F. F. Kuo | John Wiley and sons

j. List of Practical:

List of Practical	
1.	Familiarization with the Electrical Equipment.
2.	To study and verify the Kirchhoff's law.
3.	Verification of Loop and Node Analysis.
4.	Verification of Thevenin Theorem.
5.	Verification of Norton Theorem.
6.	Verification of Superposition and Thevenin's Theorem.
7.	R-L-C Circuit Analysis.
8.	Determination of different parameters of Two-port network and verification of their interrelations.
9.	To Determine the Resonance Frequency in a series RLC circuit.
10.	Frequency response of R-L-C series Circuit.

a. Course Name: Specialised Electrical Machines

b. Course Code: 03011303PC05

c. Prerequisite: Knowledge of basics of Electrical Engineering

d. Rationale: Knowledge of different electrical machines is essential for student to understand applications of various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. The knowledge acquired by the students will help them to design, test, trouble-shoot problems in electrical motors and generators.

e. Course Learning Objective:

1. Explain the electromagnetic principles involved in the conversion of electrical energy into mechanical energy.
2. Describe the construction, working principles, and applications of various electrical machines.
3. Understand the functions and practical applications of different electrical machines used in daily life and industrial systems.
4. Demonstrate speed control techniques of different electrical motors and analyze their role in automation systems.
5. Test various electrical machines and determine their performance characteristics and operating parameters.
6. Identify and explain the applications of special-purpose motors used in modern engineering systems.

f. Course Learning Outcomes:

1. Explain the electromagnetic system for converting electrical energy into mechanical energy.
2. Explain the construction, working principle and applications of different electrical machines.
3. Understand the functions of different electrical machines and its extent of application in daily life.
4. Demonstrate speed control of different electrical motors and its role in automation.
5. Test different electrical machines and determine their performance parameters.
6. Identify the application of special purpose motors.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
2	0	0	0	2	20	20	-	60	-	100

h. Course Content:

Course Content		W - Weightage (%) , T - Teaching hours	
Sr.	Topics	W	T

1	**Principle of Electromechanical Energy Conversion** Magnetic circuits - Singly excited systems - doubly excited systems - Force and Torque. Induc on Motors - Introduction	**10**	**4**
2	**Stepper Motors** Constructional features – Principle of opera on – Types, Hybrid Stepper motor. Modes of Excitation – Static and Dynamic characteristics of stepper motors – introduction to Drive systems, Sizing of stepper motors - Applications.	**22**	**10**
3	**AC / DC Servomotors** Servomotors: Types – Constructional features - Principle of operation Feedback system - Sizing of servomotors – Applications.	**13**	**6**
4	**Special Machines** Geared Motors: Design Principle – Types of Gearboxes – Selection of a Gear Unit – Operation Factor – Equivalent Power –Factors that affect operation factor – Geared Motor Applications Linear Motors: Linear Induction motor classification – Construction – Principle of operation – DC Linear motor (DCLM) types –DCLM Control applications – Linear Synchronous motor (LSM) – Types Applications	**18**	**8**
5	**Reluctance Motors Switched Reluctance Motors:** Constructional feature – principle of operation – torque production –Power converters and their controllers – methods of rotor position sensing sensor less operation-characteristics- closed loop control applications. **Synchronous Reluctance Motors:** Constructional feature -Axial and Radial flux motor-operating principles-voltage and torque equation – Phasor diagram --performance characteristics applications.	**22**	**10**
6	**Permanent Magnet Brushless DC Motors** Permanent Magnet Materials-Magnet Characteristics-Permeance coefficient-Permanent magnet Vs. Electromagnet. Magnetic circuit analysis – EMF and torque equations – Commutation – Power Converter and their controllers – Characteristics – Applications.	**15**	**7**
	Total	**100**	**45**

i. Text Book and Reference Book:

Reference Books	
1.	**Electrical Machine** By Smarajit Ghosh | Pearson
2.	**A text book of Electrical technology** By B.L.Theraja | S. Chand Publication
3.	**Computer Aided Design of Electrical Machines** By K.M.V. Murthy | B.S. Publications, Pub. Year 2008
4.	**Electrical Machines** By Kothari D P and Nagrath I J | McGraw Hill Education
5.	**Electrical Machines** By Bhattacharya S. K | McGraw Hill Education
6.	**Rotating machinery analysis - from analysis to troubleshooting** By M.Adams | Marcel Dekker, New York | 01

j. List of Practical:

List of Practical	
1.	To understand the Working of Stepper Motor.
2.	Characteristics of DC Servomotor.
3.	Characteristics of AC Servomotor.
4.	Experiment to draw the speed torque characteristics of (i) AC servo motor (ii) DC servo motor

5.	BLDC motor drive using digital simulation.
6.	Stepper motor speed control using digital simulation.
7.	Universal motor speed control using digital simulation.

a. Course Name: Specialised Electrical Machines Laboratory

b. Course Code: 03011303PC06

c. Prerequisite: Knowledge of basics of Electrical Engineering

d. Rationale: Knowledge of different electrical machines is essential for student to understand applications of various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. The knowledge acquired by the students will help them to design, test, trouble-shoot problems in electrical motors and generators.

e. Course Learning Objective:

7. Explain the electromagnetic principles involved in the conversion of electrical energy into mechanical energy.
8. Describe the construction, working principles, and applications of various electrical machines.
9. Understand the functions and practical applications of different electrical machines used in daily life and industrial systems.
10. Demonstrate speed control techniques of different electrical motors and analyze their role in automation systems.
11. Test various electrical machines and determine their performance characteristics and operating parameters.
12. Identify and explain the applications of special-purpose motors used in modern engineering systems.

f. Course Learning Outcomes:

7. Explain the electromagnetic system for converting electrical energy into mechanical energy.
8. Explain the construction, working principle and applications of different electrical machines.
9. Understand the functions of different electrical machines and its extent of application in daily life.
10. Demonstrate speed control of different electrical motors and its role in automation.
11. Test different electrical machines and determine their performance parameters.
12. Identify the application of special purpose motors.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
0	0	2	0	1	-	-	20	-	30	50

h. Course Content:

Course Content		**W** - Weightage (%) , **T** - Teaching hours	
Sr.	**Topics**	**W**	**T**

1	**Principle of Electromechanical Energy Conversion** Magnetic circuits - Singly excited systems - doubly excited systems - Force and Torque. Induc on Motors - Introduction	**10**	**4**
2	**Stepper Motors** Constructional features – Principle of opera on – Types, Hybrid Stepper motor. Modes of Excitation – Static and Dynamic characteristics of stepper motors – introduction to Drive systems, Sizing of stepper motors - Applications.	**22**	**10**
3	**AC / DC Servomotors** Servomotors: Types – Constructional features - Principle of operation Feedback system - Sizing of servomotors – Applications.	**13**	**6**
4	**Special Machines** Geared Motors: Design Principle – Types of Gearboxes – Selection of a Gear Unit – Operation Factor – Equivalent Power –Factors that affect operation factor – Geared Motor Applications Linear Motors: Linear Induction motor classification – Construction – Principle of operation – DC Linear motor (DCLM) types –DCLM Control applications – Linear Synchronous motor (LSM) – Types Applications	**18**	**8**
5	**Reluctance Motors Switched Reluctance Motors:** Constructional feature – principle of operation – torque production –Power converters and their controllers – methods of rotor position sensing sensor less operation-characteristics- closed loop control applications. **Synchronous Reluctance Motors:** Constructional feature -Axial and Radial flux motor-operating principles-voltage and torque equation – Phasor diagram --performance characteristics applications.	**22**	**10**
6	**Permanent Magnet Brushless DC Motors** Permanent Magnet Materials-Magnet Characteristics-Permeance coefficient-Permanent magnet Vs. Electromagnet. Magnetic circuit analysis – EMF and torque equations – Commutation – Power Converter and their controllers – Characteristics – Applications.	**15**	**7**
	Total	**100**	**45**

i. Text Book and Reference Book:

Reference Books	
1.	**Electrical Machine** By Smarajit Ghosh | Pearson
2.	**A text book of Electrical technology** By B.L.Theraja | S. Chand Publication
3.	**Computer Aided Design of Electrical Machines** By K.M.V. Murthy | B.S. Publications, Pub. Year 2008
4.	**Electrical Machines** By Kothari D P and Nagrath I J | McGraw Hill Education
5.	**Electrical Machines** By Bhattacharya S. K | McGraw Hill Education
6.	**Rotating machinery analysis - from analysis to troubleshooting** By M.Adams | Marcel Dekker, New York | 01

j. List of Practical:

List of Practical	
1.	To understand the Working of Stepper Motor.
2.	Characteristics of DC Servomotor.
3.	Characteristics of AC Servomotor.
4.	Experiment to draw the speed torque characteristics of (i) AC servo motor (ii) DC servo motor

5.	BLDC motor drive using digital simulation.
6.	Stepper motor speed control using digital simulation.
7.	Universal motor speed control using digital simulation.

a. Course Name: Analog and Digital Electronics

b. Course Code: 03011303ES01

c. Prerequisite: Knowledge of Basic Electronics

d. Rationale: This subject introduces the fundamentals of analog and digital electronics, enabling students to understand and design basic electronic circuits essential for modern engineering applications.

e. Course Learning Objective:

1. Understand the working principles and characteristics of diodes, BJTs, FETs, and fundamental digital logic concepts.
2. Analyze differential amplifiers, multistage amplifiers, power amplifiers, and operational amplifiers considering both ideal and non-ideal parameters.
3. Design linear and non-linear operational amplifier circuits for applications such as amplification, oscillation, and waveform generation.
4. Implement and simplify combinational digital circuits using logic gates, Karnaugh maps (K-maps), and standard digital building blocks.
5. Analyze sequential circuits and data conversion systems, including flip-flops, counters, analog-to-digital (A/D), and digital-to-analog (D/A) converters.

f. Course Learning Outcomes:

1. Understand the working and characteristics of diodes, BJTs, FETs, and basic digital logic concepts.
2. Analyze differential, multistage, power, and operational amplifiers considering ideal and non-ideal parameters.
3. Design linear and non-linear op-amp-based circuits for amplification, oscillation, and waveform generation.
4. Implement and simplify combinational digital circuits using logic gates, K-maps, and standard digital blocks.
5. Analyze sequential circuits and data conversion systems, including flip-flops, counters, and A/D–D/A converters.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
4	0	0	0	4	20	20	-	60	-	100

h. Course Content:

Course Content		W - Weightage (%), T - Teaching hours	
Sr.	Topics	W	T
1	**Diodes and Junction** Basics of Diodes and Applica ons, Junction Diode Characteristics. **BJTs:** Basics of Bipolar Junction Transistors (BJTs), Transistor Biasing, Characteristics, and Configuration **FETs and Digital Circuits:** Basics of FET, Characteris cs, Logic Gate Operations, and Number Systems.	10	8
2	**Differential, Mul-stage and Operational Amplifiers** Differential amplifier; power amplifier; internal structure of an operational amplifier, ideal op-amp, non-ideali es in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)	20	12

3	**Linear applications of Op-Amp** Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differen al amplifier, instrumentation amplifier, integrator, oscillators (Wein bridge and phase shift) **Nonlinear applica ons of Op-Amp**: Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular wave generators. Precision rectifier, peak detector.	**20**	**10**
4	**Combinational Digital Circuits** Standard representa on for logic functions, K-map representa on, simplification of logic functions using K-map, and minimiza on of logical functions. Don't care conditions, Mul plexer, De- Multiplexer/Decoders, Adders, Subtractors, parity checker/generator, code converters.	**20**	**12**
5	**Sequential Circuits and Systems** A 1-bit memory, the circuit proper es of Bi-stable latch, the clocked SR flip flop, JK-T and D types flip-flops, applica ons of flip-flops, shi registers, applications of shi registers, serial to parallel converter, parallel to serial converter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using.	**20**	**10**
6	**A/D and D/A Converters** **A/D and D/A Converters:** Basic Block diagram of Analog to Digital Converter (A/D), successive approxima on, dual slope, A/D converter using voltage to frequency and voltage to me conversion, specifica ons of A/D converters, example of A/D converter ICs. **D/A Converters:** Basic Block diagram of Digital to analog converters(D/A), weighted resistor/converter, R-2R Ladder D/A converter, specifica ons for D/A converters, examples of D/A converter ICs.	**10**	**8**
	Total	**100**	**60**

i. Text Book and Reference Book:

Reference Books	
1.	**OPAMP & Linear Integrated Circuits (TextBook)** By Ramakant Gaiekwad | PHI
2.	**Fundamentals of Digital Electronics (TextBook)** By A. Anandkumar | PHI Publication
3.	**Modern Digital Electronics** By R. P. Jain | Tata McGraw-Hill Education
4.	**Design with Operational Amplifiers & Analog Integrated Circuits** By Sergio Franco | McGraw Hill
5.	**Operational Amplifiers and Linear IC's** By David A. Bell | Oxford University Press | 3rd edition

j. List of Practical:

List of Practical	
1.	I/P & O/P Characteristics of Bipolar Junction Transistor.
2.	Study the different parameters of the op-amp.
3.	Frequency response of the inverting amplifier and non-inverting amplifier.
4.	Study of the op-amp as an inverting amplifier and a non-inverting amplifier.
5.	OPAMP circuits –integrator, differentiator, and comparator.
6.	Phase shift and Wein's Bridge oscillator with amplitude stabilization using OPAMPs.
7.	Waveform generation – Square, triangular, and saw tooth waveform generation using OPAMPs.

8.	Verification of the function of Half/Full adder circuits.
9.	Verification of the function of the Multiplexer and Demultiplexer.
10.	Verification of the function of the latch and flip-flop.
11.	Verification of counter circuits like binary up/down counter, decimal counter, ring counter, Johnson counter etc.
12.	Verification of Specification and Performance indices of D/A and A/D converters.

a. Course Name: Analog and Digital Electronics Laboratory

b. Course Code: 03011303ES02

c. Prerequisite: Knowledge of Basic Electronics

d. Rationale: This subject introduces the fundamentals of analog and digital electronics, enabling students to understand and design basic electronic circuits essential for modern engineering applications.

e. Course Learning Objective:

1. Understand the working principles and characteristics of diodes, BJTs, FETs, and fundamental digital logic concepts.
2. Analyze differential amplifiers, multistage amplifiers, power amplifiers, and operational amplifiers considering both ideal and non-ideal parameters.
3. Design linear and non-linear operational amplifier circuits for applications such as amplification, oscillation, and waveform generation.
4. Implement and simplify combinational digital circuits using logic gates, Karnaugh maps (K-maps), and standard digital building blocks.
5. Analyze sequential circuits and data conversion systems, including flip-flops, counters, analog-to-digital (A/D), and digital-to-analog (D/A) converters.

f. Course Learning Outcomes:

1. Understand the working and characteristics of diodes, BJTs, FETs, and basic digital logic concepts.
2. Analyze differential, multistage, power, and operational amplifiers considering ideal and non-ideal parameters.
3. Design linear and non-linear op-amp-based circuits for amplification, oscillation, and waveform generation.
4. Implement and simplify combinational digital circuits using logic gates, K-maps, and standard digital blocks.
5. Analyze sequential circuits and data conversion systems, including flip-flops, counters, and A/D–D/A converters.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
0	0	2	0	1	-	-	20	-	30	50

h. Course Content:

List of Practical

1.	I/P & O/P Characteristics of Bipolar Junction Transistor.
2.	Study the different parameters of the op-amp.
3.	Frequency response of the inverting amplifier and non-inverting amplifier.
4.	Study of the op-amp as an inverting amplifier and a non-inverting amplifier.
5.	OPAMP circuits –integrator, differentiator, and comparator.
6.	Phase shift and Wein's Bridge oscillator with amplitude stabilization using OPAMPs.

7.	Waveform generation – Square, triangular, and saw tooth waveform generation using OPAMPs.
8.	Verification of the function of Half/Full adder circuits.
9.	Verification of the function of the Multiplexer and Demultiplexer.
10.	Verification of the function of the latch and flip-flop.
11.	Verification of counter circuits like binary up/down counter, decimal counter, ring counter, Johnson counter etc.
12.	Verification of Specification and Performance indices of D/A and A/D converters.

i. Text Book and Reference Book:

Reference Books	
1.	**OPAMP & Linear Integrated Circuits (TextBook)** By Ramakant Gaiekwad | PHI
2.	**Fundamentals of Digital Electronics (TextBook)** By A. Anandkumar | PHI Publication
3.	**Modern Digital Electronics** By R. P. Jain | Tata McGraw-Hill Education
4.	**Design with Operational Amplifiers & Analog Integrated Circuits** By Sergio Franco | McGraw Hill
5.	**Operational Amplifiers and Linear IC's** By David A. Bell | Oxford University Press | 3rd edition

j. List of Practical:

List of Practical	
1.	I/P & O/P Characteristics of Bipolar Junction Transistor.
2.	Study the different parameters of the op-amp.
3.	Frequency response of the inverting amplifier and non-inverting amplifier.
4.	Study of the op-amp as an inverting amplifier and a non-inverting amplifier.
5.	OPAMP circuits –integrator, differentiator, and comparator.
6.	Phase shift and Wein's Bridge oscillator with amplitude stabilization using OPAMPs.
7.	Waveform generation – Square, triangular, and saw tooth waveform generation using OPAMPs.
8.	Verification of the function of Half/Full adder circuits.
9.	Verification of the function of the Multiplexer and Demultiplexer.
10.	Verification of the function of the latch and flip-flop.
11.	Verification of counter circuits like binary up/down counter, decimal counter, ring counter, Johnson counter etc.
12.	Verification of Specification and Performance indices of D/A and A/D converters.

a. Course Name: Theory of Complex Variable, Partial Differential Equation

b. Course Code: 03019103BS03

c. Prerequisite: Geometry, Multivariable Calculus, Ordinary Differential Equations

d. Rationale: NA

e. Course Learning Objective:

1. Analyze the properties of functions of complex variables, including differentiability, analyticity, and conformal mappings.
2. Understand various types of singularities and residues, and apply the residue theorem to evaluate complex integrals.
3. Solve linear partial differential equations (PDEs) using methods such as separation of variables and transform techniques.

f. Course Learning Outcomes:

1. Analyse various properties of a function of complex variable such as differentiability, analyticity as well as Conformal mappings.
2. Understand various types of singularities, Residues and apply it to evaluate complex integrals using residue theorem.
3. Solve linear PDEs using separation of variables, transform methods,

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	-	-	-	3	20	20	-	60	-	100

h. Course Content:

Course Content		**W** - Weightage (%) , **T** - Teaching hours	
Sr.	**Topics**	**W**	**T**
1	**Analytic Functions and Complex Integration**Cauchy-Riemann equations (Cartesian and polar forms), Harmonic functions and harmonic conjugates. Contours and line integrals, Cauchy-Goursat theorem (without proof), Cauchy's integral formula (without proof).	**30**	**14**
2	**Series representation, Residue Theory and Conformal Mapping**Taylor Series, Laurent's series. Singularity and its' type, Residues, Cauchy Residue theorem (without proof), Residue Integration method. Mobius transformations and their properties.	**30**	**14**
3	**Partial Differential Equations**Solutions of first order linear and nonlinear PDEs, Classifications of PDE, Separation of Variables Method.	**40**	**17**
	Total	**100**	**45**

i. Text Book and Reference Book:

Reference Books

1.	**Complex variables and Applications (TextBook)** By J. W. Brown and Ruel V. Churchill | McGraw-Hill
2.	**Advanced Engineering Mathematics (TextBook)** By Erwin Kreyszig | Willey India Edition
3.	**Elements of Partial Differential Equations (TextBook)** By I. Sneddon | McGraw Hill
4.	**Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem** By R. Haberman | Prentice Hall | 4th
5.	**A First Course in Complex Analysis with Applications** By D. G. Zill, P. D. Shanahan | Jones and Bartlett Publishers
6.	**Introduction to Partial Differential Equations** By Rao.K. S. | PHI Learning Pvt. Ltd

j. List of Practical:

NA

a. Course Name: Functional Communication Skill

b. Course Code: 03011303ES01

c. Prerequisite: Knowledge of Advanced Communication and Interpersonal Skills

d. Rationale: This course develops workplace-oriented communication skills by bridging academic language competence with professional communication requirements.

e. Course Learning Objective:

1. Identify grammatical, usage, and style errors; logically reorder sentences; and differentiate facts from assumptions in workplace problem scenarios.
2. Understand the usage of grammatical rules, cohesion markers, professional writing formats, and communication etiquette to produce accurate workplace communication.
3. Apply principles of professional communication to ensure clarity, coherence, time management, and etiquette in both written and spoken workplace contexts.
4. Analyse effective verbal, digital, and virtual communication skills through JAM participation, LinkedIn profile optimization, and telephone/video call interactions.
5. Create ATS-friendly resumes, customized cover letters, professional emails, structured reports, optimized LinkedIn profiles.

f. Course Learning Outcomes:

1. Identify grammatical, usage, and style errors; logically reorder sentences; and differentiate facts from assumptions in workplace problem scenarios.
2. Understand the usage of grammatical rules, cohesion markers, professional writing formats, and communication etiquette to produce accurate workplace communication.
3. Apply principles of professional communication to ensure clarity, coherence, time management, and etiquette in both written and spoken workplace contexts.
4. Analyse effective verbal, digital, and virtual communication skills through JAM participation, LinkedIn profile optimization, and telephone/video call interactions.
5. Create ATS-friendly resumes, customized cover letters, professional emails, structured reports, optimized LinkedIn profiles.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
1	-	2	-	2	40	-	20	60	30	150

h. Course Content:

Course Content			
		W - Weightage (%) , **T** - Teaching hours	
Sr.	**Topics**	**W**	**T**

1	**Sentence Correction** Error identification (grammar, usage, style) Common workplace errors Contextual grammar usage	**10**	**2**
2	**Para Jumbles & Sentence Reordering** Logical sequencing Cohesion markers Theme identification	**8**	**1**
3	**Statement and Assumptions** Fact vs assumption Logical reasoning basics Workplace problem scenarios	**10**	**1**
4	**Reading Comprehension (Level of Difficulty - Advanced)** Inferential questions Author's tone & intent Vocabulary in context	**12**	**2**
5	**Resume and Cover Letter Writing** Resume formats Achievement-based bullet points Customizing cover letters	**14**	**2**
6	**Building a Professional LinkedIn Profile** Professional headline Summary writing Digital networking ethics	**8**	**1**
7	**Just a Minute (JAM)** Idea organization Fluency techniques Time management in speech	**8**	**1**
8	**Telephone and Video Call Etiquette** Opening & closing calls Voice modulation Virtual meeting etiquette	**8**	**1**
9	**Email Writing** Format Professional tone Subject lines, Email etiquette	**10**	**2**
10	**Report Writing Report Writing** **Types of reports Structure & formatting Use of visuals & data**	**12**	**2**

i. Text Book and Reference Book:

Reference Books	
1.	**Business Communication Today** By Bovee, Courtland L., and John V. Thill | Pearson Education, Pub. Year 2019
2.	**Essentials of Business Communication** By Guffey, Mary Ellen, and Dana Loewy. | Cengage Learning, Pub. Year 2018
3.	**Advanced Grammar in Use** By Hewings, Martin. | Cambridge University Press, Pub. Year 2013

4.	**English Vocabulary in Use: Advanced.** By McCarthy, Michael, and Felicity O'Dell | Cambridge University Press, Pub. Year 2017
5.	**Personality Development and Soft Skills.** By Mitra, Barun K | Oxford University Press, Pub. Year 2011
6.	**Technical Communication: Principles and Practice** By Raman, Meenakshi, and Sangeeta Sharma | Oxford University Press, Pub. Year 2018

j. List of Practical:

List of Practical	
1.	Sentence Correction ● Grammar & usage error identification ● Context-based sentence correction worksheets ● Common workplace error correction ● Peer editing activities
2.	Para Jumbles and Reordering of Sentence ● Identifying topic sentences ● Logical sequencing exercises ● Use of cohesion markers ● Timed para-jumble practice
3.	Reading Comprehension (Level of Difficulty - Advanced) Inferential and analytical questions ● Identifying author's tone & intent ● Vocabulary-in-context activities ● Group discussion on passages
4.	Resume and Cover Letter Writing ● Resume formats (chronological, functional) ● Achievement-based bullet writing ● ATS-friendly resume drafting ● Customized cover letter writing
5.	Statement and Assumptions ● Identification of implicit assumptions through guided exercises ● Application of assumption-testing techniques (possibility test) ● Analysis of case-based and real-life reasoning scenarios ● Timed practice drills with discussion of common errors
6.	Building a Professional LinkedIn Profile ● Writing professional headlines ● Summary and About section drafting ● Profile optimization task ● Digital networking ethics
7.	Just a Minute (JAM) ● Topic-based JAM speaking practice ● Fluency and coherence drills ● Time-management techniques ● Individual feedback sessions
8.	Telephone and Video Call Etiquette ● Professional call role-plays ● Voice modulation exercises ● Mock video meeting practice ● Virtual etiquette evaluation
9.	Report Writing ● Types of reports (incident, progress, proposal) ● Structure and formatting practice ● Use of visuals and data ● Writing and reviewing short reports
10.	Email Writing ● Professional email drafting ● Subject-line writing activities ● Tone and etiquette correction ● Peer review and rewriting

a. **Course Name:** Indian Constitution

b. **Course Code: 17013003MC01**

c. **Prerequisite:** Basic understanding of what law is, its sources (statutes, case law, customs), and the legal system's structure. Familiarity with the distinction between Public Law (e.g., Constitutional and Administrative Law) and Private Law (e.g., Contract Law, Tort Law). Knowledge of the historical evolution of constitutions, particularly the Constitution in question (e.g., Indian Constitution for India, U.S. Constitution for the United States). Awareness of the colonial, political, and socio-economic circum

d. **Rationale:**

The rationale for Constitutional Law lies in its foundational role in structuring and guiding the governance of a nation while protecting the rights and freedoms of its citizens. Below are the key rationales for the existence and study of Constitutional Law: Constitutional Law provides the legal framework for the formation, powers, functions, and structure of government institutions (Legislature, Executive, and Judiciary). Ensures a clear distribution of power among the organs of government, preventing abuse and promoting accountability.

e. **Course Learning Objective:**

1. Understand the history, nature, salient features, and preamble of the Indian Constitution.
2. Explain the provisions related to citizenship, the concept of the State, and the significance of Articles 13 and 14 of the Indian Constitution.
3. Analyze the Fundamental Rights guaranteed under Articles 15 to 20 of the Indian Constitution.
4. Understand and interpret the Fundamental Rights under Articles 21 to 32 and the Fundamental Duties of citizens as provided in the Indian Constitution.

f. **Course Learning Outcomes:**

1. Understand the history, nature, salient features, and preamble of the Indian Constitution.
2. Explain the provisions related to citizenship, the concept of the State, and the significance of Articles 13 and 14 of the Indian Constitution.
3. Analyze the Fundamental Rights guaranteed under Articles 15 to 20 of the Indian Constitution.
4. Understand and interpret the Fundamental Rights under Articles 21 to 32 and the Fundamental Duties of citizens as provided in the Indian Constitution.

g. **Teaching & Examination Scheme:**

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
1	-	-	-	0	-	50	-	-	-	50

h. Course Content:

Course Content		W - Weightage (%) , T - Teaching hours	
Sr.	**Topics**	**W**	**T**
1	**UNIT – I History of Indian Constitution Nature of the Indian Constitution Salient Features of the Indian Constitution The preamble of the Indian Constitution**		
2	**UNIT – IIA] Citizen ship [From Article 1 to 11] B] State B] Article 13 C] Article 14**		
3	**Unit – IIIFundamental rights from article 15 to 20**		
4	**Unit- IVFundamental right from article 21 to 32 of the Indian Constitution and Fundamental duties.**		
	Total		

i. Text Book and Reference Book:

Reference Books	
1.	**History of Democratic Constitution: The Indian Expenditure** By Austin G | Oxford, Pub. Year 2000

j. List of Practical:

NA

Second Year Curriculum

Admission Year 2026-27

Bachelor of Technology
Robotics and Automation

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Semester 4

a. Course Name: Basics of Signal & Systems

b. Course Code: 03012304PC01

c. Prerequisite: Inclination to learn mathematics, basic knowledge of differential equations and difference equations, electrical circuits and networks.

d. Rationale: The course will provide strong foundation on signals and systems which will be useful for creating foundation of communication and signal processing. The students will learn basic continuous time and discrete time signals and systems. Student will understand application of various transforms for analysis of signals and systems both continuous time and discrete time. Students will also explore to power and energy signals and spectrum.

e. Course Learning Objective:

1. Understand the characteristics and classification of different types of signals.
2. Understand the behavior and properties of various types of systems.
3. Analyze systems in different domains using transformation techniques such as Fourier Transform and Z-Transform.
4. Evaluate and determine the stability of systems using appropriate analytical methods

f. Course Learning Outcomes:

1. Understand the characteristics and classification of different types of signals.
2. Understand the behavior and properties of various types of systems.
3. Analyze systems in different domains using transformation techniques such as Fourier Transform and Z-Transform.
4. Evaluate and determine the stability of systems using appropriate analytical methods

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	-	-	-	3	20	20	-	60	-	100

h. Course Content:

Course Content		**W** - Weightage (%) , **T** - Teaching hours	
Sr.	**Topics**	**W**	**T**
1	**Introduction to signals and systems** Introduction to signals, classification of signals, basic continuous- time and discrete- time signals, step and impulse functions, transformation of independent variable.	**20**	**8**

2	**Systems** Introduction to systems, properties of systems, classification of systems, mathematical model for systems, normal form of system equations, initial conditions.	**15**	**7**
3	**Time-Domain Representations of Linear Time-Invariant System** Introduction, Convolution, Impulse response representation for LTI systems, Properties of the impulse response representation for LTI systems, Block diagram representation, State-variable descriptions for LTI systems.	**25**	**11**
4	**Z-transform** Z-transform, convergence of Z-transform, properties of Z-transform, inversion of Z-transform, evaluation of system frequency response, applications of Z-transform.	**25**	**11**
5	**Fourier series and transform** Fourier series representation, power spectrum, Fourier Transform, system function, energy spectrum. Calculation of simple transforms, Discrete Fourier Transform (DFT), properties of Discrete Fourier Transform.	**15**	**7**
	Total	**100**	**44**

i. Text Book and Reference Book:

Reference Books	
1.	**Signals and System** By Oppenheim, Wilskey and Nawab | Prentice Hall India
2.	**Signals and Systems** By Simon Haykin | Wiley Publication
3.	**Digital Signal Processing** By S. Shalivahanan | TMH Publication
4.	**Signals and systems** By H. P. Hsu | Schaum's series, McGraw Hill Education, Pub. Year 2010

j. List of Practical:

List of Practical	
1.	**To Familiarize With Matlab Software, General Functions and Signal Processing Toolbox Functions.** To Familiarize With Matlab Software, General Functions and Signal Processing Toolbox Functions.
2.	**To Generate The Following Waveform Using Matlab In Continuous and Discrete Time. 1) Sine 2) Cosine 3) Square 4) Saw Tooth Wave.** To Generate The Following Waveform Using Matlab In Continuous and Discrete Time. 1) Sine 2) Cosine 3) Square 4) Saw Tooth Wave.
3.	**To Generate The Following Waveform Using Matlab In Continuous and Discrete Time. 1) Unit Step 2) Unit Impulse 3) Unit Ramp 4) Exponential** To Generate The Following Waveform Using Matlab In Continuous and Discrete Time. 1) Unit Step 2) Unit Impulse 3) Unit Ramp 4) Exponential
4.	**Implementation of Nyquist Criteria using sampling theorem.** Implementation of Nyquist Criteria using sampling theorem.
5.	**To perform linear convolution of two discrete time sequences.** To perform linear convolution of two discrete time sequences.

6.	**Write a Matlab program to locate Poles And Zeros from the transfer function.** Write a Matlab program to locate Poles And Zeros from the transfer function.
7.	**Computation of partial fraction expansion of a given Z-Transform.** Computation of partial fraction expansion of a given Z-Transform.
8.	**To compute FFT And IFFT from user defined input sequences.** To compute FFT And IFFT from user defined input sequences.
9.	**To circular convolution of two given sequences.** To circular convolution of two given sequences.
10.	**To write a Matlab program to verify the time shifting properties of DFT.** To write a Matlab program to verify the time shifting properties of DFT.
11.	**To write a Matlab program to verify the linearity properties of DFT.** To write a Matlab program to verify the linearity properties of DFT.

a. Course Name: Basics of Signal & Systems Laboratory

b. Course Code: 03012304PC02

c. Prerequisite: Inclination to learn mathematics, basic knowledge of differential equations and difference equations, electrical circuits and networks.

k. Rationale: The course will provide strong foundation on signals and systems which will be useful for creating foundation of communication and signal processing. The students will learn basic continuous time and discrete time signals and systems. Student will understand application of various transforms for analysis of signals and systems both continuous time and discrete time. Students will also explore to power and energy signals and spectrum.

d. Course Learning Objective:

1. Understand the characteristics and classification of different types of signals.
2. Understand the behavior and properties of various types of systems.
3. Analyze systems in different domains using transformation techniques such as Fourier Transform and Z-Transform.
4. Evaluate and determine the stability of systems using appropriate analytical methods

e. Course Learning Outcomes

1. Understand the characteristics and classification of different types of signals.
2. Understand the behavior and properties of various types of systems.
3. Analyze systems in different domains using transformation techniques such as Fourier Transform and Z-Transform.
4. Evaluate and determine the stability of systems using appropriate analytical methods

f. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	-	-	-	3	20	20	-	60	-	100

g. Course Content:

Course Content		W - Weightage (%) , T - Teaching hours	
Sr.	Topics	W	T

1	**Introduction to signals and systems** Introduction to signals, classification of signals, basic continuous- time and discrete- time signals, step and impulse functions, transformation of independent variable.	**20**	**8**
2	**Systems** Introduction to systems, properties of systems, classification of systems, mathematical model for systems, normal form of system equations, initial conditions.	**15**	**7**
3	**Time-Domain Representations of Linear Time-Invariant System** Introduction, Convolution, Impulse response representation for LTI systems, Properties of the impulse response representation for LTI systems, Block diagram representation, State-variable descriptions for LTI systems.	**25**	**11**
4	**Z-transform** Z-transform, convergence of Z-transform, properties of Z-transform, inversion of Z-transform, evaluation of system frequency response, applications of Z-transform.	**25**	**11**
5	**Fourier series and transform** Fourier series representation, power spectrum, Fourier Transform, system function, energy spectrum. Calculation of simple transforms, Discrete Fourier Transform (DFT), properties of Discrete Fourier Transform.	**15**	**7**
	Total	**100**	**44**

h. Text Book and Reference Book:

Reference Books	
1.	**Signals and System** By Oppenheim, Wilskey and Nawab | Prentice Hall India
2.	**Signals and Systems** By Simon Haykin | Wiley Publication
3.	**Digital Signal Processing** By S. Shalivahanan | TMH Publication
4.	**Signals and systems** By H. P. Hsu | Schaum's series, McGraw Hill Education, Pub. Year 2010

i. List of Practical:

List of Practical	
1.	**To Familiarize With Matlab Software, General Functions and Signal Processing Toolbox Functions.** To Familiarize With Matlab Software, General Functions and Signal Processing Toolbox Functions.
2.	**To Generate The Following Waveform Using Matlab In Continuous and Discrete Time. 1) Sine 2) Cosine 3) Square 4) Saw Tooth Wave.** To Generate The Following Waveform Using Matlab In Continuous and Discrete Time. 1) Sine 2) Cosine 3) Square 4) Saw Tooth Wave.
3.	**To Generate The Following Waveform Using Matlab In Continuous and Discrete Time. 1) Unit Step 2) Unit Impulse 3) Unit Ramp 4) Exponential** To Generate The Following Waveform Using Matlab In Continuous and Discrete Time. 1) Unit Step 2) Unit Impulse 3) Unit Ramp 4) Exponential
4.	**Implementation of Nyquist Criteria using sampling theorem.** Implementation of Nyquist Criteria using sampling theorem.
5.	**To perform linear convolution of two discrete time sequences.** To perform linear convolution of two discrete time sequences.

6.	**Write a Matlab program to locate Poles And Zeros from the transfer function.** Write a Matlab program to locate Poles And Zeros from the transfer function.
7.	**Computation of partial fraction expansion of a given Z-Transform.** Computation of partial fraction expansion of a given Z-Transform.
8.	**To compute FFT And IFFT from user defined input sequences.** To compute FFT And IFFT from user defined input sequences.
9.	**To circular convolution of two given sequences.** To circular convolution of two given sequences.
10.	**To write a Matlab program to verify the time shifting properties of DFT.** To write a Matlab program to verify the time shifting properties of DFT.
11.	**To write a Matlab program to verify the linearity properties of DFT.** To write a Matlab program to verify the linearity properties of DFT.

a. Course Name: Manufacturing Technology

b. Course Code: 03012304PC03

c. Prerequisite: Workshop Technology, Engineering Materials

d. Rationale: The course explores various manufacturing processes, various casting and metal forming processes, and metal cutting processes.

e. Course Learning Objective:

1. To provide knowledge of various manufacturing processes such as casting, forming, machining, joining, and modern manufacturing techniques used in industry.
2. To develop understanding of conventional and non-conventional machining processes, cutting tools, machining parameters, and process selection.
3. To familiarize students with metal forming, welding, and joining operations along with their applications, advantages, limitations, and defects.
4. To introduce modern manufacturing practices including CNC machining, additive manufacturing, Industry 4.0, and lean manufacturing concepts.
5. To enable students to analyze, compare, and select appropriate manufacturing processes for different engineering materials and industrial applications.

f. Course Learning Outcomes:

1. Explain the principles, methods, and applications of metal casting processes and identify suitable casting techniques for manufacturing applications.
2. Analyze various metal forming processes such as rolling, forging, extrusion, and sheet metal operations, and evaluate their advantages, limitations, and defects.
3. Understand conventional machining processes, cutting tool geometry, machining parameters, and tool wear mechanisms for efficient material removal operations.
4. Compare and select appropriate non-traditional machining (NTM) processes for machining advanced materials and complex geometries used in modern industries.
5. Describe different joining processes including welding, brazing, soldering, and adhesive bonding, and identify welding defects and inspection methods.
6. Understand modern manufacturing trends such as additive manufacturing, CNC machining, Industry 4.0, and lean manufacturing for smart and automated production systems.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	-	-	-	3	20	20	-	60	-	100

h. Course Content:

Course Content			
		W - Weightage (%) , **T** - Teaching hours	
Sr.	**Topics**	**W**	**T**

1	**Metal Casting Processes** Introduction to casting - principles, applications in robotics manufacturing. Types of patterns - wooden, metal, plastic patterns, pattern allowances. Molding processes - green sand molding, dry sand molding, CO2 molding. Special casting processes: Die casting - hot chamber and cold chamber, Permanent mold casting, Investment casting (Lost wax process), Centrifugal casting, Shell molding, Continuous casting. Casting defects and inspection methods, Design considerations for castings. Melting furnaces and pouring techniques.	**18**	**8**
2	**Metal Forming Processes** Hot working and cold working processes - advantages and limitations. Rolling - types of rolling mills, rolling defects, Forging - open die and closed die forging, smith forging, drop forging. Extrusion - forward and backward extrusion, impact extrusion, Wire drawing and tube drawing, Sheet metal operations: Shearing, blanking, punching, bending, drawing, stretch forming. Press working and press tools, Spring back and spring back compensation. Hydroforming and explosive forming, Defects in forming processes.	**18**	**8**
3	**Machining Processes - Conventional** Theory of metal cutting - chip formation, types of chips, Cutting tool materials - HSS, carbides, ceramics, coated tools. Tool geometry and tool signature, Cutting forces and power requirements, Tool wear and tool life - Taylor's equation. Turning operations - types, cutting parameters, lathe machine components, Drilling operations - drill types, drilling machines, reaming and boring. Milling operations - types of milling, milling cutters, indexing. Shaping, planing and slotting operations, Grinding operations - types of grinding, grinding wheels, wheel specification. Broaching, sawing and filing operations.	**22**	**10**
4	**Non-Traditional Machining (NTM) Processes** Need for non-traditional machining, Classification of NTM processes. Abrasive Jet Machining (AJM) - principle, applications, Water Jet Machining (WJM) and Abrasive Water Jet Machining (AWJM). Ultrasonic Machining (USM) - working principle, applications, Electric Discharge Machining (EDM) - die sinking EDM, wire EDM, process parameters. Electrochemical Machining (ECM) - principle, electrolytes, applications, Electron Beam Machining (EBM) - working, applications. Laser Beam Machining (LBM) - types of lasers, laser cutting, laser welding, Plasma Arc Machining (PAM), Chemical machining and photochemical machining. Comparison of NTM processes and selection criteria.	**20**	**9**
5	**Joining Processes** Welding fundamentals - types of joints, welding positions, Arc welding processes - SMAW, GMAW, GTAW, SAW. Resistance welding - spot, seam, projection, butt welding, Special welding processes - friction welding, explosion welding, diffusion bonding. Brazing and soldering processes, Adhesive bonding, Welding defects and inspection methods - NDT techniques. Design for welding and weld symbols.	**12**	**6**

i. Text Book and Reference Book:

Reference Books	
1.	**Manufacturing Engineering and Technology (TextBook)** By Seropekalakjian | Wesley longman (Singapore) pvt.ltd.
2.	**Manufacturing processes for Engineering Materials (TextBook)** By Scrope Kalpakjian | Addision Wesley
3.	**Manufacturing Science** By Ghosh and Mallik | East West Press
4.	**Workshop Technology** By Chapman, W.A.J. ELBS Low Price Text | Edward Donald Pub. Ltd
5.	**Production Technology** By R.K. Jain | Khanna Pub.

j. List of Practical:

List of Practical	
1.	Study of pattern, allowances and pattern making.
2.	Study of various types of cutting tools and measurement of tool geometry.
3.	Determination of chip-thickness ratio and shear angle during Machining.
4.	Demonstration on Lathe Machine.
5.	Demonstration on Drilling and Milling Machine.
6.	To study the basic concept of press working operations.
7.	Study and measure the Spring Back effect in V bending.
8.	Performance of gas welding and gas cutting process.
9.	Demonstration on TIG and MIG Welding.
10.	To study the working principle of Resistance Welding process.

a. **Course Name:** Manufacturing Technology Laboratory

b. **Course Code:** 03012304PC04

c. **Prerequisite:** Workshop Technology, Engineering Materials

d. **Rationale:** The course explores various manufacturing processes, various casting and metal forming processes, and metal cutting processes.

e. **Course Learning Objective:**

1. To provide knowledge of various manufacturing processes such as casting, forming, machining, joining, and modern manufacturing techniques used in industry.
2. To develop understanding of conventional and non-conventional machining processes, cutting tools, machining parameters, and process selection.
3. To familiarize students with metal forming, welding, and joining operations along with their applications, advantages, limitations, and defects.
4. To introduce modern manufacturing practices including CNC machining, additive manufacturing, Industry 4.0, and lean manufacturing concepts.
5. To enable students to analyze, compare, and select appropriate manufacturing processes for different engineering materials and industrial applications.

f. Course Learning Outcomes:

1. Explain the principles, methods, and applications of metal casting processes and identify suitable casting techniques for manufacturing applications.
2. Analyze various metal forming processes such as rolling, forging, extrusion, and sheet metal operations, and evaluate their advantages, limitations, and defects.
3. Understand conventional machining processes, cutting tool geometry, machining parameters, and tool wear mechanisms for efficient material removal operations.
4. Compare and select appropriate non-traditional machining (NTM) processes for machining advanced materials and complex geometries used in modern industries.
5. Describe different joining processes including welding, brazing, soldering, and adhesive bonding, and identify welding defects and inspection methods.
6. Understand modern manufacturing trends such as additive manufacturing, CNC machining, Industry 4.0, and lean manufacturing for smart and automated production systems.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
-	-	2	-	1	-	-	20	-	30	50

h. Course Content:

List of Practical

1.	Study of pattern, allowances and pattern making.
2.	Study of various types of cutting tools and measurement of tool geometry.
3.	Determination of chip-thickness ratio and shear angle during Machining.

4.	**Demonstration on Lathe Machine.**
5.	**Demonstration on Drilling and Milling Machine.**
6.	**To study the basic concept of press working operations.**
7.	**Study and measure the Spring Back effect in V bending.**
8.	**Performance of gas welding and gas cutting process.**
9.	**Demonstration on TIG and MIG Welding.**
10.	**To study the working principle of Resistance Welding process.**

i. Text Book and Reference Book:

Reference Books	
1.	**Manufacturing Engineering and Technology (TextBook)** By Seropekalakjian | Wesley longman (Singapore) pvt.ltd.
2.	**Manufacturing processes for Engineering Materials (TextBook)** By Scrope Kalpakjian | Addision Wesley
3.	**Manufacturing Science** By Ghosh and Mallik | East West Press
4.	**Workshop Technology** By Chapman, W.A.J. ELBS Low Price Text | Edward Donald Pub. Ltd
5.	**Production Technology** By R.K. Jain | Khanna Pub.

j. List of Practical:

List of Practical	
1.	**Study of pattern, allowances and pattern making.**
2.	**Study of various types of cutting tools and measurement of tool geometry.**
3.	**Determination of chip-thickness ratio and shear angle during Machining.**
4.	**Demonstration on Lathe Machine.**
5.	**Demonstration on Drilling and Milling Machine.**
6.	**To study the basic concept of press working operations.**
7.	**Study and measure the Spring Back effect in V bending.**
8.	**Performance of gas welding and gas cutting process.**
9.	**Demonstration on TIG and MIG Welding.**
10.	**To study the working principle of Resistance Welding process.**

a. Course Name: Fundamentals of Robotics and Robot Kinematics

b. Course Code: 03012304PC05

c. Prerequisite: Zeal to learn the subject

d. Rationale: This course introduces the concepts of Robotic system, its components and instrumentation and control related to robotics.

e. Course Learning Objective:

1. To provide knowledge of various manufacturing processes such as casting, forming, machining, joining, and modern manufacturing techniques used in industry.
2. To develop understanding of conventional and non-conventional machining processes, cutting tools, machining parameters, and process selection.
3. To familiarize students with metal forming, welding, and joining operations along with their applications, advantages, limitations, and defects.
4. To introduce modern manufacturing practices including CNC machining, additive manufacturing, Industry 4.0, and lean manufacturing concepts.
5. To enable students to analyze, compare, and select appropriate manufacturing processes for different engineering materials and industrial applications.

f. Course Learning Outcomes:

1. Explain the fundamentals of robotics and its components.
2. Illustrate the kinematics and dynamics of robotics.
3. Elucidate the need and implementation of related instrumentation & control in robotics.
4. Illustrate the movement of robotic joints with computers/microcontrollers.
5. Explain sensors and instrumentation in robotics.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	0	0	-	3	20	20	-	60	-	100

h. Course Content:

Course Content		**W** - Weightage (%) , **T** - Teaching hours	
Sr.	**Topics**	**W**	**T**
1	**Basic Concepts in Robotics** Automation and robotics, Robot anatomy, Basic structure of robots, Resolution, Accuracy and repeatability, and Classification and Structure of robots, Point to point and continuous path systems.	**20**	**9**

2	**Robotic System and Control Systems** Components of robotic system, Hydraulic systems, D.C. servo motors, Basic control systems concepts and models, Control system analysis, Robot activation and feedback components. Positional and velocity sensors, actuators. Power transmission systems,	**20**	**9**
3	**Robot arm Kinematics and Dynamics** Robot joints, The direct kinematics problem, The inverse kinematics solution, Lagrange-Euler formation,Generalized D'Alembert equations of motion, Denavit Hartenberg convention and its applications.	**20**	**9**
4	**Sensors and Instrumentation in Robotics** Tactile sensors, proximity and range sensors, Force and torque sensors, Uses of sensors in robotics. Vision equipment, Image processing, Concept of low level and high level vision.	**20**	**9**
5	**Computer based Robotics** Method of robots programming, GUI based robotic arm control, Interfacing with computer, communication and data processing, Introduction to Artificial Intelligence.	**20**	**9**
	Total	**100**	**45**

i. Text Book and Reference Book:

Reference Books	
1.	**Introduction to Robotics: Analysis, Systems, Applications (TextBook)** By A. B. Niku | Prentice Hall
2.	**Introduction to Robotics, Mechanics and control** By John J. Craig, Addison – Wesley.
3.	**Fundamentals of Robotics, Analysis & Control by Schilling (TextBook)** By Robert J., | Prentice Hall of India.
4.	**Introduction to Robotics** By S. K. Saha | Mc Graw Hill publication
5.	**Robotics for Engineers** By Koren Yoram | McGraw - Hill Education

j. List of Practical:

List of Practical	
1.	To study and understand the working of wire Robot (DTMF).
2.	To study and understand the working of Wireless Robot (Bluetooth based).
3.	To study and understand the working of Gesture controlled Robot.
4.	To study and understand the working of Ultrasonic based self-operated Robot.
5.	To study and understand the working of Line follower Robot.
6.	To study and understand the working of Camera Drone.
7.	To study and understand the working of Humanoid Robot.
8.	To study and understand the working of Wi-Fi operated Robot.
9.	To study and understand the working of DOBOT with different applications (Pick and Place, Drawings).
10.	To study of 3D Printer.

a. Course Name: Fundamentals of Robotics and Robot Kinematics Laboratory

b. Course Code: 03012304PC06

c. Prerequisite: Zeal to learn the subject.

d. Rationale: This course introduces the concepts of Robotic system, its components and instrumentation and control related to robotics.

e. Course Learning Objective:

1. To introduce the fundamentals of robotics and the functions of various robotic components.

2. To develop understanding of robot kinematics and dynamics for analyzing robotic motion and behavior.

3. To explain the role and implementation of instrumentation and control systems in robotics applications.

4. To provide knowledge of robotic joint movement control using computers and microcontrollers.

5. To familiarize students with sensors and instrumentation techniques used in robotic systems.

f. Course Learning Outcomes:

1. Explain the fundamentals of robotics and its components.
2. Illustrate the kinematics and dynamics of robotics.
3. Elucidate the need and implementation of related instrumentation & control in robotics.
4. Illustrate the movement of robotic joints with computers/microcontrollers.
5. Explain sensors and instrumentation in robotics.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
0	0	2	-	1	-	-	20	-	30	50

h. Course Content:

List of Practical	
1.	To study and understand the working of wire Robot (DTMF).
2.	To study and understand the working of Wireless Robot (Bluetooth based).
3.	To study and understand the working of Gesture controlled Robot.
4.	To study and understand the working of Ultrasonic based self-operated Robot.
5.	To study and understand the working of Line follower Robot.

6.	To study and understand the working of Camera Drone.
7.	To study and understand the working of Humanoid Robot.
8.	To study and understand the working of Wi-Fi operated Robot.
9.	To study and understand the working of DOBOT with different applications (Pick and Place, Drawings).
10.	To study of 3D Printer.

i. Text Book and Reference Book:

Reference Books	
1.	**Introduction to Robotics: Analysis, Systems, Applications (TextBook)** By A. B. Niku | Prentice Hall
2.	**Introduction to Robotics, Mechanics and control** By John J. Craig, Addison – Wesley.
3.	**Fundamentals of Robotics, Analysis & Control by Schilling (TextBook)** By Robert J., | Prentice Hall of India.
4.	**Introduction to Robotics** By S. K. Saha | Mc Graw Hill publication
5.	**Robotics for Engineers** By Koren Yoram | McGraw - Hill Education

j. List of Practical:

List of Practical	
1.	To study and understand the working of wire Robot (DTMF).
2.	To study and understand the working of Wireless Robot (Bluetooth based).
3.	To study and understand the working of Gesture controlled Robot.
4.	To study and understand the working of Ultrasonic based self-operated Robot.
5.	To study and understand the working of Line follower Robot.
6.	To study and understand the working of Camera Drone.
7.	To study and understand the working of Humanoid Robot.
8.	To study and understand the working of Wi-Fi operated Robot.
9.	To study and understand the working of DOBOT with different applications (Pick and Place, Drawings).
10.	To study of 3D Printer.

a. **Course Name:** Material Engineering

b. **Course Code:** 03012304PE01

c. **Prerequisite:** Knowledge of Engineering Physics and Engineering Chemistry

d. **Rationale:** Basic principles of science are used to study the structure-properties relationship of various materials for their proper applications in this subject. Especially study of different types of ferrous and non-ferrous metals and alloys, in terms of their composition, structure, properties and applications; non- destructive testing are included in this course to understand the basic concept of selection and processing of metals and materials for their applications.

e. **Course Learning Objective:**

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	0	0	-	3	20	20	-	60	-	100

f. **Course Learning Outcomes:**

1. To develop understanding of the properties and characteristics of engineering materials used in various applications.
2. To explain the relationship between crystal structure, grain size, and the properties of metals.
3. To introduce phase diagrams and their significance in understanding material behavior and alloy systems.
4. To provide knowledge of ferrous metals, non-ferrous metals, and their alloys along with their engineering applications.
5. To explain heat treatment processes of steels and various strengthening mechanisms used to improve material properties.
6. To familiarize students with powder metallurgy processes and their industrial applications.

g. **Teaching & Examination Scheme:**

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	0	0	-	3	20	20	-	60	-	100

h. **Course Content:**

Course Content	**W** - Weightage (%) , **T** - Teaching hours

Sr.	Topics	W	T
1	**Engineering Materials and Crystal Structures** Classification of Engineering Materials, Engineering requirements of materials, Criterion for selection of materials for engineering applications through Structure-Properties, Performance correlation ship. Unit Cell, Crystal structure, Bravais lattice, atomic packing factor, coordination number, crystal directions and planes, Miller indices, Imperfections in crystals and their effect on properties, Strain hardening, Recovery, Recrystalization and Grain Growth.	**15**	**9**
2	**Phase Diagrams and Theory of Alloys** Unary and Binary equilibrium phase diagrams, Lever rule, Gibb¶s phase rule, solid solutions and compounds, Solid Solution Strengthening Mechanisms, Hume-Rothery rules; cooling curves, Different reactions like eutectic, eutectoid etc. Allotropy of Iron, Iron-Iron-Carbide equilibrium diagram. Plain carbon steels, its classification and properties, Alloy Steel, its classification and properties, Stainless steel, Tool Steel, designation of Steels, Effect of alloying elements like Cr, Mo, Ni, W, V, Nb, B, Al, etc on the Properties of Steel, Cast Iron, its classification and properties, White Cast iron, Grey Cast iron, Nodular Cast iron, Malleable Cast iron, Chilled Cast Iron etc.	**25**	**15**
3	**Heat Treatment of Steels and Alloys** Heat Treatment Cycle, Time-Temperature-Transformation (TTT) Diagram, CCR, Different types of heat Treatments like Annealing, Normalizing, Hardening, Tempering, Austempering, Martempering, Ausforming, Surface hardening and Case hardening treatments, Jominy Hardenability Test.	**15**	**9**
4	**Non-Ferrous Alloys ,Non Metallic Materials and Nanomaterials** Copper alloys, Aluminium alloys: Classification, Composition, Properties and applications. Plastics, Composites, Ceramics: Classification, Composition, Properties and applications. Introduction to Nanomaterials and its applications.	**20**	**12**
5	**Powder Metallurgy**Production of Powder, blending, Compacting, Sintering; Application, advantages and limitations.	**10**	
6	**Non Destructive Testing** Principle, Advantages, limitations and Applications of Dye Penetration Testing, Magnetic Particle Testing, Eddy current testing Radiography Testing, Ultrasonic Testing.	**10**	
7	**Metallography** Structure of Metals, Macro-examination: Macro-etching; Microscopic examinations: Specimen Preparation, etching, grain size measurement; Concept of chemical analysis of steel and Iron for Carbon, Sulphur & Phosphorous.	**5**	
	Total	**100**	**45**

i. Text Book and Reference Book:

Reference Books	
1.	**Introduction to Physical Metallurgy** By Sydney H. Avner | Tata McGraw-Hill
2.	**Callister's Material Science and Engineering** By R. Balasubramaniam | Wiley India
3.	**Practical Non-Destructive Testing** By Baldev Raj, T. Jayakumar and M. Thavasimuthu | Narosa Pub. House
4.	**Mechanical Metallurgy** By George E. Dieter | McGrawhill book company
5.	**Materials Science and Engineering** By Raghavan V.

j. List of Practical:

List of Practical	
1.	Study of Engineering Materials and its Classification.
2.	Demonstration of Metallurgical Micro Scope.
3.	Specimen Preparation for Micro Structural Examination.
4.	Observation of Micro Structure for Standard Samples.
5.	Demonstration on Heat Treatment of Steels.
6.	Demonstration of Liquid Penetrant Test/Dye Penetrant Test.
7.	Demonstration of Magnetic Particle Test.
8.	Flaw Detection through Ultrasonic Testing.
9.	Demonstration of Jominy Hardenability Test.
10.	Performance Evaluation of Non-Destructive Testing (NDT) Methods.

a. **Course Name:** Energy Systems & Sustainable Technologies

b. **Course Code:** 03012304PE03

c. **Prerequisite:**

d. **Rationale:**

e. **Course Learning Objective:**

f. **Course Learning Outcomes:**

g. **Teaching & Examination Scheme:**

h. **Course Content:**

i. **Text Book and Reference Book:**

j. **List of Practical:**

a. **Course Name:** Biomedical and Assistive Technologies

b. **Course Code:** 03012304PE05

c. **Prerequisite:**

d. **Rationale:**

e. **Course Learning Objective:**

f. **Course Learning Outcomes:**

g. **Teaching & Examination Scheme:**

h. **Course Content:**

i. **Text Book and Reference Book:**

j. **List of Practical:**

a. **Course Name:** Material Engineering Laboratory
b. **Course Code:** 03012304PE02
c. **Prerequisite:**
d. **Rationale:**
e. **Course Learning Objective:**
f. **Course Learning Outcomes:**
g. **Teaching & Examination Scheme:**
h. **Course Content:**
i. **Text Book and Reference Book:**
j. **List of Practical:**

a. **Course Name:** Energy Systems & Sustainable Technologies Laboratory

b. **Course Code:** 03012304PE04

c. **Prerequisite:**

d. **Rationale:**

e. **Course Learning Objective:**

f. **Course Learning Outcomes:**

g. **Teaching & Examination Scheme:**

h. **Course Content:**

i. **Text Book and Reference Book:**

j. **List of Practical:**

a. **Course Name:** Biomedical and Assistive Technologies Laboratory

b. **Course Code:** 03012304PE06

c. **Prerequisite:**

d. **Rationale:**

e. **Course Learning Objective:**

f. **Course Learning Outcomes:**

g. **Teaching & Examination Scheme:**

h. **Course Content:**

i. **Text Book and Reference Book:**

j. **List of Practical:**

a. **Course Name:** Introduction to Cognitive Psychology

b. **Course Code:** 15M10504UE01

c. **Prerequisite: :** Basic knowledge of English and General Knowledge

d. **Rationale:** NA

e. **Course Learning Objective:**

1. To develop an understanding of the fundamental concepts and processes of cognitive psychology, including perception and memory.
2. To explain the types, stages, and processes of memory along with factors responsible for forgetting and memory distortion.
3. To apply principles of cognitive psychology in practical areas such as eyewitness testimony, crime investigation, and interview techniques.
4. To examine the effects of biological rhythms, hormonal changes, and psychoactive substances on cognitive performance.
5. To understand the influence of emotions, music, and sports on cognitive and emotional processes.
6. To integrate recent research findings and theoretical perspectives into real-world applications in education, law enforcement, sports, and related fields.

f. **Course Learning Outcomes:**

1. Demonstrate an understanding of fundamental concepts and processes in cognitive psychology, including perception and memory.
2. Analyse the types, stages, and processes of memory, along with factors contributing to forgetting and memory distortion.
3. Apply cognitive psychology principles to practical areas such as eyewitness testimony, crime investigation, and interview techniques.
4. Evaluate the effects of biological rhythms, hormonal changes, and psychoactive substances on cognitive performance.
5. Interpret the influence of emotions, music, and sports on cognitive and emotional processes.
6. Integrate updated research and theoretical perspectives into real-world applications in fields like education, law enforcement, and sports.

g. **Teaching & Examination Scheme:**

Teaching and Examination Scheme										
Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	-	-	-	3	-	40	-	60	-	100

h. **Course Content:**

Course Content	**W** - Weightage (%) , **T** - Teaching hours		
Sr.	**Topics**	**W**	**T**
1	**Unit I**Introduction Introduction to cognitive psychology Basics of Visual and auditory perception Introduction to other Cognitive Processes		
2	**Unit II**Memory Types and Stages of Memory Processes Involved in Memory Forgetting and Memory Distortion		
3	**Unit III**Thought Process and Problem Solving Introduction to thought process Introduction to problem-solving Factors influencing problem solving		
4	**Unit IV**Human Language Introduction to basic human language processing Speech Perception and Phonological Processing Language Production and Articulation		
5	**Unit V**Reasoning and Decision Making Deductive and Inductive Reasoning Heuristics and Cognitive Biases Judgment and Decision Making		
	Total		

i. Text Book and Reference Book:

Reference Books	
1.	**Cognitive Psychology and Its Implications** By Anderson, J. R. | Worth Publishers. | 8th ed, Pub. Year 2015
2.	**Cognition: Exploring the Science of the Mind** By Reisberg, D. | W. W. Norton & Company. | 5th ed., Pub. Year 2013
3.	**Cognitive Psychology. 6th Edition.** By Solso, R.L. (2001) | Pearson Education

j. List of Practical: NA

a. **Course Name:** Human Behaviour

b. **Course Code:** 15M10504UE02

c. **Prerequisite: NA**

d. **Rationale: NA**

e. **Course Learning Objective: -**

f. **Course Learning Outcomes: -**

g. **Teaching & Examination Scheme:**

Teaching and Examination Scheme										
Teaching Scheme					**Examination Scheme**					**Total**
Lecture Hrs/Week	**Tutorial Hrs/Week**	**Lab Hrs/Week**	**Seminar Hrs/Week**	**Credit**	**Internal Marks**			**External Marks**		
					T	**CE**	**P**	**T**	**P**	
3	-	-	-	3	20	20	-	60	-	100

h. **Course Content: NA**

i. **Text Book and Reference Book: NA**

j. **List of Practical: NA**

a. **Course Name:** Emotional Intelligence

b. **Course Code:** 15M10504UE03

c. **Prerequisite: NIL**

d. **Rationale: NIL**

e. **Course Learning Objective: NIL**

f. **Course Learning Outcomes: NIL**

g. **Teaching & Examination Scheme:**

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
3	-	-	-	3	20	20	-	60	-	100

h. **Course Content:**

Course Content

W - Weightage (%) ,
T - Teaching hours

Sr.	Topics	W	T
1	**Unit IIntroduction to Emotional Intelligence** Definition and Historical Development of Emotional Intelligence Major Models of Emotional Intelligence (Goleman, Mayer-Salovey, Bar-On) Importance of EI in Technology and Professional Fields		
2	**Unit IICore Components of Emotional Intelligence** Intelligence and Emotional Intelligence Culture and Emotions Measurement of Emotional Intelligence		
3	**Unit IIISocial Aspects of Emotional Intelligence** Emotional Intelligence and Happiness Emotional Intelligence and Leadership Emotional Intelligence and Empathy		
4	**Unit IVEmotional Intelligence in the Workplace** Workplace relations and Emotional Intelligence Conflict Management and Resolution Using EI Emotional Intelligence for Enhancing Creativity and Innovation		
5	**Unit VBuilding and Applying Emotional Intelligence** Techniques for Developing Emotional Intelligence Emotional Intelligence Training Programs and Tools Integrating EI into Personal Growth and Organisational Culture		

	Total		

i. Text Book and Reference Book:

Reference Books	
1.	**Emotional Intelligence** By Daniel Goleman | Bantam Books
2.	**"Emotional Intelligence 2.0"** By Travis Bradberry and Jean Greaves
3.	**Emotional Intelligence: Theory, Findings, and Implications.** By Mayer, J. D., Salovey, P., & Caruso, Daa. R. | Psychological Inquiry, Pub. Year 2004
4.	**The Bar-On Model of Emotional-Social Intelligence (ESI).** By Bar-On, R. | Psicothema, Pub. Year 2006
5.	**Emotional Intelligence: Toward Clarification of a Concept.** By Cherniss, C. | Industrial and Organisational Psychology, Pub. Year 2010

j. List of Practical: NA

a. **Course Name:** Psychiatry: An overview
b. **Course Code:** 19M10004UE01
c. **Prerequisite:**
d. **Rationale:**
e. **Course Learning Objective:**
f. **Course Learning Outcomes:**
g. **Teaching & Examination Scheme:**
h. **Course Content:**
i. **Text Book and Reference Book:**
j. **List of Practical:**

a. **Course Name:** Philosophy and Critical Thinking
b. **Course Code:** 19M10004UE02
c. **Prerequisite:**
d. **Rationale:**
e. **Course Learning Objective:**
f. **Course Learning Outcomes:**
g. **Teaching & Examination Scheme:**
h. **Course Content:**
i. **Text Book and Reference Book:**
j. **List of Practical:**

a. Course Name: Professional Soft Skills - I

b. Course Code: 03010004HM0

c. Prerequisite: Knowledge of Functional Communication Skills

d. Rationale: This course develops interpersonal effectiveness, leadership orientation, and critical thinking abilities required for collaborative and professional environments

e. Course Learning Objective:

1. To introduce concepts related to professional grooming, workplace etiquette, leadership qualities, interview types, and group discussion practices.
2. To develop understanding of teamwork principles, leadership styles, motivation techniques, and conflict resolution strategies in professional environments.
3. To enhance effective speaking, listening, and reasoning skills through activities such as cross talk, debates, and group discussions.
4. To improve interview performance by developing professional communication, body language, and interpersonal skills.
5. To strengthen decision-making and critical thinking abilities for analyzing and solving real-life professional situations.

f. Course Learning Outcomes:

6. Recall concepts related to professional grooming, workplace etiquette, leadership qualities, interview types, and group discussion norms.
7. Understand teamwork principles, leadership styles, motivation techniques, and conflict resolution strategies in group-based activities.
8. Apply effective speaking, listening, and reasoning skills during cross talk, debates, and basic group discussion activities.
9. Analyse interview performance by examining the effectiveness of responses, body language, and professional conduct.
10. Evaluate real-life situations using decision-making frameworks and critical thinking techniques to arrive at reasoned solutions.

g. Teaching & Examination Scheme:

Teaching and Examination Scheme

Teaching Scheme					Examination Scheme					Total
Lecture Hrs/Week	Tutorial Hrs/Week	Lab Hrs/Week	Seminar Hrs/Week	Credit	Internal Marks			External Marks		
					T	CE	P	T	P	
-	-	2	-	1	-	-	20	-	30	50

h. Course Content:

Course Content	**W** - Weightage (%) , **T** - Teaching hours		
Sr.	**Topics**	**W**	**T**
1	**Professional Grooming and Etiquette** ● Personal hygiene and appearance ● Dress code (formal & informal) ● Workplace manners and etiquette ● Body language and first impressions	**8**	**2**
2	**Teamwork and Collaboration Skills** ● Importance of teamwork ● Team roles and responsibilities ● Communication in teams ● Conflict resolution	**10**	**2**
3	**Leadership Skills** ● Meaning and qualities of leadership ● Leadership styles ● Motivation and influence ● Ethical leadership	**14**	**4**
4	**Decision Making** ● Decision-making process ● Types of decisions ● Evaluating alternatives ● Real-life decision scenarios	**12**	**4**
5	**Critical Thinking** ● Meaning of critical thinking ● Analytical thinking skills ● Identifying assumptions and bias ● Problem-solving techniques	**12**	**4**
6	**Cross Talk** ● Concept of cross talk ● Active listening skills ● Spontaneous responses ● Turn-taking and clarity	**6**	**2**
7	**SOAR Analysis** ● Concept of SOAR ● Strengths, Opportunities, Aspirations and Results ● Practical application of SOAR	**8**	**2**
8	**Debate** ● Format and rules of debate ● Argument and counterargument	**8**	**2**
	● **Logical reasoning** ● **Persuasive speaking**		
9	**Foundations of Group Discussion** ● **Purpose and types of GD** ● **Do's and don'ts of GD** ● **Initiation and participation**	**10**	**4**
10	**Foundations of Interview** ● **Types of interviews** ● **Interview preparation** ● **Common interview questions** ● **Interview etiquette and body language**	**12**	**4**

i. Text Book and Reference Book:

Reference Books	
1.	**Emotional Intelligence** By Goleman, Daniel | Bloomsbury Publishing, Pub. Year 2015
2.	**Personality Development and Soft Skills** By Barun K Mitra | Oxford, 2011
3.	**Business Communication.** By Rai, Urmila, and S. M. Rai | Himalaya Publishing House,, Pub. Year 2016
4.	**Organizational Behaviour.** By Robbins, Stephen P. | Pearson Education,, Pub. Year 2018
5.	**Business Communication Today.** By Bovee, Courtland L., and John V. Thill. | Pearson Education,, Pub. Year 2019

j. List of Practical:

a. **Course Name:** NCC / NSS / Yoga / Mental Health / Sports

b. **Course Code:** 03010004MC01

c. **Prerequisite:**

d. **Rationale:**

e. **Course Learning Objective:**

f. **Course Learning Outcomes:**

g. **Teaching & Examination Scheme:**

h. **Course Content:**

i. **Text Book and Reference Book:**

j. **List of Practical:**