Syllabus for

B.Voc in ROBOTICS AND AUTOMATION

Academic Year 2024-2025

Department of Vocational Studies and Skill Development

School of Engineering and Technology

Central University of Rajasthan

NH-8 Jaipur- Ajmer Highway, Bandarsindri
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1. List of programs to be offered by the department (Officially correct nomenclature to be followed)

- B.Voc in Robotics and Automation
- B.Voc in Interior Design

2. For B.Voc in Robotics and Automation:

Program Outcomes:

Vocational studies prepare the students for specific trades, crafts and careers at various levels and scopes. Scope of modern fabric of vocational education builds Human resource from a trade/ craftsmanship, technician or professional position in R & D organizations.

The Program Outcomes are the skills and knowledge which the students have at each exit level/ at the time of graduation. These Outcomes are generic and are common to all exit levels mentioned in the programme structure. Graduates of the B.Voc program are expected to -

PO1. Ability to apply fundamental knowledge of the specific skill-based trade for the solution of target skill sector.

PO2. Ability to identify industry related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using first principles of domain sectors and technical literature.

PO3. Ability to design/ develop solutions for broad based problems in the target skill-based trade to address changing challenges put forward by market demand/ stakeholder.

PO4. Ability to design and conduct technology enabled experiments, analyze the resulting data and interpret the same to provide valid conclusions.

PO5. Ability to use the techniques, skills and modern tools that are necessary for skill-based trade to practice with clear understanding of limitations.

PO6. Ability to apply broad understanding of ethical and professional skill-based trade practice in the context of global, economic, environmental and societal realities while encompassing relevant contemporary issues.

PO7. Ability to apply broad understanding of impact of skill-based trade in a global, economic, environmental and societal context.

PO8. Ability to develop practical solutions for skill trade problems within positive professional and ethical boundaries.

PO9. Function effectively as a leader and as well as team member in diverse/multidisciplinary environments.

PO10. Ability to communicate effectively in oral and written format addressing specific professional/social demands.

PO11. Ability to demonstrate knowledge and understanding of the first principles of skill trade and apply these to one's own work as a member and leader in a team, to complete project in any environment.

PO12. Ability to recognize the need for and have the ability to acquire advance knowledge for addressing the changing technological demands of the target skill trade.

- **Program Specific Outcomes (PSO):**

  Graduates of the B.Voc (Industrial Automation) program are expected to -

  - ✓ Apply basic and fundamental knowledge of electronics, electrical, mechatronics fundamentals and Industrial automation specialization for the solution of automated manufacturing and process related problems.
  - ✓ Identify complex industrial automation related problems at varied complexity and analyze the same to formulate/ develop substantiated conclusion using first principles of electronics, electrical and mechatronics and technical literature.
  - ✓ Design and conduct technology enabled experiments, analyze the resulting data and interpret the same to provide valid conclusions.
  - ✓ Use the techniques, skills and modern tools necessary for industrial automation practice clear understanding of limitations.

b. Approved Intake (30)

Admission through CUET and CURAJ norms: 30 (Seats)

c. Minimum Eligibility for entry

Candidate must have passed 10+2 Science (PCM) with at least 50% Marks for UR and 45% for reserved category.

d. Course Structure of the programe

- Skill Development Components – 60-70% Weight age
- General Education Component – 30-40% Weight age

The B.Voc Programme should comprise 60-70% Skill Development Components (60-70% of total Credit) and 40% General Education Component (30-40% total Credit) as per guidelines of UGC and NSQL.

As an illustration, awards shall be given at each stage as per Table 1 below for cumulative credits awarded to the learners in skill based vocational courses.

Exit Option

The programme allows exit of a student in an intermediate stage, on successful employment. Scopes will be there for further continuation of study. The otherwise exit options will be as follows-

Exit point	**Duration**	**Diploma/Degree to be offered**
First exit	After 6 month Certificate in Vocation	
Second exit	After 1 yr	Diploma in Vocation (D.Voc.)
Third Exit	After 2yr	Advanced Diploma in Vocation (Adv. D. Voc.
Fourth exit	After 3 yr	Bachelor in Vocation (B.Voc.)

3Year B.Voc in Robotics and Automation

Detailed Scheme

First Year

	NSQF Level 5 SEMESTER I						
Sr.No	Course Code	Course Name	Course type (GC/SC)	L	T	P	Credits
				Hours/week			
1	VSSD101	Basics of Electronics and Electrical Systems	SC	3	0	2	4
2	VSSD102	Fundamentals of Industrial Automation	SC	3	0	2	4
3	VSSD103	Basics of Mechanical Systems	GC	3	0	0	3
4	VSSD104	Introduction to Robotics	SC	3	0	2	4
5	VSSD105	Applied mathematics-I	GC	3	0	0	3
6	VSSD106	Introduction to Computer Programming	SC	2	0	2	3
7	VSSD107	English (Language and Communication Writing Skills)	GC	3	0	0	3
8	VSSD108	Laboratory Project-I	SC	0	0	6	6
		SC-Skill Component, GC-General Component					
	Total Credit						30

	NSQF Level 5 SEMESTER II						
Sr. No	Course Code	Course Name	Course type (GC/SC)	L	T	P	Credits
				Hours/week			
1	VSSD109	Sensor and Transducer	SC	3	0	2	4
2	VSSD110	Fundamentals of Artificial Intelligence	SC	2	0	2	3
3	VSSD111	Kinematics and Dynamics of Robotics	SC	3	0	2	4
4	VSSD112	Professional Ethics in Engineering	GC	3	0	0	3
5	VSSD113	Basics of Welding Technology	GC	3	0	0	3

6	VSSD114	Introduction to Computer Aided Design	SC	0	0	4	2
7	VSSD115	Applied mathematics-II	GC	3	0	0	3
8	VSSD116	Laboratory Project II	SC	0	2	6	8
		SC-Skill Component, GC-General Component					
	Total Credit						30

2nd Year

	NSQF Level 6 SEMESTER III						
Sr. No	Course Code	Course Name	Course type (GC/SC)	L	T	P	Credits
				Hours/week			
1	VSSD201	Energy and Environment	GC	3	0	0	3
2	VSSD202	Electrical machine for Automation	SC	3	0	2	4
3	VSSD203	Manufacturing Technology	GC	3	0	0	3
4	VSSD204	IOT & Embedded Systems	SC	3	0	2	4
5	VSSD205	Industrial safety Practices	GC	3	0	0	3
6	VSSD206	Electrical Drives and Control for Automation	SC	2	0	2	3
7	VSSD207	Laboratory Project-III	SC	0	2	8	10
		SC-Skill Component, GC-General Component					
	Total Credit						30

	NSQF Level 6 SEMESTER IV						
Sr. No	**Course Code**	**Course Name**	**Course type (GC/SC)**	**L**	**T**	**P**	**Credits**
1	**VSSD208**	Industrial on Job Training-I	**SC**				**30**
	Total Credit						**30**
	SC-Skill Component, GC-General Component						

3rd Year

	NSQF Level 7 SEMESTER V						
Sr. No	Course Code	Course Name	Course type (GC/SC)	L	T	P	Credits
				Hours/week			
1	VSSD301	Entrepreneurship Development	GC	3	0	0	3
2	VSSD302	Robotics for Industrial Automation	SC	3	0	2	4
3	VSSD303	IoT in Industrial Automation	SC	3	0	2	4
4	VSSD304	Introduction to Control System	GC	3	0	0	3
5	VSSD305	Fundamental of Mechatronics	GC	3	0	0	3
6	VSSD306	Open Elective-I	SC	2	0	2	3
7	VSSD307	Laboratory Project-IV	SC	0	2	8	10
		SC-Skill Component, GC-General Component					

	Total Credit	30

	NSQF Level 7 SEMESTER VI						
Sr. No	**Course Code**	**Course Name**	**Course type (GC/SC)**	**L**	**T**	**P**	**Credits**
1	**VSSD308**	Industrial on Job Training-II	**SC**				**30**
	Total Credit						**30**
	SC-Skill Component, GC-General Component						

Job role

Matrix based frame work under NSQF

Level	**Process required**	**Professional knowledge**	**Professional skill**	**Core skill**	**Responsibility**
Level 5	Basic understanding of Electrical &Electronics systems, basics of Mechanicals and ROBOTICS	Acquire knowledge on working of Robotics with automation	Enhancement of skills to perform some projects related to Robotics and automation	Desired applied mathematical skill, understanding of sufficient Robotics skill for enhancement of employability	After completion of first year, students can work as Technician or operator in the field of Electronic, Robotics and Automation industry.
Level 6	Demands of wide range of technical skill, clarity of knowledge and practice in Robotics & Automation	Factual and theoretical knowledge in broad contexts in the field of Robotics	A range of cognitive and practical skills required to generate solutions to specific problems in Robotics study	Reasonably good in mathematical calculation, understanding of social, reasonably good in data collecting organizing information, and logical communication	After completion of second year, students can work as Technician or Supervisor in the field of Electronic, Embedded, Robotics and Automation industry.

Level 7	Requires a command of wide ranging theoretical and practical skill, involving variable routine and non-routine context in the field of Robotics	Wide ranging, factual and theoretical knowledge in broad contexts in Robotics and Automation	Wide range of cognitive and practical skills required to generate solutions to specific problems in a field of Robotics	Good logical and mathematical skill; understanding of Social, political and natural environment; ability in collecting and organizing information, communication and presentation skill	After completion of Third year, students can work as Technician, Supervisor, Engineer or Manager in the field of Electronic, Embedded, Robotics and Automation industry.

Total Credit is: 30+30+30+30+30+30=180

List of electives/open electives

1. VSSD215: Microprocessor and Microcontroller
2. VSSD216: Electrical Drives
3. VSSD217: Tool and Die Making
4. VSSD218: CNC Technology
5. VSSD219: Modern Automated and Intelligent Vehicles
6. VSSD220: Robotics and Artificial Intelligence
7. VSSD221: Computer Vison in Robotics

Basic Electronics and Electrical Systems (VSSD 101)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+ Practical 2 h/week	End of semester Examination-60 marks	Theory + Practical -4
Course Prerequisite: Knowledge of 10+2 Physics.		
Course Objective: The main objective of this course is to understand the basics knowledges on electrical and electronics systems and their operation of the several electrical or electronics devices. Also, to emphasis on important electrical installation used in domestics or household purposes.		
Course Outcomes: On completion this course, students will be able to		
CO1: To understand and analyze basic electrical and electronics circuits CO2: To study the working principles of electrical machines and energy converters. CO3: To introduce the components of low voltage electrical installations. CO4: Understand about digital electronics. They will get insights on digital logics theorems and basic combinational logic devices.		
Level	Bachelor	
Course Content:		
Unit -I	Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, Superposition,	10 hrs

	Thevenin and Norton Theorems. Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonances, Concept of Transformer.	
Unit-II	Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries, power factor improvement and battery backup.	10 hrs
Unit-III	Diodes and Applications covering, Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters.	10 hrs
Unit-IV	Various Number systems, Decimal to Binary and Binary to Decimal Conversion, BCD, Octal and Hexadecimal numbers, Negative numbers representation, 1's, 2's, Complements, Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs)	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill.
2. S.K. Bhattacharya, "Basic Electrical and Electronics Engineering", Pearson Education; Second edition (15 July 2017.
3. Electronic Devices and Circuits" Salivahanan, N Suresh Kumar, 3/e, McGraw Hill Publications, 2013.
4. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
5. Robert L. Boylestad / Louis Nashelsky, " Electronic Devices and Circuit Theory", Latest Edition, Pearson Education.

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	2	1								2
CO2	2	2	2	1		3	2		1		2	1
CO3	3	3	3	2					2			2
CO4	2								1			1

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

List of Experiments:

1. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Identification various passive components without multimeters.

3. V-I Characteristics of Silicon & Germanium PN Junction diodes
4. Signal characterization using CRO-Applications
5. Diode as clipper and clamper
6. V-I Characteristics of Zener Diode
7. Characteristics of BJT in Common Emitter Configuration
8. Regulated power supply using Transistor and Zenner Diodes
9. Half Wave and Full Wave Rectifier with Filter
10. Common Emitter BJT Amplifier
11. Introduction to Logic Gates

Fundamentals of Industrial Automation (VSSD 102)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+ Practical 2 h/week	End of semester Examination-60 marks	Theory+ Practical -4
Course Prerequisite: Knowledge of 10+2 Physics.		
Course Objective: The main objective of this course is to make the learners acquainted with the conceptual as well as practical knowledge of the fundamentals of Industrial Automation. It's also necessary for the students to realize the various types of Automated systems etc.		
Course Outcomes: On completion this course, students will be able to		
CO1: To understand and analyze basics of automation systems. CO2: To study the working principles of various machines for automation. CO3: To introduce various types of automations and work part transport and its mechanisms. CO4: To understand working of various automated systems.		
Level	Bachelor	
Course Content:		
Unit -I	Automation and its advantages, goals, types, need, laws and principles of Automation. Elements of Automation. Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.	10 hrs
Unit-II	Manufacturing Automation: Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single and multi-model, Programmable Manufacturing Automation CNC machine tools, Programmable robots.	10 hrs
Unit-III	Automation types: Automated Flow lines, Methods of Workpart Transport, Transfer Mechanism, Buffer Storage, Control Functions, and Automation for Machining Operations, Design and Fabrication Considerations.	8 hrs
Unit-IV	Automated Guided Vehicle Systems, Automated Storage Systems: Storage System Performance, Automated Storage/Retrieval Systems, Interfacing Handling and Storage with Manufacturing. Product identification system: Barcode, RFID etc.	12 hrs
Internal assessment		

Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. KATARIYA SANJAY B, "INDUSTRIAL AUTOMATION SOLUTIONS FOR PLC, SCADA, DRIVE AND FIELD INSTRUMENTS: EASY TO LEARN INDUSTRIAL AUTOMATION", Notion Press; 1st edition (23 May 2020).
2. Ravindra Sharma, "Advanced Industrial Automation and Its Applications", Laxmi Publications Pvt Ltd (1 January 2021).
3. R.G.Jamkar, "Industrial Automation Using PLC SCADA & DCS" Global Education Limited; second edition (1 January 2018
4. Himanshu Kumar, "Advanced Industrial Automation: PLC programming in simplest way with 110 solved examples", Notion Press (1 July 2020.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	3	3	3	2					2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

Basics of Mechanical Systems (VSSD103)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of 10+2 Physics.

Course Objective: The main objective of this course is to make the students acquainted with the basics of mechanical systems. Preliminary ideas on forces and fluid dynamics are also essential to know.

Course Outcomes: On completion this course, students will be able to

CO1: To understand the basics of various mechanical` systems.
CO2: To study the working principles of various sensors for automation.
CO3: To introduce electrical machines for automations.
CO4: To acquire knowledge on PLC and apply for the development of various auotomated systems.

Level	Bachelor	
Course Content:		
Unit -I	Mechanical Systems: Gears, drives, bearings, pulleys etc., Stress, strain, elastic constraints, stress in circular shaft subjected to pure torsion only, Riveted and bolted joints.	10 hrs
Unit-II	Elementary idea of Shear force and bending moment for concentrated, uniformly distributed loads simply supported beam cantilever and overhanging beam, Simple Shear force and bending moment diagrams, Relationship between shear force and bending moment	10 hrs
Unit-III	Classification of Pulleys, Types of Belts, Simple calculation of pulley diameter, Classification of Gears, Simple	10 hrs

	calculation of number of teeth and speed, Power transmission by solid and hollow shaft	
Unit-IV	Properties of fluids, pressure of fluid and its measurement. Flow of fluids, velocity and discharge, Bernoulli's theorem and its application in venturimeter, flow through pipe, head loss due to friction.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. M.P. Poonia & S.C. Sharma, "Basic Mechanical Engineering, Khanna Publishing House
2. D.S. Bedi, Strength of Materials, Khanna Publishing House

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	3	3	3	2					2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

Introduction to Robotics (VSSD 104)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+ Practical 2 h/week	End of semester Examination-60 marks	Theory + Practical -4

Course Prerequisite: Knowledge of 10+2 Physics.

Course Objective: To identify robots and its peripherals for satisfactory operation and control of robots for industrial and non-industrial applications

Course Outcomes: On completion this course, students will be able to

CO1: list and explain the basic elements of industrial robots.
CO2: analyze robot kinematics and its control methods.
CO3: classify the various sensors used in robots for better performance.
CO4: summarize various industrial and non-industrial applications of robots.

Level	Bachelor	
Course Content:		
Unit -I	Robot-Basic concepts, Need, Law, History, Anatomy, specifications; Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot	10 hrs
Unit-II	End effectors-Classification, Types of Mechanical actuation, Gripper design, Robot drive system Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation.	10 hrs
Unit-III	Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors. Force sensor-Light sensors, Pressure	10 hrs

	sensors, Introduction to Machine Vision and Artificial Intelligence.	
Unit-IV	Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defense, Disaster management. Applications, Micro and Nanorobots, Future Applications.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, "Industrial Robotics Technology,
2. Programming and Applications", Tata –McGraw Hill Pub. Co., 2008.
3. Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Company Limited, 2010.
4. Klafter.R.D, Chmielewski.T.A, and Noggin's., "Robot Engineering: An Integrated Approach"', Prentice
5. Hall of India Pvt. Ltd., 1994.
6. Fu.K.S, Gonzalez.R.C&Lee.C.S.G, "Robotics control, sensing, vision and intelligence", Tata- McGraw Hill Pub. Co., 2008
7. Yu. "Industrial Robotics", MIR Publishers Moscow, 1985.

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	3		3	2		3			2			2
CO4	3		3	2	2				2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

Applied mathematics-I (VSSD105)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of 10+2 Physics.

Course Objective: To provide the students with sufficient knowledge of differential equations, higher orders, power series and Fourier series, so that it can be used in their respective fields.

Course Outcomes: On completion this course, students will be able to

CO1: Analyze the behavior of functions by using differential equations concepts.
CO2: To understand second order and higher order differential equations.
CO3:- To understand series solutions and to apply in higher order applications.
CO4:- Analyze Fourier series, partial differential equations and to apply in further synthesis.

Level	Bachelor	
Course Content:		
Unit -I		10 hrs

	Differential equations of first order & of first degree: Linear form, reducible to linear form, exact form, Reducible to exact form, Picard's Theorem (Statement only).	
Unit-II	Differential equations of second & higher order with constant coefficients, Algebra of Limit, Continuous functions, Differentiability of a function, Algebra of derivatives, Application of derivatives, Increasing and decreasing functions, Tangents and normal.	10 hrs
Unit-III	Sequence, Power series, radius of conversions, solution in series of second order LDE with variable co-efficient (C.F. only). Regular Single points and extended power series (Frobenius Method).	10 hrs
Unit-IV	Fourier series, half range series, change of intervals, harmonic analysis. Formulation and classification of linear and quasi linear partial differential equation of the first order, Lagrange's method for linear Partial Differential Equation of the first order.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathmatics, John Wiley.
2. B.V.Ramana, Higher Engineering Mathematics, McGraw – Hill.
3. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage Learning, NewDehli
4. M Ray, A Text Book On Differential equations Students Friends & Co., Agra-2
8. Robert C. Mcowen, Partial Differential Equation Pearson Education.
9. George F. Simmons & S.G. krantz, Differential Equation Tata McGraw – Hill.
10. R.K.Jain & S R K Iyengar, Advanced Engineering Mathematics, Narosa
11. T Amarnath , An Elementary course in partial differential equations, Narosa, New Delhi.
12. S. G. Deo and V. Raghavendra: Ordinar Differential Equations, Tata McGraw Hill Pub. Co., New Delhi

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3	1								
CO2	3	3	3	1					1		2	2
CO3	3		3	2	2				2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

Introduction to Computer Programming (VSSD 106)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 2 h/week + Practical 2 h/week	End of semester Examination-60 marks	Theory + Practical-3
Course Prerequisite: Knowledge of 10+2 Physics.		

Course Objective: This course is written with the primary objective to introduce the C and C++ programming languages. C is a practical and still-current software tool; it remains one of the most popular programming languages in existence, particularly in areas such as embedded systems.

Course Outcomes: On completion this course, students will be able to

CO1: understand and analyze basics of computer Programming.
CO2: writing code that is very efficient and powerful and, given the ubiquity of C compilers.
CO3: understand the various operation of Microsoft office.
CO4: To understand and realize the details use of internet for various purposes.

Level	Bachelor	
Course Content:		
Unit -I	Programming and Programming Languages, Flowchart, The C Programming Language, Identifiers, Symbolic Constants, Declarations, Arithmetic Operations, Relational and Logical Operations, If-Else,?: Conditional Expression, Switch, While Loops, Do-While Loops, For Loops, Break and Continue, Goto.	10 hrs
Unit-II	Function Prototypes, Call by reference, Call by arguments, recursive function, inline function; Function Prototypes, Call by reference, Call by arguments, recursive function, inline function;	10 hrs
Unit-III	What is a Pointer? Pointer Syntax, Pointers and Arrays, Pointer Arithmetic, Return Values and Pointer, Pointers to Pointers, Function Pointers, Dynamic Memory allocation; Array Initialization, Character Arrays and Strings, Strings and the Standard Library, Arrays of Pointers, Multi-dimensional Arrays.	10 hrs
Unit-IV	Formatted IO: printf, scanf, string formatting; File IO: Opening and Closing Files, Standard IO, Sequential File Operations; Introduction to User define datatype, Fundamentals of the object-oriented approach.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. V. Rajaraman, COMPUTER PROGRAMMING IN C, PHI Learning (2004).
2. E. Balagurusamy, Programming In Ansi C, 3rd edition, Tata McGraw-Hill Publication, New Delhi, 2004.
3. Walter Savitch, Problem Solving with C++: Global Edition, 9th edition, Pearson Education, November 2014.
4. Robert Lafore, Object Oriented Programming In C++, 4th edition, Pearson Education India (2004
5. Darrell W. Hajek, Introduction to Computers, independently published (May 12, 2023)

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**

CO1	3	3	3	1								2
CO2		3	3	1	3		1		1			2
CO3	3		3	2					2			2
CO4	3	3	3	2					2			1
**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping												

English (Language and Communication Writing Skills-I) (VSSD 107)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: Knowledge of 10+2 Physics.		
Course Objective: The main objective of this course is to make the students skilled in writing and communication skills which is essential in near future for job purposes.		
Course Outcomes: On completion this course, students will be able to		
CO1: understand how to make sentences and grammatical mistakes etc. CO2: improve writing skills. CO3: spoken English		

Level	Bachelor	
Course Content:		
Unit -I: Grammar and its Usage	i. Phrases, clauses and elements of a sentence ii. Articles, Tenses and Modals	13 hrs
Unit-II: Oral and Written Communication	i. Letter Writing-Formal and Informal ii. Short Presentation, so as to get across one's perspective, 200-250 words	12 hrs
Unit-III: Forms of Writing	i. Extract from Abdul Kalam's Wings of Fire, Section One : Orientation ii. Resume Writing and Job Application.	15 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Thomson, A.J. & Martinet: A Practical English Grammar; Oxford University Press.
2. Hyland, Ken: Second Language Writing; University of Michigan Press.
3. Gabor Don: How to start conversations and make friends; New York: Fireside
4. Krishnaswamy, N: Modern English – A Book of Grammar, Usage and Composition, Macmillan India Ltd.
5. Quirk and Greenbaum: A University Level Grammar of English, Pearson.

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	3	3	3	2					2			1

CO4	3	3	3	2					2			2
**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping												

Laboratory Project -I (VSSD 108)			

2nd Semester

Sensor and Transducer (VSSD 109)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week + Practical 2h/week	End of semester Examination-60 marks	Theory-4
Course Prerequisite: Knowledge of 10+2 Physics.		
Course Objective: • To make students familiar with the constructions and working principle of different typ es of sensors and transducers. • To make students aware about the measuring instruments and the methods of measurem ent and the use of different transducers.		
Course Outcomes: On completion this course, students will be able to		
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Level	Bachelor	
Course Content:		
Unit -I	Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types; Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer., – GPS, Bluetooth.	10 hrs
Unit-II	Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.	10 hrs
Unit-III	Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure– Diaphragm, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouples.	10 hrs
Unit-IV	Acoustic Sensors – flow and level measurement, Radiation Sensors – Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors, Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multichannel data acquisition – Data logging - applications - Automobile, Aerospace etc.	10 hrs
Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks

	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. D.V.S. Murty, SENSORS AND TRANSDUCERS, Prentice Hall India Learning Private Limited.
2. Dr R. Krishna Priya, Dr. Sushamma Chako, and Mr. Suhail Ahmed, SENSORS AND TRANSDUCERS, Notion Press
3. D. Patranabis, Sensors and Transducers, PHI Learning; 2nd edition (1 January 2003)
4. Livin P Wilson, Sensors and Transducers, Notion Press (20 March 2023)

CO/PO mapping

	PO1	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO12**
CO1	3	3	3	1								2
CO2	3		3	1					1			2
CO3		3	3	2	2				2			2
CO4	3	3	3	2					2			2

**‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low-level’ mapping

List of Experiments:

Fundamentals of Artificial Intelligence (VSSD 110)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week + Practical 2 h/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of 10+2 Physics.

Course Objective:

- To make students familiar with basics of Artificial Intelligence etc.
- To develop the problem-solving ability

Course Outcomes: On completion this course, students will be able to

- Design user interfaces to improve human–AI interaction and real-time decision-making.
- Design user interfaces to improve human–AI interaction and real-time decision-making.
- Explain the main concepts, models, technologies, and services of cloud computing, the reasons for the shift to this model, and its advantages and disadvantages.

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Level	Bachelor	
Course Content:		
Unit -I	Definition of AI, birth of AI, brief history, Turing test, Types of environment, Types of agents, PEAS (Performance measure, Environment, Actuators, Sensors), Introduction to searching, State Space, SAGP (State, Action, Goal test, Path cost), DFS, BFS (Completeness, Time complexity	10 hrs
Unit-II	Constrain Satisfaction Problems examples, Approaches to solve CSPs, Test and generate method, back tracking. Game Playing, Optimal decision in games, Min Max	10 hrs

	algorithm, Evaluation functions, Introduction to Propositional Logic and First Order Logic, Syntax, Substitution	
Unit-III	Probabilistic Reasoning, Review of Probability Theory, Probabilistic Inference Rules, Bayes Theorem, examples of Bayes theorem, Introduction to Learning, Taxonomy of Learning Systems, Concept Learning, Find-S algorithm, Candidate Elimination Algorithm.	10 hrs
Unit-IV	Introduction to Neural Networks, Introduction to Neural Networks, Biological Neural Networks, Artificial Neural Networks, Perceptron, Perceptron Learning Rule, Delta Rule, Applications of Neural Networks.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Dr. K. Saraswathi Dr. A Rajasekaran, Dr. T. Dinesh Kumar, Fundamentals of Artificial Intelligence, Book Rivers (25 September 2023).
2. Stuart Russel and Peter Norvig**,** Artificial Intelligence: A Modern Approach, Pearson Education; 4th edition.
3. Reema Thareja, Artificial Intelligence: Beyond Classical AI, Pearson Education.

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	1	2	3	2					2			2
CO4	3	3	3	2					2			2

**‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low-level’ mapping

Kinematics and Dynamics of Robotics (VSSD111)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+ Tutorial 1h/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of 10+2 Physics.

Course Objective:

- To make students familiar with the constructions and working principle of different typ es of sensors and transducers.
- To make students aware about the measuring instruments and the methods of measurem ent and the use of different transducers.

Course Outcomes: On completion this course, students will be able to

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Level	Bachelor	
Course Content:		
Unit -I	Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, Purpose of sensors, internal and external sensors, common sensors	8 hrs
Unit-II	Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots; Active and passive joints, Constraint and loop-closure equations, Direct kinematics problems.	12 hrs
Unit-III	Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion.	10 hrs
Unit-IV	Models of flexible links and joints, Kinematic modeling of multi-link flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations results, Experiments with a planar two-link flexible manipulator.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Chang Liu, "Foundations of MEMS", Pearson; 2nd edition (26 May 2011)
2. Gaberiel M.Rebiz, "RF MEMS Theory,Design and Technology", John Wiley & Sons.
3. Eun Sok Kim, Fundamentals of Microelectromechanical Systems (MEMS), 1st Edition.

CO/PO mapping

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO 11	PO12
CO1	3	3	3	1								2
CO2	2	3	2	1					1			2
CO3	2	1	3	2					2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

List of Experiments:

Professional Ethics in Engineering (VSSD112)		
Teaching Scheme	Examination Scheme	Credits allocated

Theory 3 h/week+ Tutorial 1h/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of 10+2 Physics.

Course Objective:

- To make students familiar with the constructions and working principle of different typ es of sensors and transducers.
- To make students aware about the measuring instruments and the methods of measurem ent and the use of different transducers.

Course Outcomes: On completion this course, students will be able to

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Level	Bachelor	
Course Content:		
Unit -I	Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management	8 hrs
Unit-II	Senses of Engineering Ethics,, – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlbergs theory – Gilligans theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.	12 hrs
Unit-III	Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	8 hrs
Unit-IV	Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.	12 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. V. S. BAGAD, Professional Ethics in Engineering (V-MECH, VI-Civil, VIII-IT/ECE/EEE/CSE - 2013 course), Technical Publications.
2. Shirley Mathew, PROFESSIONAL COMMUNICATION AND ETHICS-I - For First Year Degree Course in Engineering - Semester 2 - University of Mumbai Paperback – 31 December 2019, Nirali Prakashan; First Edition (31 December 2019).

CO/PO mapping

	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO 11	PO12
CO1	3	3	3	1								2
CO2	2	3	3	1					1			2
CO3	3	3	3	2					2			2
CO4	3	3	1	2					2			1
**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping												

Basics of Welding Technology (VSSD 113)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+	End of semester Examination-60 marks	Theory-3
Course Prerequisite: Knowledge of 10+2 Physics.		
Course Objective: • To make students familiar with the constructions and working principle of different types of sensors and transducers. • To make students aware about the measuring instruments and the methods of measurement and the use of different transducers.		
Course Outcomes: On completion this course, students will be able to		
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Level	Bachelor	
Course Content:		
Unit -I	GAS AND ARC WELDING PROCESSES: Fundamental principles Air Acetylene welding, Oxyacetylene welding, Carbon arc welding,Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations and applications	10 hrs
Unit-II	RESISTANCE WELDING PROCESSES: Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.	10 hrs
Unit-III	SOLID STATE WELDING PROCESSES: Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forgewelding, Roll welding and Hot pressure welding processes - advantages, limitations andapplications	10 hrs
Unit-IV	OTHER WELDING PROCESSES: Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear andsurface transport vehicles	10 hrs
Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks

Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Dr. R.S. Parmar, Welding Processes and Technology, Khanna Publishers; Classic Edition (1 January 1996).
2. Karen Ruth, Welding Basics: An Introduction to Practical & Ornamental Welding, Cool Springs Press (1 September 2003).

CO/PO mapping

	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12
CO1	3	3	3	1								2
CO2	3	3	3	1					1			1
CO3	2	2	3	2					2			2
CO4	3	2	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

2nd Year

3rd Semester

Energy and Environment (VSSD 201)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of 10+2 Physics.

Course Objective:

- To make students familiar with the constructions and working principle of different types of sensors and transducers.
- To make students aware about the measuring instruments and the methods of measurement and the use of different transducers.

Course Outcomes: On completion this course, students will be able to

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Level	Bachelor	
Course Content:		
Unit -I	Energy and power, forms of energy, primary energy sources, energy flows, world energy production and consumption, Key energy trends in India: Demand, Electricity, Access to modern energy, Energy production and trade, Factors affecting India's energy development: Economy and demographics Policy and institutional framework, Energy prices and affordability, Social and environmental aspects, Investment.	10 hrs
Unit-II	Thermal energy storage methods, Energy saving, Thermal energy storage systems; Principles of Energy Management, Energy demand estimation, Energy pricing, Multidisciplinary nature of environmental studies- Definition, scope and importance, Need for public awareness.	10 hrs

Unit-III	Definition, Cause, effects and control measures of - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards, Solid waste Management, Disaster management Role of an individual in prevention of pollution, Pollution case studies.	10 hrs
Unit-IV	Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. V K Ahluwalia, Energy and Environment, The Energy and Resources Institute, TERI (6 June 2019).
2. Kogent Learning Solutions Inc., Energy, Environment, Ecology and Society, Dreamtech Press (1 January 2012).
3. Anshul Vardhan, Energy - Sustainability and Environment, Notion Press (31 October 2018)

CO/PO mapping

	PO1	**PO2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO12**
CO1	3	3	3	1								2
CO2	2	3	3	1					1			2
CO3	3	3	3	2					2			2
CO4	3	1	3	2					2			2

**‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low-level’ mapping

Electrical Machine for Automation (VSSD 202)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week + Practical 2 h/ week	End of semester Examination-60 marks	Theory-4

Course Prerequisite: Knowledge of 10+2 Physics.

Course Objective: The main objective of this course is to make the students acquainted with the basics of electrical machines for automation. Preliminary ideas on stepper motors, servomotors, DC motors, but geared and linear motors are also essential to know.

Course Outcomes: On completion this course, students will be able to

CO1: To understand and analyze the basics of stepper motor and its applications.
CO2: To understand concept of the servomotor and its application.
CO3: To introduce permanent magnet brushless dc motor and synchronous motor and its applications for automations.

CO4: To acquire knowledge of geared motor and linear motor for the development of various automated systems.		
Level	Bachelor	
Course Content:		
Unit -I	STEPPER MOTORS: Constructional features – Principle of operation – Types, Hybrid Stepper motor. Modes of Excitation – Static and Dynamic characteristics of stepper motors – introduction to Drive systems, Sizing of stepper motors - Applications.	10 hrs
Unit-II	SERVOMOTORS: Types – Constructional features - Principle of operation – Feedback system - Sizing of servomotors – Applications.	10 hrs
Unit-III	PERMANENT MAGNET BRUSHLESS DC MOTORS: Principle of operation – Types, control of BLDC Motors-Applications. PERMANENT MAGNET SYNCHRONOUS MOTORS: Principle of operation, control of PMSM Motors - Applications.	10 hrs
Unit-IV	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.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Kenjo T, Stepping Motors and their Microprocessor Controls, Clarendon Press London, 2003.
2. J. R. Hendershot, Timothy John Eastham Miller, Design of Brushless Permanent-magnet Machines ,Motor Design Books, 2010.

References:

1. Jacek F. Gieras, Zbigniew J. Piech, BronislawTomczuk, Linear Synchronous Motors: Transportation and Automation Systems, CRC Press.New York, 2011.
2. BonfiglioliRiduttori, Gear Motor Handbook, Springer, 1995.
3. WilfriedVoss, A Comprehensible Guide to Servo Motor Sizing, Copperhill Media, 2007.

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	2	2	3	2					2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

Manufacturing Technology (VSSD 203)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: Knowledge of 10+2 Physics.		
Course Objective: The main objective of this course is to make the students acquainted with the basics of manufacturing technology. Preliminary ideas on forces and fluid dynamics are also essential to know.		
Course Outcomes: On completion this course, students will be able to		
CO1: To understand and analyze basics of Manufacturing Technology with metal shaping-smithy and sheet metal working. CO2: To introduce the various welding and riveting methods and tools. CO3: To study the working principles of foundry pattern and moulding. CO4: To acquire knowledge on melting and pouring of metals and alloys.		
Level	Bachelor	
Course Content:		
Unit -I	**GENERAL PROCESS:** Classification and elementary idea of metal forming processes on the basis of the properties of deformability (Plasticity), fusibility and divisibility viz., Rolling, Forging, Drawing, Extruding,. **Metal Fabrication** (A) Metal Shaping-Smithy: Operations involved (concept only),Tool and equipment used (Names, size, specification for identification only), (B) Sheet metal Working-Tools and operation: Operations involved (Names and concept only, Sheet metal joints Tools and equipment used (Name, size, specifications for identification only)	10 hrs
Unit-II	**TESTING OF WELDS & RELEVENT WELDING CODES:** (a) Destructive methods (b) Non-destructive methods-visual, X-ray, Y-ray, Magnetic particles, fluorescent, penetrant and ultrasonic testing. **(**A) Metal Joining During Fabrication- (a) Permanent Joining: (i) Welding methods (ii) Electric welding (b) Soldering & Brazing:Its concept, comparison with welding as joining method and classification **(**B) Riveting- its comparison with welding as joining method. (ii) Rivets and Materials. (C) Familiarity with the Use of Various Tools Used in Mechanical Engineering Workshop (a)Marking & Measuring Tools	10 hrs
Unit-III	**FOUNDRY PRACTICE PATTERN & MOULDING:** The pattern materials used, Types of pattern allowances and pattern layout, Colour scheme patterns defects, Types of cores and their utility.	10 hrs

	Moulding and Pouring: Classification of mould materials according to characteristics, Types of sands and their importance test, parting powders and liquids, Sand mixing preparation, Moulding defects.	
Unit-IV	**MELTING AND POURING**: Brief idea of refractory material and fluxes, Fuels and metallic materials used in foundry. Melting furnaces used in foundry such as pit furnace, Tilting and cupola furnaces, their construction and operation, metals and alloys. Additions to molten metal, Closing and pouring of the moulds.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Workshop Technology, vol.1, Hazra & Chaudhry
2. Workshop Technology, Vol.1, BS Raghuvanshi
3. Karyashala Takniki, JK Kapoor

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	3	3	3	2					2			2
CO4	3	3	3	2					2			2

**‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low-level’ mapping

IOT & Embedded System (VSSD 204)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week + Practical 2 h/week	End of semester Examination-60 marks	Theory-4

Course Prerequisite: Knowledge of embedded system.

Course Objective: The main objective of this course is to make the students acquainted with the basics of embedded systems. Preliminary ideas on architecture of microcontroller, C programming and simulation are also essential to know.

Course Outcomes: On completion this course, students will be able to

CO1 To acquire knowledge of basic function, characteristic and application of Embedded C Software in the modern embedded systems and on the function and area of application of Arduino and Microcontroller based embedded systems used in modern electronics control and Artificial Intelligence Systems.

CO2 To understand the Embedded C programming simulation model for Arduino automation.

CO3 To introduce PIC 18 Architecture and its programming.

CO4 To acquire knowledge on I/O interfacing, Programming and Simulation model.

Level	Bachelor	
Course Content:		
Unit -I	**Embedded System Design Basics:** Introduction to embedded systems, Components of embedded system, Comparison among 8051, Arduino and PIC **Architecture review of Arduino Uno board:** Introduction to ARDUINO, ARDUINO History and Family- Mega, Nano, Bluetooth, Lilypad, Pin configuration and architecture Of ATmega328 microcontroller, Study of an Arduino Board- Power Supply, Power Connectors, Analog Inputs, Digital Connections	10 hrs
Unit-II	**Embedded C programming simulation model for Arduino:** Introduction to Embedded C and steps to install Arduino Integrated development platform, Basic commands for Arduino Functions, Parameters, Variables-Global, local and static, Numeric variables-Int, Float, Boolean, # Define directives, Looping statements-if, for, while, Logical Operators, Mathematical operators, Return values, Coding styles.	10 hrs

Unit-III	**PIC 18 Architecture and its programming:**
	• PIC 18 architecture and assembly level programming – The WREG register in PIC, PIC file register, using instruction with the default access bank, Status register, PIC data format and directives, Branch, call and time delay loop,
	  • Proteus simulation model for PIC
	  • PIC I/O port programming
	  • ADC programming
		10 hrs

Unit-IV	**I/O interfacing , Programming and Simulation model:** • LED interfacing with Arduino /PIC - Circuit diagram, program for LED blinking. • 2Single switch and seven segment interface with Arduino /PIC - Circuit diagram. • Sensors (Temperature, Light, Proximity) and LED/LCD interface with Arduino /PIC Circuit diagram, program. • Interfacing with DC motor with Arduino /PIC –speed control program with direction change: Circuit diagram, program, Proteus simulation model.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Arduino-Based Embedded System, Rajesh Singh, Anita Gehlot, Bhupendra Singh and Sushabhan Choudhary, Taylor& Francis.

2. Fundamentals of Microcontrollers and Applications in Embedded System (with the PIC 18 microcontroller family), R. Gaonkar, Penram International Publishing.
3. Embedded C, Pont, Michael J, Addison-Wissley professional.
4. Getting Started with Arduino: The Open Source Electronic Prototyping Platform, Massimo Banzi, Shroff Publishers & Distributors Pvt Ltd, 2014.
5. Programming Aurdino: Getting Started with Sketches, Simon Monk, McGraw-Hill Education, Second Edition, 2016.
6. Arduino Cookbook, Margolis, Shroff/O'Reilly Publication, 2nd edition, 2012.
7. Embedded Systems, Himanshu Dave, Parag Dave, Pearson (ISBN: 9789332543522).
8. The Essential PIC 18 Microcontroller, Sid Katzen, Springer.
9. PIC Microcontroller and Embedded System using Assembly and C for PIC 18, M A Mazidi, R D Mckinlay and D Causey, Pearson.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	3	3	1					1			1
CO3	3	3	3	2					2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

Industrial Safety Practices (VSSD 205)

Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+ Tutorial 1h/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of welding technology.

Course Objective: The main objective of this course are as follows:

- Industrial safety is needed to check all the possible chances of accidents for preventing loss of life and permanent disability of any industrial employee, any damage to machine and material.
- It is needed to eliminate accidents causing work stoppage and production loss.
- It is needed to reduce workman's compensation, insurance rate, and all the cost of accidents.
- It is needed to achieve better morale among industrial employees.

Course Outcomes: On completion this course, students will be able to

- Analyze the effect of release of toxic substances
- Understand the industrial laws, regulations and source models.
- Apply the methods of prevention of fire and explosions.
- Understand the relief and its sizing methods.

Level	Bachelor	
Course Content:		
Unit -I	History of Safety. Movement in India and abroad. Need for safety, legal, humanitarian, economic and social considerations, Role of management in Industrial Safety. Safety Management - Principles & practices. National policy on Safety, Health & Environment at workplace.	10 hrs

Unit-II	Accident, Incident, injury, hazard, risk, danger, unsafe acts, unsafe conditions, dangerous occurrences, Type of Accidents, etc. Accident Prevention: Theories of accident causation; H. W. Henrich, Frank bird and Multiple causation theories of accident occurrences. Principles of accident prevention.	10 hrs
Unit-III	Understand importance of plant and work station design in safety, Significance of housekeeping in OSH, understand concepts of safety in machine guarding, use of tools, material handling and storage, appraise hazard associated with hot and cold work.	10 hrs
Unit-IV	Understand elements of Environment Management system and ecosystem, Evaluate factors contributing water, air, soil and noise pollution and their effects, Apply various techniques of Environmental monitoring and waste management, Fulfil Sustainability reporting requirements.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. KATARIYA SANJAY B, "INDUSTRIAL AUTOMATION SOLUTIONS FOR PLC, SCADA, DRIVE AND FIELD INSTRUMENTS : EASY TO LEARN INDUSTRIAL AUTOMATION", Notion Press; 1st edition (23 May 2020).
2. Ravindra Sharma, "Advanced Industrial Automation and Its Applications", Laxmi Publications Pvt Ltd (1 January 2021).
3. R.G.Jamkar, "Industrial Automation Using PLC SCADA & DCS" Global Education Limited; second edition (1 January 2018
4. Himanshu Kumar, "Advanced Industrial Automation : PLC programming in simplest way with 110 solved examples", Notion Press (1 July 2020).

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	3	2	2	2					2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

Electrical Drives and Control for Automation (VSSD 206)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 2h/week + Practical 2 h/week	End of semester Examination-60 marks	Theory-2
Course Prerequisite: Knowledge of 10+2 Physics.		
Course Objective:		

- To understand the basic concepts of different types of electrical machines and their performance.
- To know the different methods of starting D.C motors and induction motors.
- To introduce the controllers for automation

Course Outcomes: On completion this course, students will be able to

CO1: Select a drive for a particular application based on power rating.
CO2: Select a drive based on mechanical characteristics for a particular drive application.
CO3: Discuss the controllers used for automation.
CO3: To introduce electrical machines for automations.

Level	Bachelor	
Course Content:		
Unit -I	Components of electrical Drives – electric machines, power converter, controllers - dynamics of electric drive - torque equation - equivalent values of drive parameters components of load torques types of load - four quadrant operation of a motor — steady state stability – load equalization	10 hrs
Unit -II	DC motor drives – dc motors & their performance (shunt, series, compound, permanent magnet motor, universal motor, dc servomotor) – braking – regenerative, dynamic braking, plugging –Transient analysis of separately excited motor – converter control of dc motors – analysis of separately excited & series motor with 1-phase and 3-phase converters.	10 hrs
Unit -III	Induction motor drives – stator voltage control of induction motor – torque-slip characteristics – operation with different types of loads – operation with unbalanced source voltages and single phasing – analysis of induction motor fed from non-sinusoidal voltage supply – stator frequency control – variable frequency operation – V/F control, controlled current and controlled slip operation.	10 hrs
Unit -IV	Synchronous motor drives – speed control of synchronous motors – adjustable frequency operation of synchronous motors – principles of synchronous motor control – voltage source inverter drive with open loop control – self-controlled synchronous motor with electronic commutation – self-controlled synchronous motor drive using load commutated thyristor inverter.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. M.P. Poonia & S.C. Sharma, "Basic Mechanical Engineering, , Khanna Publishing House
2. 2. Strength of Materials, D.S. Bedi, Khanna Publishing House

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	3	2	2	1					1			2
CO3	3	3	3	2					2			2
CO4	3	3	3	2					2			2

**‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low-level’ mapping

Laboratory Project-III (VSSD 207)		

	NSQF Level 7 SEMESTER VI						
Sr. No	**Course Code**	**Course Name**	**Course type (GC/SC)**	**L**	**T**	**P**	**Credits**
1	**VSSD208**	Industrial on Job Training-II	**SC**				**30**
	Total Credit						**30**
	SC-Skill Component, GC-General Component						

3rd Year

Entrepreneurship Development (VSSD 301)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week	End of semester Examination-60 marks	Theory-3
Course Prerequisite: Knowledge of Entrepreneurship Development.		
Course Objective:		
Course Outcomes: On completion this course, students will be able to		
CO1: To understand and analyze basics of entrepreneurship. CO2: To study the working principles of various sensors for automation. CO3: To introduce electrical machines for automations. CO4: To acquire knowledge on PLC and apply for the development of various automated systems.		
Level	Bachelor	
Course Content:		
Unit –I	**Introduction to Entrepreneurship** - Meaning and Importance, Evolution of term ‘Entrepreneurship, Factors influencing entrepreneurship, Psychological factors, Social factors, Economic factor, Characteristics of an entrepreneur, Entrepreneur and Entrepreneur, Types of entrepreneurs, New generations of entrepreneurship viz. social entrepreneurship.	10 hrs
Unit-II	**Entrepreneurial Motivation** – Motivation, Maslow’s theory, Herjburg’s theory, McGragor’s Theory, McClelland’s Need – Achievement Theory, Culture & Society, Values / Ethics, Risk taking behavior	10 hrs
Unit-III	**Creativity-** Creativity and entrepreneurship, Steps in Creativity, Innovation and inventions, Using left brain skills to harvest right brain ideas, Legal Protection of innovation, Skills of an entrepreneur, Decision making and Problem Solving (steps indecision making)	8 hrs
Unit-IV	**Rules And Legislation -** Applicability of Legislation Industries Development (Regulations) Act, 1951, Factories Act, 1948, The Industrial Employment (Standing Orders), 5.5 West Bengal Shops and Establishment Act, 1963, 5.6	12 hrs

	Environment (Protection) Act, 1986, 5.7 The sale of Goods Ac, 1950, 5.8 Industrial Dispute Act 1947	

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Robert Hisrich and Michael Peters, Entrepreneurship, Tata Mc Graw– Hill.
2. Vasant Desai, Entrepreneurship.
3. Marc J Dollinger, Entrepreneurship – Strategies and Resources, Pearson Education.

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1								2
CO2	2	3	2	1					1			2
CO3	3	3	3	2					2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' Mapping

Robotics for Industrial Automation (VSSD302)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+ Tutorial 2 h/week	End of semester Examination-60 marks	Theory-4

Course Prerequisite: Knowledge of Industrial Robotics.

Course Objective:

Course Outcomes: On completion this course, students will be able to

1. explain robot anatomy and classification (L2)
2. analyze the applications of robots in various industrial application (L2)
3. Describe different sensors used in robots (L3)
4. Discuss the concept of grippers and force analysis (L4)
5. Describe different drives and actuators used in robots (L5)
6. Discuss the concept of control systems (L6)
7. explain the robot programming and languages (L7)
8. write programming for simple operations (L8)

CO1: To explain robot anatomy, classification, and applications of robots.
CO2: To understand the various sensors, grippers and its selection in robotics.
CO3: To obtain basic idea on working principle of various drives, actuators and control concepts.
CO4: To program different robot operations and appreciate applications of robots in industry.

Level	Bachelor	
Course Content:		
Unit –I	**Introduction to robotics:** Brief History, Basic Concepts of Robotics such as Definition, Three laws, Elements of Robotic Systems i.e. Robot anatomy, DOF, Misunderstood	10 hrs

	devices etc., Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc., Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device etc., Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot.	
Unit-II	**Grippers and Sensors for Robotics:** Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system. Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot.	10 hrs
Unit-III	**Drives and Control for Robotics:** Drive - Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to closed loop control.	8 hrs
Unit-IV	**Programming and Languages for Robotics:** Robot Programming: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS.	12 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. 1. S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014)
2. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006)
3. Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019)
4. R. K. Mittal, I. J. Nagrath, Robotics and Control, TATA McGraw Hill Publishing Co Ltd, New Delhi (2003)
5. S. B. Niku, Introduction to Robotics – Analysis, Control, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
6. R. Siegwart, I. R. Nourbakhsh, "Introduction to Autonomous Mobile Robots", The MIT Press, 2011

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	2	2	3	2					2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' Mapping

IoT in Industrial Automation (VSSD 303)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week + Practical – 2 h/ week	End of semester Examination-60 marks	Theory-4
Course Prerequisite: Knowledge of IoT.		
Course Objective: The main objective of this course is to provide the knowledge about IoT and concept of IoT to the students with the applications of IoT. Preliminary ideas on forces and fluid dynamics are also essential to know.		
Course Outcomes: On completion this course, students will be able to		
CO1: To explain concept, standards, components, and applications of IoT. **CO2:** To understand the various smart objects, market, environment cloud computing and real time analysis in the context of IoT. **CO3:** To obtain basic idea on working principle of various sensors, actuators and control concepts, and communication protocols in context of IoT. **CO4:** To acquire knowledge about network communication in aspect of IoT and use of IoT in Drones.		
Level	Bachelor	
Course Content:		
Unit –I	**Introduction to Industrial IoT (IIoT) Systems**: The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories.	10 hrs
Unit-II	**Implementation systems for IIoT**: Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.	10 hrs
Unit-III	**IIoT Data Monitoring & Control**: IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology. **Cyber Physical Systems**: Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis	8 hrs
Unit-IV	**Industrial IoT- Applications**: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. **Case Studies of IIoT Systems**: IIoT application development with Embedded PC based development boards, Development of mini Project on new version of Operating systems and Edge development board. That project should also address to the current societal needs.	12 hrs
Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks

	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	2	3	2	2					2			2
CO4	3	3	3	2					2			2

**‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low-level’ Mapping

Introduction to control system (VSSD 304)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of Networking.

Course Objective: The main objective of this course is to make the students acquainted with the basics of control system. Preliminary ideas on control system and its applications etc. for these in automation and programmability are also essential to know.

Course Outcomes: On completion this course, students will be able to

- **CO1:** Perform time domain and frequency domain analysis of control systems required for stability analysis.
- **CO2:** Design of compensators that can be used to stabilize the control systems.
- **CO3:** Demonstrate the ability to apply Laplace transform, transfer functions, and block diagrams for simulation and control.
- **CO4:** Identify, evaluate and solve control engineering problems.

Level	Bachelor	
Course Content:		
Unit –I	**Control Systems and Components:** Systems and their representation: Basic elements in control systems, open and closed loop systems, Electrical analogy of mechanical systems, Transfer function, Block diagram reduction techniques, Signal flow graphs- AC and DC servomotor, synchro-, stepper motor.	10 hrs
Unit-II	**Time Response Analysis and Design Specifications:** Time response: Time domain specifications, Types of test input, I and II order system response, Error coefficients, Generalized error series, Steady state error, P, PI, PD and PID compensation.	10 hrs
Unit-III	**Frequency Response Analysis:** Frequency response: Bode plot, Polar plot, frequency domain specifications, Correlation between frequency domain and time domain specifications, Introduction to the design of lead, lag and lag-lead compensators.	12 hrs
Unit-IV	**Concepts of Stability:**	8 hrs

	Stability Analysis: Characteristics equation, Location of roots in S plane for stability, Routh Hurwitz criterion, Root locus diagram and its application, Dominant poles-Nyquist stability criterion, relative stability.	

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Norman S. Nise, "Control Systems Engineering", 4th Ed, John Wiley, New Delhi, 2007.
2. K. Ogata, "Modern Control Engineering", 4th Ed, PHI, New Delhi, 2002.
3. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.

Benjamin C. Kuo, "Automatic Control Systems", Pearson Education, New Delhi, 2003.

CO/PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	1								2
CO2	3	3	3	1					1			2
CO3	3	3	3	2					2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' Mapping

Fundamental of Mechatronics (VSSD 305)		
Teaching Scheme	Examination Scheme	Credits allocated
Theory 3 h/week+	End of semester Examination-60 marks	Theory-3

Course Prerequisite: Knowledge of Mechatronics fundamentals.

Course Objective: The main objective of this course is to make the students acquainted with the basics of mechanical systems. Preliminary ideas on forces and fluid dynamics are also essential to know.

Course Outcomes: On completion this course, students will be able to

CO1: To introduce Real Time Operating System with GUI and Simulation of mechatronics with trends, methods and applications of various sensors for automation.
CO2: To study the introduction of Signal Conditioning, hardware, Digital I/O, Analog I/P, filtering noise using passive component etc.
CO3: To understand and analyze precision of mechanical system for automations.
CO4: To acquire knowledge of electrotechnical drivers, stepper motor, wave modulation for automated systems.

Level	Bachelor	
Course Content:		
Unit -I	Introduction: Definition – Trends - Control Methods: Stand alone, PC Based (Real Time Operating Systems, Graphical User Interface, Simulation) - Applications: identification of Sensors and actuators in Washing machine, Automatic	10 hrs

	Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.	
Unit-II	Signal Conditioning : Introduction – Hardware - Digital I/O, Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors – Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering	10 hrs
Unit-III	Precision Mechanical Systems : Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.	10 hrs
Unit-IV	Electromechanical Drives: Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.	10 hrs

Internal assessment		
Part A	CIA-I: Unit I, and II	20 Marks
	CIA-II: Unit III, and IV	20 Marks
Part B	ESE: Term Exam	60 Marks

Text/Reference Books:

1. Mechatronics, Bolton w, Addison Wesley Longman Ltd., USA 1999, ISBN: 9780582357051
2. Mechatronics, H.M.T., McGraw-Hill Education, New Delhi, 2000, ISBN: 0074636435
3. Mechatronics Electronics in production and Process, Dawson D.A., Burd N.C., Loader A.J., Chapman-Hall, New Delhi, 2003, ISBN: 9780072402414
4. Mechanical Measurement and Instrumentation, Sawhney Puneet, Sawhney A.K., Dhanpat Rai and Sons, 2013, New Delhi

CO/PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1								2
CO2	3	3	3	1					1			2
CO3	2	2	3	2					2			2
CO4	3	3	3	2					2			2

**'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low-level' mapping

	Open Elective (VSSD 306)	
Examination Scheme	Credits allocated	
End of semester Examination-60 marks	Theory-3	

	NSQF Level 7 SEMESTER VI

Sr. No	Course Code	Course Name	Course type (GC/SC)	L	T	P	Credits
1	VSSD308	Industrial on Job Training-II	SC				30
	Total Credit						30
	SC-Skill Component, GC-General Component						