



CIRCULAR NO.SU/B.Sc./CBC&GS /08/2023

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted the **following syllabi of Bachelor of Science with Practical Pattern of Question Paper under the scheme of Choice Based Credit & Grading System** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Courses	Semester
1.	B.Sc.Electronics (Optional)	IIIrd & IVth semester
2.	B.Sc. Instrumentation Practice (Optional)	IIIrd & IVth semester
3.	B.Sc.Non Conventional and Conventional Energy (Degree)	IIIrd & IVth semester

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/2023/ 4017-25
Date:-04.07.2023.

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*Deputy Registrar,
Academic Section*

Copy forwarded with compliments to :-

- 1] **The Principal of all concerned Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

- 1] **The Director, Board of Examinations & Evaluation, Dr.BAMU,A'bad.**
- 2] The Section Officer,[B.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
- 3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
- 4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
- 5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.BAMU,A'bad.
- 6] The Public Relation Officer, Dr.BAMU,A'bad.
- 7] The Record Keeper, Dr.BAMU,A'bad.

**DR. BABASAHEB AMBEDKAR MARATHWADA
UNIVERSITY, AURANGABAD**



Instrumentation Practice

As per

Choice Based Credit & Grading System

**B. Sc. S. Y.
Semester III & IV**

B. Mole
23/6 2023

**Effective from
Academic Year- 2023-24**

[Signature]

B. Mole

B.Sc. Second Year Instrumentation Practice Syllabus
Choice Based Credit System Syllabus
To be implemented from Academic Year 2023-24

Title of the Course: Instrumentation Practice

Preamble:

The curriculum for the B. Sc. (Instrumentation Practice) programme is designed to cater to the requirement of Choice Based Credit System following the University Grants Commission (UGC) guidelines. In the proposed structure, due consideration is given to Core and Elective Courses (Discipline specific Instrumentation Practice), along with Ability Enhancement (Compulsory and Skill based) Courses Furthermore, continuous assessment is an integral part of the CBCS, which will facilitate systematic and thorough learning towards better understanding of the subject. The systematic and planned curricula from first year to the third year (comprised of six semesters) shall motivate the student for pursuing higher studies in Instrumentation Practice and inculcate enough skills for becoming an entrepreneur.

Objectives:

- To foster scientific attitude, provide in-depth knowledge of scientific and technological concepts of Instrumentation Practice.
- To enrich knowledge through problem solving, minor/major projects, seminars, tutorials, review of research articles/papers, participation in scientific events, study visits, etc.
- To familiarize with recent scientific and technological developments
- To create foundation for research and development in Instrumentation and Instrumentation Practice.
- To help students to learn various experimental and computational tools thereby developing analytical abilities to address real world problems.
- To train students in skills related to research, education, industry, and market.
- To help students to build-up a progressive and successful career in Instrumentation Practice.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Choice Based Credit System (CBCS) Curriculum for instrumentation practice Under Faculty of Science and Technology

**Course Structure and Scheme of Examination
B.Sc. Three Year Undergraduate Degree Program**

	Course Code	Course Title	Total periods (Teaching periods/ week)	Cre dits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Semester III								
Optional I (DSC-1C) Core Courses	IP 311	Digital Electronics- I	45(3/week)	2	50	10	40	20
	IP 312	Operational Amplifier & Its Applications	45(3/week)	2	50	10	40	20
	IP 321	Practical Paper – III	45(3/week)	1.5	50	10	40	20
	IP 322	Practical Paper – IV	45(3/week)	1.5	50	10	40	20
Skill Enhancement course (SEC-1)	SEC-313	SEC-1 Any one skill to be chosen out of two SEC-1(A): Industrial Sensing Devices, SEC-1(B): Fundamentals of Control Systems	45(3/week)	2	50	10	40	20
Ability Enhancement compulsory courses (AECC-3)	CLE-3	Communication skills in English-III	45(5/week)	3	50	10	40	20
	AECC-3	Marathi/Hindi/Urdu/Sanskrit A student can opt for any one of these languages (SL-III)	45(4/week)	3	50	10	40	20
			315	15	350	70	280	140
Total Credits for Semester III : 15 (Theory : 12 ; Laboratory : 3)								
Semester IV								
Optional I (DSC-1D) Core Courses	IP 411	Digital Electronics- II	45(3/week)	2	50	10	40	20
	IP 412	Signal Generators and IC's	45(3/week)	2	50	10	40	20
	IP 421	Practical Paper – V	45(3/week)	1.5	50	10	40	20
	IP 422	Practical Paper – VI	45(3/week)	1.5	50	10	40	20
Skill Enhancement course (SEC-2)	SEC-413	SEC-2 Any one skill to be chosen out of two SEC-2 (C): Kinematics machines SEC-2 (D): Introduction to Robotics	45(3/week)	2	50	10	40	20
Ability Enhancement compulsory courses (AECC-4)	CLE-4	Communication skills in English-IV	45(5/week)	3	50	10	40	20
	AECC-4	Marathi/Hindi/Urdu/Sanskrit A student can opt for any one of these languages (SL-IV)	45(4/week)	3	50	10	40	20
Additional credits		Environmental Studies	45(3/week)	2*				
			360	17	350	70	280	140
Total Credits for Semester IV : 17 (Theory : 12; Laboratory : 5)								

Important Notes:

- i) **Nomenclature:** DSC- Discipline Specific Core course, SEC – Skill Enhancement Course, AECC- Ability Enhancement compulsory course, DSE- Discipline Specific Elective, UA- University Assessment (Semester End), CIA-Continuous Internal Assessment.
- ii) **There shall be one skill enhancement course (SEC) IIIrd to VIth Semester (any one SEC course to be chosen (any one from three optional subjects) from the basket of SEC courses for the respective semester.**
- iii) **Code description:** XXX code has to be decided by BoS of the respective subject while designing their respective curriculum (e.g., for Instrumentation Practice it will be IP; for Electronics it will be ELE)
 - The codes for first semester courses will start from XXX-111, Second-semester courses will start from XXX-211 and so on
 - XXX-111: The first digit indicates the Semester Number; the second two digits indicate paper numbers for the first-semester courses and the same analogy is for the remaining semesters
 - The codes for theory courses will start from XXX-111 (for the first semester and the same analogy is for the remaining semesters)
 - The codes for practical courses will start from XXX-121 (for the first semester and the same analogy is for the remaining semesters)
 - The codes for Ability Enhancement compulsory courses will start from XXX-131 (for the first semester and the same analogy is for the remaining semesters)
- iv) **Assessment:** 80% for University Assessment (Semester End Examination) and 20 % for Continuous Internal Assessment (CIA)
- v) **Continuous Internal Assessment (CIA): Theory** (10 Marks): Internal Test 05 Marks (Two Internal Tests of 05 marks each and average of the two tests will be considered) and 05 Marks for Assignment/tutorials.
- vi) **Continuous Internal Assessment (CIA): Practical** (10 Marks): 07 Marks for Internal Practical Examination and 03 Marks for record book/submission of collection and field survey report and excursion report
- vii) **Practical examination:** Annual examination

B. Sc. Second Year Instrumentation Practice

(Semester-III)

(Digital Electronics- I)

Course Code: IP-311

Periods 45

Credit 02

Marks 50 (CA=10, ESE 40)

Course Outcome: On successful completion of this course students will be able to:

- Show an analytic ability to solve problems relevant to Digital Electronics.
- Demonstrate inter-conversions between number systems , operation of simple and combinational logic gates.
- Design basic circuits using analog and/or digital electronic components for simple applications that include (but not limited to) power supply, water level control etc.

Unit I . Digital Number Systems

[10 L]

Decimal number system, Binary number system, Decimal- Binary, Binary-Decimal conversions, Octal number system, Hexadecimal number system, Decimal- Octal , Octal-Decimal conversions, Hexadecimal- Decimal, Decimal- Hexadecimal conversions, Binary-Octal, Octal-Binary conversions.

Unit II. Binary codes and digital arithmetic

[11 L]

BCD code, BCD- Binary , Binary-BCD conversions, Excess-3 code, Decimal-Excess-3 conversion, Gray code, Binary-Gray, Gray- Binary conversions, Binary addition, subtraction, multiplication, division, one's and two's complement, addition and subtraction using two's complement.

Unit III. Boolean Algebra and Logic Gate Operation

[11 L]

The AND gate, OR gate, NOT gate, NAND gate, NOR gate, Ex- OR gate, Ex-NOR gate, Boolean algebra laws and rules, simplification of combinational logic circuits, De Morgan's theorems, Karnaugh mapping.

Unit IV. Arithmetic Circuits

[13 L]

Half Adder, Full Adder, Half Subtractor, Full Subtractor, 4-bit binary adder, Excess-3 adder, 4-bit binary Subtractor.

Reference Book:

1. Digital Electronics & Microcomputers : R. K. Gaur, Dhanpat rai publications.
2. Digital Electronics :- Anil K. Maini , Wiley India Pvt.Ltd.
3. Digital and Microprocessor fundamentals :- William Kleitz, Prentice Hall Internationals.
4. Electronic Devices- Thomas l. Floyd; Pearson Education, Ninth Edition, 2012, New Jersey

**B. Sc. Second Year Instrumentation Practice
(Semester-III)**

(Operational Amplifier & Its Applications)

Course Code: IP-312

Periods 45

Credit 02

Marks 50 (CA=10, ESE 40)

Course Outcome: On successful completion of this course students will be able to:

- Explain fundamental characteristics of Operational Amplifiers (OP-AMPs) and illustrate OP-AMPs as building blocks of Signal conditioners .
- Design and apply various signal conditioning circuits using OPAMPs
- Define and describe different voltage regulator for domestic and industrial applications

Unit I. Introduction to Op-Amp

[10 L]

Inverting and noninverting amplifier, OP-Amp parameters, Op- Amp symbol, Op-Amp transfer characteristics, equivalent circuit of Op- Amp, Ideal operational amplifier, Voltage follower, differential input – differential output amplifier, Bridge amplifier, Reference Voltage Sources, Charge amplifier.

Unit II. Op-Amp Application

[11 L]

Summing amplifier, Difference amplifier, Instrumentation Amplifier, Transducer bridge Amplifier. Half wave and full wave Rectifier, Log and Antilog Amplifiers. D. C. Sources, Current Amplifier, A. C. Amplifier.

Unit III. Voltage regulators

[11 L]

Parameters of voltage regulators, Basic configuration of voltage regulators, Basic block diagram of linear voltage regulator. Study of LM 105, LM 723, LM7805, LM 7905, LM 317

Unit IV. Active Filters

[13 L]

Ideal and Realistic frequency response, various filter responses, Basic low pass and high pass filters, Second order low pass filter, Second order high pass filter, the Biquad filter.

Reference Books-

1. Op-amps and Linear Integrated Circuits by Ramakant A. Gayakwad, Prentice-Hall
2. Integrated circuits by K. R. Botkar (Khanna Publications)
3. Analog Electronics by L. K. Maheshwari , M.M.C. Anand P H I India

B. Sc. Second Year Instrumentation Practice
(Semester-III)
Instrumentation Practice Practical: Lab Course-3
Course Code: IP-321

Credit 1.5

Marks-50 (CIA-10 and UA-40)

List of Experiments:

1. Study of Inverting Amplifier
2. Study of Noninverting Amplifier
3. Study of Offset null arrangement
4. Study of Load and Line Regulation of IC 7805
5. Study of Load and Line Regulation of IC LM317
6. Study of Astable Multivibrator using timer IC 555
7. Study of Instrumentation Amplifier

**B. Sc. Second Year Instrumentation Practice
(Semester-III)**

Instrumentation Practice: Lab Course-4

Course Code: IP-322

Credit 1.5

Marks-50 (CIA-10 and UA-40)

List of Experiments:

1. Study of Full Adder
2. Study of Digital Basic Gates
3. Study of NAND gate as universal building block
4. Study of De Morgan's theorem
5. Study of Decoder (3 : 8)
6. Study of Multiplexer
7. Study of J-K Flip flop

**B. Sc. Second Year Instrumentation Practice
(Semester-III)
Skill Enhancement Course**

NOTE:

Any one skill Enhancement Course to be chosen out of two either 'SEC-1(A): Industrial Sensing Devices,' or 'SEC-1(B): Fundamentals of Control Systems'

**B. Sc. Second Year Instrumentation Practice
(Semester-III)**

Title of the course: SEC-1(A) Industrial Sensing Devices

Course code: SEC-313

Periods 45

Credit 02

Marks 50 (CA=10, ESE 40)

Learning Objectives:

At the completion of this course, the student should be –

- Discuss primary blocks of an Instrumentation System and describe basic selection criteria for transducers as per application demand
- Describe and classify displacement and position detection sensors, and apply them for real time measurements
- Describe and classify temperature sensors, and apply them for real time measurements
- Discuss humidity measurement devices, speed measurement methods, weight measurement principle and principle of vibration and thickness sensing

Unit I: Displacement and Detection Sensors

[10 L]

Instrumentation System- Block diagram, Function of each block Sensors and Transducers- Definition, Needs, Classification, Selection criteria Measurement of Linear and Angular Displacement - Linear and Angular Potentiometers, Capacitive Transducers, LVDT Detection Sensors – Limit Switches, Proximity Detectors, Hall Effect Sensor, Photoelectric sensors, Ultrasonic Sensors

Unit II: Temperature

[12 L]

Temperature measurement - Temperature: Definition and units, Different temperature scales & their conversions; Classification of temperature measuring transducers: Gas Filled thermometer, Bimetallic thermometer, Thermistors, RTD – (PT-100) , 2 wire systems (circuit diagram only), Thermocouple – Seebeck & Peltier effect, Types J, K, R , S, T (Based on material, temperature ranges)

Unit III : Flow Sensor

[10 L]

Flow measurement - Flow: Definition, Types of Flow – Laminar, turbulent , Reynolds number Classification of flow measuring transducers : Variable head flow meter- Venturimeter, orifice plate meter, Variable area flow meter – Rota meter, Electromagnetic Flow meter, Ultrasonic flow meter-Doppler Type, Solid flow measurement, Flow measurement

Unit IV : Special Purpose Sensors

[13 L]

Humidity: Definition, unit, Types - Absolute, relative Humidity measurement devices: Psychrometer - Dry & wet Bulb thermometer type, Hygrometer- hair type ,Speed : Definition, unit, Classification of speed measurement methods. Photoelectric pick-up & Proximity sensor (Non contact type)

Weight: Definition, unit, Classification of weight measurement methods.

Load cells. Vibration Sensor, Thickness Sensor

Reference books:

1. Electrical and Electronic Measurements and Instrumentation - A.K.Sawhney; Dhanpat Rai & Sons.
2. Industrial Instrumentation & Control - S.K.Singh; Tata McGraw Hill Publishing Co. Ltd; 2006, Second Edition, New Delhi
3. Principles of Industrial Instrumentation - D. Patranabis; Tata McGraw Hill Publishing Co. Ltd; Third Edition, 1995, New
4. Electronics Instrumentation – H. S. Kalsi; Second Edition, 2004, Tata McGraw Hill Publishing Co. Ltd; N. Delhi
5. Industrial Electronics – Terry Bartlet; Cengage Learning India Edition, Second Indian Reprint, 2006, New Delhi
6. Mechatronics- M.D.Singh, B.Joshi; First Edition, 2006,Prentice Hall of India, New Delhi

**B. Sc. Second Year Instrumentation Practice
(Semester-III)**

**Title of the course: SEC-1(B) Fundamentals of Control Systems
Course code: SEC-313**

Periods 45

Credit 02

Marks 50 (CA=10, ESE 40)

Learning Objectives:

At the completion of this course, the student should be –

- Describe primary blocks of an Instrumentation System and Qualities of Measurement.
- Classify physical measurement backgrounds.
- Select transducers as per application demand.
- Identity terminals of industry grade transducers.
- Describe operation of basic transducers employed for industrial process parameter monitoring applications

Unit I: Introduction to Industrial Control Systems

[13 L]

Classification of Control System, Industrial Control System, Elements of Open and Close Loop Control System, Feedback Control, Dynamic Response of a Closed Loop System, Control System Parameters

Unit II: The Controller Operation

[12 L]

Block Diagram, Algebra Of Control System, Concept Of Process Control, Automatic Controllers – Analog And Digital, Control Modes- On-Off, Proportional Control, Integral Control, Derivative Control, PID Control, Time Proportioning Control, Time Proportioning Circuit

Unit III: The Controller Operation

[10 L]

Batch Process, Continuous Process, Instrumentation, Measurement Devices, Feedback Loop Interface Instruments, Controllers

Unit IV: Industrial Process Instrumentation

[10 L]

Monitoring Instruments - Indicators, Alarms and Recorders. Manipulation Devices- The Control Valve, the Valve Body, Instrumentation Symbolology- General Instrument Symbol, Tag Numbers, Line Symbols, Valve and Actuators Symbols

Reference books:

1. Terry Bartelt; 2006; Industrial Electronics: Circuits, Instrument and Control Technique (INDIA EDITION) ; Cengage Learning India PVT LTD; Delhi (India)
2. Curtis D. Johnson; 2012 ; Process Control Instrumentation Technology (EIGHTH EDITION); PHI Learning PVT LTD; New Delhi (India).
3. <http://www.electrical4u.com/control-system-closed-loop-open-loop-control-system/>
4. <https://www.facstaff.bucknell.edu/mastascu/eControlHTML/Intro/Intro1.html>
5. <http://www.electronics-tutorials.ws/systems/closed-loop-system.html>
6. I.J.Nagrath, M.Gopal; 2009; Control Systems Engineering (Fifth Edition); New Age International Publishers; India
7. N. Barapate; 2006; Control System; Tech Max publications; Pune (India)

**B. Sc. Second Year Instrumentation Practice
(Semester-IV)**

(Digital Electronics-II)

Course code IP-411 Theory Paper-VII

Periods 45

Credit 02

Marks 50 (CA=10, ESE 40)

Course Outcome: On successful completion of this course students will be able to:

- Identify basic data control devices
- Interpret Flip-flops and Sequential Logic
- Justify Interfacing to analog world

Unit – I: . Data Control Devices

[10 L]

Comparators, Decoders, Encoders, Multiplexers, Demultiplexers

Unit – II. Flip-flops

[10 L]

R S Flip flops, R-S Flip flop with active low inputs, R-S Flip flop with active high inputs, D Latch, D Flip flop, J-K Flip flop

3. Counter Circuits and Shift Registers

[13 L]

Ripple (Asynchronous) counter, Synchronous counter, modulus of a counter, Divide by n counter, Binary ripple counter, Decade counter, BCD counter, Shift register, serial in serial out shift register, serial in parallel out shift register, parallel in serial out, parallel in parallel out shift register, ring shift counter.

4. Interfacing to analog world

[12 L]

Digital to analog representations, Binary weighted D/A converter, R-2R Ladder D/A converter, parallel encoded A/D converter, counter type A/D converter, Successive approximation A/D converter.

Reference Books :

1. Digital Electronics & Microcomputers : R. K. Gaur, Dhanpat rai publications.
2. Digital Electronics :- Anil K. Maini , Wiley India Pvt.Ltd.
3. Digital and Microprocessor fundamentals :- William Kleitz, Prentice Hall Internationals.

**B. Sc. Second Year Instrumentation Practice
(Semester-IV)**

(Signal Generators and IC's)

Course code IP-412 Theory Paper-VII

Periods 45

Credit 02

Marks 50 (CA=10, ESE 40)

Course Outcome: On successful completion of this course students will be able to:

- Identify basic data control devices
- Interpret Flip-flops and Sequential Logic
- Justify Interfacing to analog world

Unit I: Signal generators

[10 L]

Ramp generators using IC 555 in monostable mode, free running ramp generators, missing pulse detectors, timer/ counter circuits. Study of XR-2240 timer/counter, XR-2242 timer/counter, Triangular waves generators, Basic Triangular waves generators, Voltage controlled Triangular/square waves generators, Triangular to sine wave conversion.

Unit II: Signal Conditioning

[11 L]

Signal amplification (opamp), Filtering (opamp), Interfacing with μP (ADC), Protection (Zener & photo isolation), Linearization, Current – voltage change circuits, resistance change circuits (Wheatstone bridge), error compensation.

Unit III: Study of IC

[12 L]

Study of IC-566 VCO, Study of IC- 8038 function generator, Study of XR-2206 function generator, Voltage to frequency and frequency to voltage converter.

Unit IV: Study of LED

[12 L]

LCD display, Various display formats, display characteristics, addressing techniques, construction of LED display, direct drive circuits for LED display, multiplexed drive circuits for LED display, Alphanumeric LED display.

Reference Books-

1. Integrated circuits by K. R. Botkar (Khanna Publications)
2. Digital Electronics Anil K. Maini , Wiley India Pvt.Ltd.
3. Digital Signal Processing: Principles, Algorithms, and Applications John G Proakis, 1992

**B. Sc. Second Year Instrumentation Practice
(Semester-IV)**

Instrumentation Practice: Lab Course-5

Course Code: IP-421

Credit 1.5

Marks-50 (CIA-10 and UA-40)

List of Experiments:

- 1 Study of Load and Line regulation of IC 7905
2. Study of Monostable Multivibrator using timer IC 555
3. Study of V.C.O. IC 566
4. Study of Function Generator IC 2206
5. Study of Function Generator IC 8038
6. Study of Op-Amp as summing amplifier
7. Study of Op-Amp as difference amplifier

**B. Sc. Second Year Instrumentation Practice
(Semester-IV)**

Instrumentation Practice: Lab Course-5

Course Code: IP-421

Credit 1.5

Marks-50 (CIA-10 and UA-40)

List of Experiments:

1. Study of Full Subtractor
2. Study of De multiplexer
3. Study of NOR gate as universal building block
4. Study of DFF and TFF
5. Study of 4-Bit asynchronous counter
6. Study of study of mod-8 counter
7. Study of Study of 8-bit A/D converter
8. Study of 8-bit D/A converter

**B. Sc. Second Year Instrumentation Practice
(Semester-IV)
Skill Enhancement Course**

NOTE:

Any one skill Enhancement Course to be chosen out of two either 'SEC-2(C) Kinematics of machines' or 'SEC-2(D) Introduction to Robotics'

**B. Sc. Second Year Instrumentation Practice
(Semester-IV)**

Title of the course: SEC-2(C) Kinematics of machines

Course code: SEC-413

Periods 45

Credit 02

Marks 50 (CA=10, ESE 40)

Learning Objectives: At the completion of this course, the student should be –

- Illustrate fundamental concepts of kinetics and kinematics of motion
- Explain kinematic links, kinematic pairs, related classification and constrained motion
- Explain friction as a power transfer entity, classify types of friction, and evaluate role of friction

Unit I: Simple Mechanisms

[10 L]

Revision of concepts (vector and scalar, vector addition and subtraction, resultant vector), Rectilinear Motion, Equations of Rectilinear Motion, Angular Motion, Equations of angular motion, Newton's laws, Force, Couple, Centripetal and centrifugal force, Moment of Inertia, Moment of Momentum

Introduction to Kinematic links, types, structure, Kinematic pairs, classification, types of constrained motion, Kinematic chain, Types of joints in a chain, Mechanism

Unit II: Friction

[11 L]

Introduction to friction as a power transfer entity, Types of friction, limiting friction, laws of static and dynamic friction, friction co-efficient, Limiting angle, angle of repose, sliding body on rough plane; Screw friction, screw jack, friction in journal bearing friction cycle; friction of pivot and collar bearing, single disc/plate clutch, Multiple disc clutch, centrifugal clutch

Unit III: : Belt, Rope and Chain Drives

[12 L]

Introduction to belt drive, Selection of a belt drive, Types of belt drives and belts, belt materials, types of flat belt drives, velocity ratio in belt drive, Slip of belt, creep of belt, Power transmission by a belt drive, Centrifugal tension in a belt drive, ; V-belt drive, Advantages and disadvantages of V-belt over flat belt;

Rope drive, Types, Advantages and disadvantages of a rope drive; Chain drives, advantages and disadvantages of a chain drive, terminologies in a typical chain drive, Classification, Relation between pitch and pitch circle diameter in a chain drive, Chain speed and angular velocity of a sprocket

Unit IV: : Gear, Gear Trains

[12 L]

Introduction to toothed wheels, Advantages and disadvantages of gear drive, Classification, Terminologies in gears, Helical gears, Spiral Gears; Introduction to gear trains, types of gear trains (simple Compound, Reverted, Epicyclic) Introduction to cams, classification of cams and followers, terms used in radial cam

Reference books:

1. R. S. Khurmi, J. K. Gupta – Theory of Machines, S. Chand Publishing, ISBN -81-219-2524-X
2. Rattan – Theory of Machines, Tata McGraw Hill Education Pvt. Ltd., ISBN- 00-701-4477-X
3. T. Bevan - Theory of Machines, B S Publishers and Distributors Pvt. Ltd., ISBN – 81-239-0874-1

**B. Sc. Second Year Instrumentation Practice
(Semester-IV)**

Title of the course: SEC-2(D) Introduction to Robotics

Course code: SEC- 413

Periods 45

Credit 02

Marks 50 (CA=10, ESE 40)

Learning Objectives:

At the completion of this course, the student should be –

- list and explain the basic elements of industrial robots
- analyse robot kinematics and its control methods.
- classify the various sensors used in robots for better performance
- summarize various industrial and non-industrial applications of robots.

UNIT-I: ROBOT BASICS

[12 L]

Robot-Basic concepts, Need, Law, History, Anatomy, specifications. Robot configurations- cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot. ROBOT ELEMENTS 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.

UNIT II – ROBOT KINEMATICS AND CONTROL

[11 L]

Robot kinematics – Basics of direct and inverse kinematics, Robot trajectories, 2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation. Control of robot manipulators – Point to point, Continuous Path Control, Robot programming

UNIT III – ROBOT SENSORS

[11 L]

Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors. Force sensor-Light sensors, Pressure sensors, Introduction to Machine Vision and Artificial Intelligence.

UNIT IV – ROBOT APPLICATIONS

[10 L]

Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defense, Disaster management. Applications, Micro and Nanorobots, Future Applications.

Reference Books

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

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
Question Paper Pattern

Nature of Question Paper (Theory) for choice-based credit system (CBCS) semester pattern.

Subject: Instrumentation Practice

Time: 2 hours

Max. Marks: 40

Instructions:

1. All questions are compulsory.
2. All questions carry equal marks.
3. Draw neat diagrams and give equations wherever necessary.
4. Figures to the right indicate full marks.
5. Use of logarithmic table and calculator is allowed.

- Q. 1) Long answer questions (Solve any one) 10
A. Question from Unit – I
B. Question from Unit – III
- Q. 2) Long answer questions (Solve any one) 10
A. Question from Unit – II
B. Question from Unit – IV
- Q. 3) Short answer questions / problems (5 Marks for each) 10
A. Short answer question / problem from Unit – I
B. Short answer question / problem from Unit – III
OR
A. Short answer question / problem from Unit – II
B. Short answer question / problem from Unit – IV
- Q. 4) Multiple Choice Questions (MCQ) 10
Note: Ten MCQ's having four alternatives based on theory and numerical.
(Minimum two MCQ's from each chapter)