Government Polytechnic Mumbai

Department of Instrumentation Engineering

P-19 Curriculum

Semester- III

(Course Contents)

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonoums Instititute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Instrumentation Engineering (Sandwich Pattern) **Term / Semester - III**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
IS19203	Industrial Measurements	3	4	--	7	7	60	20	20	--	25*	25	150
IS19208	Applied electronics	3	2	--	5	5	60	20	20	25	--	25	150
IS19205	Control System Components	3	2	--	5	5	60	20	20	--	25*	25	150
EE19211	Electrical Machines	3	2	--	5	5	60	20	20	25	--	25	150
IS19207	Digital Techniques	--	4	--	4	4	--	--	--	50*	--	50	100
IS19312	C and CPP (Spoken Tutorial)	--	4 #	--	4 #	4	--	--	--	--	--	--	--
	Total	**12**	**18**	**--**	**30**	**30**	**240**	**80**	**80**	**100**	**50**	**150**	**700**
Student Centered Activity(SCA)					**05**								
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment)

* Indicates assessment by External Examiner else internal assessment, # indicates Self, on- line learning Mode, @ indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour , TH- 2:30 hours, PR/OR – 3 hours per batch , SCA- Library - 1 hour, Sports- 2 hours, Creative Activity-2 hours

Self, on- line learning Mode through MOOCS /Spoken Tutorials / NPTEL / SWAYAM / FOSSEE etc.

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

In-Charge
Curriculum Development Cell

Head of Department
Department of Instrumentation Engg.

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code:IS19203				Course Title: Industrial Measurements						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**04**	**--**	**07**	**60**	**20**	**20**	**--**	**25***	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

In industry, Instrumentation engineering diploma graduates are expected to handle basic instruments for the measurements of various process parameters. The diploma graduates should be able to select proper instruments for the measurement of the parameters and maintain these instruments for different applications. This course mainly deals with study of various transducers as well as applications of measuring instruments.

Course Outcomes: Student should be able to

CO1	Demonstrate the operation of given displacement transducers.
CO2	Use the given pressure transducers to measure pressure.
CO3	Describe the working of given level transducers.
CO4	Explain the flow transducer application for measurement of flow.
CO5	Suggest a temperature transducer for an application.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Displacement Measurement** 1.1 Displacement – Definition, types & Units. 1.2 Resistive Displacement Transducers: Potentiometer, Strain gauge, types, Effect of temperature on strain gauge measurement, Simple Numerical on strain gauge factor. 1.3 Inductive Displacement transducers- Inductance principle, classification of inductive Transducers: LVDT, RVDT. 1.4 Capacitive Transducers- Capacitance principle, Concept & variable capacitance due to change in dielectric media, area of the plate, distance between the plates. 1.5 Displacement transducer selection criteria. (Diagram, construction, working, range, advantages, Disadvantages, and applications.) **Course Outcome: CO1 Teaching Hours : 08hrs Marks: 12 (R- 2, U-4, A-6)**

2	**Pressure Measurement** 2.1 Definition, different types of pressure. 2.2 Manometers: U-tube-type, well -type, inclined manometers, and barometer. 2.3 Elastic pressure sensors/ pressure gauges: Bourdon tubes, bellows, diaphragms. 2.4 Measurement of vacuum: McLeod gauge, thermal conductivity gauge, pirani gauge, thermocouple gauge. 2.5 Electronic pressure sensors: strain gauge-type, capacitive-type, inductive-type, and piezo-electric-type pressure sensors. 2.6 Differential pressure transmitter applications. 2.7 Calibration of pressure gauge using dead weight tester (Diagram, construction, operation, range, selection criteria, advantages, and applications and above pressure transducers.) **Course Outcome: CO2 Teaching Hours : 08hrs Marks: 12 (R- 2, U-4, A-6)**
3	**Level Measurement** 3.1 Sight-type Instruments: Glass gauges, displacers, tape float 3.2 Pressure-type Instruments: Differential pressure, bubblers, and Diaphragm. 3.3 Electrical- Instruments: Capacitance probes, resistance tapes, and conductivity probes. 3.4 Sonic- type Instruments: Ultrasonic –type level measurement 3.5 Radiation-type Instruments: Nuclear type ,Radar (microwave) type. 3.6 Level transducer selection criteria. (Diagram, construction, operation, range advantages, disadvantages & applications of above transducers.) **Course Outcome: CO3 Teaching Hours : 06hrs Marks: 10 (R- 2, U-4, A-4)**
4	**Flow Measurement** 4.1 Flow principles:Bernoulli's equation, Reynolds's number and flow types. 4.2 Flow-meters classification 4.3 Variable head flowmeters: Orifice plates, venturi-meter, flow nozzle, pitot tubes. 4.4 Variable area flowmeter: Rotameter. 4.5 Velocity-type flowmeters: Turbine-type, magnetic –type,vortex shedding type, ultrasonic type flow meters. 4.6 Positive-Displacement Flowmeters: Rotary-vane and Nutating-disk type flowmeters. 4.7 Corilios Mass flowmeters. 4.8 Flow meter selection criteria. (Diagram, construction, operation, range, advantages, disadvantages & applications of above transducers.) **Course Outcome: CO4 Teaching Hours : 12hrs Marks: 12 (R- 2, U-6, A-4)**
5	**Temperature Measurement** 5.1 Temperature: Definition, Temperature scales, International Practical Temperature Scale (IPTS). 5.2 Non electrical-type Temperature Measurement: Filled system thermometers, Bimetallic strip thermometers 5.3 Electrical -type Temperature Measurement: Resistance Temperature Detectors (RTDs), RTD measurementcircuits: 2 wire, 3wire and 4-wire compensation circuits. Thermistors, Thermocouples-Principle, thermocouple effects and laws, cold junction compensation techniques, Thermocouple tables, characteristics 5.4 Pyrometers: Radiation and optical Pyrometers.

	5.5 Integrated-Circuit Temperature Sensors. 5.6 Temperature transducer selection criteria. (Working Principle, construction, materials, range, Advantages, disadvantages, applications.) **Course Outcome: CO5 Teaching Hours : 11hrs Marks: 14 (R- 4, U-6, A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Displacement Measurement**	2	4	6	12
2	**Pressure Measurement**	2	4	6	12
3	**Level Measurement**	2	4	4	10
4	**Flow Measurement**	2	6	4	12
5	**Temperature Measurement**	4	6	4	14
	Total	**12**	**24**	**24**	**60**

List of experiments: 15-20experiments (or turns) out of 33 experiments(or turns)

Sr. No.	Unit No	CO's	Title of the Experiments	Hours
1	1	CO1	Use the potentiometer to measure the linear displacement	2
2	2	CO2	To Measure Pressure using the given Bourdon Tubes– C type, Helical type or Spiral type	2
3	3	CO3	To measure water level using the given level transducers.	2
4	4	CO4	To measure Flow rate using given flow meter.	2
5	5	CO5	To plot the characteristics of PT-100 (Temp. Vs. Resistance)	2
6	1	CO1	Use the potentiometer to measure the angular displacement	2
7	1	CO1	Use the LVDT to measure linear displacement.	2
8	1	CO1	Use the RVDT to measure angular displacement.	2
9	1	CO1	To measure displacement using capacitive transducer	2
10	1	CO1	Micro project on displacement measuring instrument	4
11	1	CO1	Use the strain gauge to measure weights.	2
12	2	CO2	To Measure Pressure using the given well/ U-tube or inclined tube manometers	2
13	2	CO2	To observe Pressure measurement using the DP transmitter	2

14	2	CO2	To Measure vacuum using the given vacuum gauge.	2
15	2	CO2	To measure the pressure using given electronic pressure sensor/instrument.	2
16	2	CO2	To Calibrate the given pressure gauge by using dead weight tester	4
17	2	CO2	Micro project on pressure measuring instrument	4
18	3	CO3	To measure water level using the Bubbler method.	2
19	3	CO3	To measure water level using the given sight type instrument.	2
20	3	CO3	To measure level using conductivity probes instrument	2
21	3	CO3	To observe level measurement using sonic type instrument	2
22	3	CO3	To observe level measurement using radiation type instrument	2
23	3	CO3	To measure Level using the given DP transmitter.	2
24	3	CO3	Micro project on level measuring instrument	4
25	4	CO4	To measure Flow rate using orifice meter/venturimeter .	2
26	4	CO4	To measure Flow rate using Rotameter.	2
27	4	CO4	To measure Flow rate using DP transmitter.	2
28	5	CO5	To plot the characteristics of the given thermocouples (Temp. Vs. Voltage) J - type , K .	2
29	5	CO5	To plot the characteristics of the given thermocouples (Temp. Vs. Voltage) T - type, S and R - type .	2
30	5	CO5	To Plot the characteristics of a thermistor (Temp. Vs. Resistance)	2
31	5	CO5	To Calibrate the given temperature transducers.	2
32	5	CO5	Micro project on temperature measuring instrument.	4
33	All	All	Industrial visit	4
				60

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos.Remaining experiments are to be performed as per importanceof the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Measurement and Control Basics	Thomas A. Hughes, ISA Press, 5th Revised edition,2015	978-0876640142
2	Instrumentation Measurement and Analysis	B.C.Nakra, K.K.Chaudhari, Tata McGraw Hill,4th edition,,2016	9789385880629
3	Transducers and Instrumentation	D.V.S. Murthy, Prentice Hall India, 2 edition,2008	978-8120335691
4	Instrumentation Devices and Systems	C.S.Rangan , V.S.V. Mani , G.R. Sarma, Tata McGraw Hill, 2nd edition,2001	9780074633502
5	Industrial Instrumentation and control	S.K.Singh, Tata McGraw Hill,2 edition,2003	9780074519141
6	A Course in Electrical and Electronics Measurement and Instrumentation	A. K. Sawhney, DhanpatRai& Co,19th edition,2011	978-8177001006
7	Principles of Industrial Instrumentaion	D. Patranabis Tata McGraw Hill,2 edition,2001	9780074623343
8	Instrument Engineers Handbook Vol .Proecss Measurement	Bela G. Liptak Chilton Book Co U.S.A ,5th edition.2016	9781498727648

E-References:

1. https://nptel.ac.in/courses/103/105/103105130/
2. https://nptel.ac.in/content/storage2/courses/108105063/pdf/L0-6(SS)(IA&C)%20((EE)NPTEL).pdf
3. https://nptel.ac.in/courses/108/105/108105063/
4. www.youtube.com “enter the name of topic”

CO Vs PO and CO Vs PSOMapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	1	2	3	-	1	1	2	1
CO2	3	2	2	3	-	1	1	2	1
CO3	1	2	2	3	-	1	1	2	1
CO4	2	2	2	2	-	1	1	2	1
CO5	3	2	2	2	-	1	1	2	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr Sagar Panchal	Senior Engineer	VVF Ltd Taloja.
2	Mr. C.S. Tamkhane	Lecturer in Instrumentation	Govt. Polytechnic Pen
3	Mrs. K.U. Waghmare	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai
4	Mr. K. U. Dawane	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code: IS19208				Course Title: Applied Electronics						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**25**	**--**	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

Instrumentation engineers deals with field data acquisition and control of parameters in industries. Data/signals are acquired in cotrol room from various sensors/ transducers and conditioned to required level and form. Based on these signal information the parmeters are controlled. Electronics and power circuits plays vital role in processing signals and controlling the parameters. This course deals with the maintenance of such electronics and power circuitaries in industries.

Course Outcomes: Student should be able to

CO1	Interpret different types of amplifiers
CO2	Demonstrate sine, square and pulse oscillators
CO3	Distinguish between various power electronics devices
CO4	Interpret different power conversion devices
CO5	Maintain power devices based basic control circuits

Course Content Details:

Unit No	Topics / Sub-topics
1	**Amplifiers** 1.1 Voltage amplifiers 1.1.1 Direct coupled 1.1.2 R-C coupled 1.1.3 Transformer coupled (circuit, operation and frequency response) 1.2 Negative feedback Amplifiers 1.2.1 Principle of negative feedback 1.2.2 Advantages of negative feedback 1.2.3 Voltage series feedback amplifier circuit & operation 1.2.4 Current series feedback amplifier circuit & operation 1.3 Power amplifiers 1.3.1 Classification

	1.3.2 Nonlinear distortion and efficiency of conversion 1.3.3 Push-pull amplifier 1.3.4 Complementry symmetry push-pull amplifier **Course Outcome: CO1 Teaching Hours : 12 Marks: 12 (R-04, U-04, A-04)**
2	**Oscillators** 2.1 Barkhausen criterion 2.2 RC phase shift oscillator 2.3 Weinbridge oscillator 2.4 Hartley oscillator 2.5 Colpit's oscillator 2.6 Crystal oscillator 2.7 Astable multivibrator 2.8 Monostable multivibrator 2.9 Bistable multivibrator 2.10 UJT relaxation oscillator (circuit, operation, equation for output frequency, no derivation) **Course Outcome: CO2 Teaching Hours : 08 Marks: 12 (R-02, U-06, A-04)**
3	**Power Devices** 3.1 SCR (Thyristor) 3.1.1 Symbol, construction, principle of operation, V-I characteristic 3.1.2 Turn On methods: R, RC triggering 3.1.3 Turn-off methods: load, line, external pulse, forced class C commutation 3.2 DIAC, TRIAC, IGBT, MOSFET 3.2.1 Symbol, construction, operation and V-I characteristic of DIAC, TRIAC, IGBT, MOSFET **Course Outcome: CO3 Teaching Hours : 08 Marks: 12 (R-02, U-06, A-04)**
4	**Power conversion** 4.1 Controlled Rectifiers 4.1.1 Single phase full controlled rectifier 4.1.2 Three phase full controlled rectifier 4.2 Chopper 4.2.1 Principle of operation 4.2.2 Control strategy: static and variable frequency system 4.2.3 Four quadrant chopper 4.3 Inverter 4.3.1 Single phase bridge inverter 4.3.2 Three phase 120˚ bridge inverter 4.3.3 Sinusoidal PWM inverter

	(circuit diagram, operation and application) **Course Outcome: CO4 Teaching Hours : 09 Marks: 12 (R-02, U-04, A-08)**
5	**Thyristor Applications** 5.1 Solid state relays 5.1.1 DC SSR 5.1.2 AC SSR 5.2 Triac based temperature control 5.3 Liquid level control using SCR 5.4 Triac based control for actuation of valves 5.5 Speed control of DC series motor with 1Ø full control converter 5.6 Speed control of 3Ø induction motor by v-f method (Circuit diagram, construction, operation and application only) **Course Outcome: CO5 Teaching Hours : 08 Marks: 12 (R-02, U-04, A-06)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Amplifiers**	04	04	04	12
2	**Oscillators**	02	06	04	12
3	**Power Devices**	02	06	04	12
4	**Power Conversion**	02	04	06	12
5	**Thyristor Applications**	02	04	06	12
	Total	**12**	**24**	**24**	**60**

List of experiments: Total 10-12 experiments(or turns) out of 15-16 experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To plot frequency response of RC-coupled amplifier.	2
2	2	CO2	To calculate the frequency of RC phase shift/ Wein bridge oscillators.	2
3	3	CO3	To plot the V-I characteristic of SCR. Measure Breakdown voltage, latching & holding current.	2
4	4	CO4	To observe/plot the output waveforms of single/three phase full controlled rectifier.	2
5	5	CO5	To test & observe the output for solid state relay.	2
6	1	CO1	To plot frequency response of transformer -coupled amplifier.	2

7	2	CO2	To calculate the frequency of Hartley/Colpit's oscillators.	2
8	3	CO3	To plot the V-I characteristic of DIAC. Measure Breakdown voltage, latching & holding current.	2
9	4	CO4	To observe/plot the output waveforms of four quadrant chopper.	2
10	5	CO5	To Test D.C motor speed control using chopper.	2
11	3	CO1	To perform Push pull amplifier and calculate its efficiency.	2
12	4	CO2	To perform Astable/ Bistable multivibrator and observe output waveforms.	2
13	5	CO3	To plot the V-I characteristic of TRIAC. Measure Breakdown voltage, latching & holding current.	2
14	3	CO4	To observe/plot the output waveforms of single-phase bridge inverter.	2
15	4	CO5	To construct TRIAC based temperature control circuit and test.	2
Total				**30**

Note: Experiments No. 1 to 5 (or 6) are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electronic devices and Circuit Theory	R. Boylestad & L. Nasnlsky, Pearson Education India, 11th edition, 2015	978-9332542600
2	Electronic devices & Circuits : An Introduction	Allen Mottershed, PRENTICE HALL, 1st edition, 1979	978-8120301245
3	Electronic devices and Circuit Theory	J. Milman & C. C. Halkias, McGraw Hill Education, 1st edition, 1967	978-0070423800
4	Integrated Electronics	J. Milman, C. C. Halkias & Chetan Parikh, McGraw Hill Education; 2nd edition, 2017	978-0070151420
5	A Textbook of Electronic Devices and Circuits	R. S. Sedha, S. Chand publications, 2nd edition, 2008	978-8121928687
6	Power Electronics	P. S. Bimbhra, Khanna publishers, 6th edition, 1990	978-8174092793
7	Power Electronics Circuits Devices and Applications	Muhammad H. Rashid, Pearson Education, 4th edition, 2017	978-9332584587
8	Power Electronics	Singh M D and Khanchandani K.B., Tata Mcgraw Hill Publication, New Delhi, 2nd edition, 2017	978-0070583894

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2. https://nptel.ac.in/courses/108/105/108105066/
3. https://vivadifferences.com/
4. https://www.tutorialspoint.com/
5. http://www.electronicshub.org/
6. http://electrofriends.com//
7. https://www.electrical4u.com/concept-of-power-electronics/
8. https://www.polytechnichub.com/

CO Vs PO and CO Vs PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1		2	2			1	2	
CO2	1		2	1			1	2	
CO3	1		1	2				2	
CO4	1		1	2				2	
CO5	1		2	1	2	2	2	2	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr.Santosh Kamble	Proprietor	Saitronics Pvt. Ltd, Kamothe, Navi Mumbai
2	Mr. Anil Gurav	Lecturer in Electronics Engg.	St. Xavier Technical Instt. Mahim, Mumbai
3	Mrs. K. U. Waghmare	Lecturer in Instrumentation Engg.	Government Polytechnic, Mumbai
4	Mr. F. S. Bagwan	Lecturer in Instrumentation Engg.	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department,
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code:IS19205				Course Title: Control System Components						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**02**	**--**	**05**	**60**	**20**	**20**	**--**	**25***	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

An Instrumentation diploma engineer has to deal with the testing, operation and maintenance of various control system components. This subject is introduced with the view that the students will get familiar with the operation of various systems such as pneumatic , hydraulic , and electrical and their basic components. This course will also help the students to understand the operation of different types of final control elements and auxiliary process control components.

Course Outcomes: Student should be able to

CO1	Operate the given hydraulic system component.
CO2	Demonstrate the operation given pneumatic component.
CO3	Use the control valve for an application.
CO4	Test the given electric control system component.
CO5	Demonstrate the working of given auxiliary process control component.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Hydraulic System Components:** 1.1. Introduction 1.2. Block diagram of Hydraulic system. 1.3. Applications of Hydraulic system. 1.4. Symbols of hydraulic components 1.5. Hydraulic pumps: Centrifugal pump, Reciprocating pump,Gear Pump,Vane Pump(construction and working) 1.6. Pressure regulation 1.7. Directional control valves: Check Valve, Spool valve,2/2, 3/2, 4/2, 4/3, 5/2 1.8. Pressure control valves: Direct type of relief valve, Unloading Valve, Sequence valve. 1.9. Actuators: single-acting cylinder & double-acting cylinders, rotary actuator. 1.10. Development of simple hydraulic circuits.

	Course Outcome: CO1eaching Hours :12hrsMarks: 14 (R- 2, U-6, A-6)
2	**Pneumatic System Components:** 2.1. Introduction 2.2. Components of a pneumatic system**.** 2.3. Air compressors:- types, Reciprocating type compressor(construction and working) 2.4. Pressure Regulator cum filter 2.5. Flapper-nozzle system. 2.6. Volume boosters 2.7. Pneumatic relay 2.8. Converters: Pneumatic to Electrical (P to I) and Electrical to Pneumatic Converters (I to P). 2.9. Development of simple pneumatic circuits. **Course Outcome:CO2Teaching Hours :08 Marks:10(R-2 , U-4 , A-4)**
3	**Control Valves** 3.1 Definition, terminology and classification. 3.2 Control valve types: Globe valve, Ball, Butterfly, Solenoid valves(construction, working, valve part materials, ISA symbols, advantages, disadvantages and applications) 3.3 Control valve flow characteristics 3.4 Control valve parameters: Control valve capacity (Cv), valve rangeability, turn-down, valve size and valve gain. 3.5 Control valve problems: Cavitation and flashing. 3.6 Control Valve Actuators: - Spring diaphragm type and piston type pneumatic, electrical actuator. 3.7 Valve positioners: Necessity, types-motion balance and force balance 3.8 Selection criteria of control valves. **Course Outcome: CO3 Teaching Hours :12hrsMarks: 14 (R- 2, U-6, A-6)**
4	**Electrical Control System Components:** 4.1 Switches:Toggle switches, push buttons, DIP switch, rotary switch, thumbwheel switch, limit switches.(No theory question to be asked in exam on switches.) 4.2 Electromechanical devices: Control Relays - Electro-mechanical relay, Reed relay, Solid state relay, Overload relay, Motor starters. 4.3 Circuit breakers: -Need of Circuit Breaker, Operating Principle, and types (Construction, symbolic representation, working, and applications.) 4.4 Special motors: servomotors, stepper motors. (construction,working principle and applications) 4.5 Comparison between pneumatic, hydraulic and electric systems. **Course Outcome:CO4 Teaching Hours :07 Marks:12 (R-2 , U-4 , A-6)**

5	**Auxiliary Components:** 5.1 Alarm annunciator. 5.2 Feeders and dampers. 5.3 Transmitters: 2 wire, 4 wire, DP Transmitter (force balance type). 5.4 Temperature Switch, Pressure Switch. 5.5 Relief Valves, safety valves and rupture disk. (Construction, diagram, symbolic representation, working, applications.) **Course Outcome:CO5 Teaching Hours :06Marks:10 (R-4 , U-4 , A-2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Hydraulic System Components	2	6	6	14
2	Pneumatic System Components	2	4	4	10
3	Control Valves	2	6	6	14
4	Electrical Control System Components	2	4	6	12
5	Auxiliary Components	4	4	2	10
	Total	**12**	**24**	**24**	**60**

List of experiments: Total 10-12 experiments(or turns) out of 17 experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Implementation and testing of Hydraulic circuits for single-acting cylinders.	2
2	2	CO2	Implementation and testing of Pneumatic circuits for single-acting cylinders.	2
3	3	CO3	To draw and identify the parts of cut-view section of single-seated globe valve.	2
4	4	CO4	To test and observe the operation of electro-mechanical relay.	2
5	5	CO5	To find switching time of a temperature switch.	2
6	1	CO1	Implementation and testing of Hydraulic circuits for double acting cylinders.	2
7	2	CO2	Implementation and testing of Pneumatic circuits for double acting cylinders.	2
8	2	CO2	To find the sensitivity of pressure to current converter.	2
9	2	CO2	To find the sensitivity of current to pressure converter.	2
10	3	CO3	To observe the construction of different valves.	2

			(Globe, ball, gate and butterfly valves).	
11	3	CO3	To demonstrate the operation of any two type of control valve actuators.	2
12	3	CO3	To test the performance of electro-pneumatic valve positioner.	2
13	4	CO4	To test and observe the operation of Solid state relay.	2
14	4	CO4	To test the given switch.	2
15	5	CO5	To find the switching time of pressure switch.	2
16	5	CO5	To observe the operation of DP Transmitter.	2
17	5	CO5	To observe the operation of Alarm Annunciator.	2
Total				**30**

Note: Experiments No. 1 to 5 are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Hydraulics and Pneumatics: A Technician's and Engineer's Guide	Andrew Parr, Butterworth-Heinemann; 3rd edition,2011	978-0080966748
2	Process control and Instrument technology	C.D.Johnson, Prentice Hall India Learning Private Limited; 8th edition,2006	978-8120330290
3	Process Control	Peter Harriott,Tata McGraw Hill,1edition ,2012	9780070993426
4	Industrial Electronics	Thomas E. Kissell,Prentice Hall Publications,3rd edition, 2012	9780131218642
5	Pneumatics, Festo Didactic	Festo	--
6	Hydraulics, Festo Didactic	Festo	--

E-References:

1. https://nptel.ac.in/courses/112/105/112105047/
2. https://nptel.ac.in/courses/112/103/112103249/
3. https://www.youtube.com/watch?v=MbKrIieogNc
4. https://www.youtube.com/watch?v=FVR7AC8ExIM
5. https://www.youtube.com/watch?v=c-468UPUV2o
6. https://www.youtube.com/watch?v=w5_89hBeRAA
7. https://nptel.ac.in/courses/103/105/103105130/

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	2	3	3	-	1	2	3	1
CO2	1	1	3	3	-	1	2	3	1
CO3	2	2	3	3	-	1	2	2	1
CO4	2	3	3	3	-	1	1	2	1
CO5	1	2	2	2	-	1	1	2	1

Industry Consultation Committee:

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1	Mr. Sagar Panchal	Senior Engineer	VVF Ltd Taloja
2	Mrs. V.K .Pawar	Lecturer in Instrumentation Engg.	Govt. Polytechnic Karad
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Coordinator,
Curriculum Development,
Department of Instrumentation Engg.

Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code:**EE19211**				Course Title: **Electrical Machines**						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	2	-	5	60	20	20	25		25	150

Abbreviations: L- Theory Lecture,P-Practical,TU-Tutorial,TH- Theory Paper TS1&TS2- Term Tests,PR-Practical,OR-Oral,TW: Term Work (progressive assessment),* Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination.
Note: For Minimum passing marks under various heads, refer, examination rule AR 25. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

This is the subject aim to teach concepts, principle and procedure for operation of electrical machine. Students will be able to analyze the characteristics of DC motor,3-phase and single-phase Induction motor. They also learn applications of 1-phase induction motors and special machine

These machines are used in various fields, industries and many more utilization systems. Learning & the skills obtained will be helpful in satisfying duties such as supervisor, controller and R& D technician.

Course Outcomes: Student should be able to

CO1	Describe working principle of different electric machines.
CO2	Identify different parts of electric machines
CO3	Select appropriate method of speed control and electric braking for the given motor used for the specified motor
CO4	Select appropriate motor suitable for the particular application.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Transformer:** 1.1 Construction and working principle of Transformer. 1.2 Transformer losses. 1.3 Transformer Testing: O.C & S.C test, direct loading test on transformer. 1.4 Efficiency, regulation and rating of transformer. 1.5 Auto Transformer advantages, disadvantages and applications. 1.6 Instrument transformer types and use. 1.7 Three phase transformer – Types of connections and applications **Course Outcome: CO1,CO2 Teaching Hours:08Hrs. Marks: 10(R- 2, U-4 , A- 4)**

2	**DC Motor:** 2.1 Principle, Constructional parts of DC motor and material used for them. 2.2 Types of DC motor and schematic diagram : series ,shunt and compound. 2.3 Back emf and torque equation of DC motor(No derivation) 2.4 Electrical, speed armature current and mechanical characteristics of DC motors series, shunt and compound motors 2.5 Necessity of starter for DC motor, basic concept. 2.6 Reversal of the direction of rotation 2.7 Speed control of DC Shunt and series motors. ● Armature voltage control method ● field control method 2.8Applications of series, shunt and compound motors. **Course Outcome:CO1,CO2,CO3 Teaching Hours:09Hrs. Marks: 12(R-2,U-4,A-6)**
3	**Induction Motor:** 3.1 Principle of operation, advantages & disadvantages. 3.2 3ph Squirrel cage induction motor – construction, application 3.3 Slip Ring Induction motor – construction, application 3.4 Synchronous speed, % slip [simple problems] 3.5 Starting of 3 phase induction motor: DOL, Star-Delta, Reduced voltage starter 3.6 Reversal of direction of rotation. 3.7 Starting Torque & Torque – Slip characteristics. 3.8 Speed control: Voltage control, Rotor resistance control &frequency control. **Course Outcome:CO1,CO2,CO3 Teaching Hours:11Hrs. Marks: 14(R-2,U-6,A-6)**
4	**Single phase Induction motor and special motors:** Schematic representation, principle of operation and applications of : 4.1 Split phase induction motors. 4.2 Capacitor start induction motor 4.3 Universal motor 4.4 Stepper motor 4.5 Brushless dc motor 4.6 AC Servo motor 4.7 DC Servo motor **Course Outcome: CO1, CO2 Teaching Hours:11Hrs. Marks:14 (R- 2, U-6 A-6)**
5	**Industrial applications of electric motors:** 5.1 Definition of electric drive and advantages 5.2 Classification of electric drive 5.3 Factors governing selection of motor 5.4 Motors for different industrial drives 5.5 Electric Braking: i) Plugging applied to D.C. motor & Induction motor ii) Rheostat braking applied to D.C. motor & Induction motor **Course Outcome:CO3, CO4 Teaching Hours :06Hrs. Marks: 10(R- 4 , U-4 , A- 2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	**Transformer**	08	2	4	4	10
2	**DC Motor**	09	2	4	6	12
3	**Induction Motor**	11	2	6	6	14
4	**Single phase Induction motor and special motors**	11	2	6	6	14
5	**Industrial applications of electric motors**	06	4	4	2	10
	Total	**45**	**12**	**24**	**24**	**60**

List of experiments: Total 08experiments (or turns) out of 10experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	**CO1CO2**	Perform OC and SC test on transformer and find copper and iron losses	04
2	2	**CO1CO2 CO3**	Connect the starter of dc shunt motor and start the motor, reverse the direction of rotation.	04
3	3	**CO1 CO2CO3**	Connect the three phase induction motor using DOL, Star Delta and reduced voltage method	04
4	4	**CO1CO2**	Prepare the specification chart of various types of special machines	04
5	5	**CO3 CO4**	Prepare chart for electric braking of motors	04
6	6	**CO1CO2**	Perform direct load test on transformer and find efficiency and regulation of transformer	04
7	2	**CO1CO2 CO3**	Control the speed of DC motor using armature voltage control method	02
8	3	**CO1CO2 CO3**	Measure the slip of induction motor by tachometer method and reverse the direction of rotation of three phase induction motor	04
9	4	**CO1 CO2CO3**	Control the speed of DC motor using field control method	02
10	6	**CO1CO2 CO3**	Control the speed of induction motor by variable frequency method	04
Total				**30**

Note: Experiments No. 1 to 5 are compulsory and should map all units and Cos.Remaining 03 experiments are to be performing on the importance of topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electrical Technology (Volume II)	B. L. Theraja and A. K. TherajaS. Chand and Co. Ltd.Twenty Third edition	ISBN-10: 8121924375 ISBN-13: 978-8121924375
2	Electric Machines	Ashfaq Husain, Dhanpat Rai & Co. Third edition 2016	ISBN-13**:** 978-8177001662
3	Electrical Machines	S.K. Bhattacharya, McGraw Hill Education; Fourth edition (1 July 2017)	ISBN-10: 9332902852 ISBN-13: 978-9332902855
4	Utilisation of Electric Power & Electric Traction	G. C. Garg; S. K. Khanna Publisher, New Delhi, edition	ISBN-10: 8174091645 ISBN-13: 9788174091642

E-References:

- www.nptel.com
- www.electrical4u.com
- www.khanacademy.org
- https://ndl.iitkgp.ac.in/

CO VsPO and CO Vs PSOMapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	-	2	2	-	2	3	-
CO2	3	3	-	2	2	-	2	3	-
CO3	3	3	-	2	2	-	2	3	-
CO4	3	3	-	2	2	-	2	3	-

Industry Consultation Committee:

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4	Dr. P. N. Padghan	Lecturer in Electrical Engineering	Govt. Polytechnic Mumbai

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Head of Department
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I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering (Sandwich Pattern)**										
Course Code:IS19207				Course Title: Digital Techniques						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2:30Hrs)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4**	**--**	**4**	**--**	**--**	**--**	**50***	**--**	**50**	**100**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

This course forms the foundation of computers. This course is introduced with the view that students will become familiar with various digital devices and circuits that are used in microprocessor, microcontroller, computers and other digital systems. It will enable the students to assemble, design, and test logical circuits like multiplexer, demultiplexer, counters, registers etc. This course covers the number systems, logic gates, combinational & sequential logic circuits, analog to digital and digital to analog converters which are important parts of digital systems.

Course Outcomes: Student should be able to

CO1	Familiarize with the number system ,codes and their conversion methods.
CO2	Make use of Boolean expressions to realize logic circuits using different logic gates .
CO3	Realize the different types of combinational circuitsusing logic gates
CO4	Design sequential circuits using flip flop.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Number Systems and codes** 1.1. Number system: Concept of base of number system, Decimal ,Binary ,Octal ,Hexadecimal number system 1.2. Conversion of one number system to another number system (fractional point numbers) 1.3. Binary addition and subtraction 1.4. Binary subtraction using 1's and 2's complement 1.5. Types of codes : BCD code, Excess 3 code, Gray code 1.6. Binary to Gray and Gray to Binary code conversion. 1.7. BCD addition and BCD subtraction using 9's complement **Course Outcome: CO1**

2	**Logic Gates and Boolean algebra:** 2.1 Symbol, truth table, logical expression of Basic Gates (AND, OR, NOT), Derived gates (EX-OR, EX-NOR),Universal gates (NAND, NOR) . 2.2 NAND and NOR gate as a universal gates. 2.3 Characteristics of logic gates: Propagation delay, power dissipation, fan in, fan out, Noise Margin. 2.4 Boolean algebra: Boolean laws, De Morgan's theorems, Simplification and realization of Boolean expression using Boolean laws and De Morgan's theorems. 2.5 Standard Boolean representation: Concept of SOP & POS, Minterm & Maxterm. 2.6 Introduction to K-map : Karnaugh map (K-map) representation of logic function, Simplification of K-map for 2, 3 and 4 variables with don't care condition, Realization of reduced expression using logic gates **Course Outcome: CO2**
3	**Combinational Circuits:** 3.1 Design of Half adder, full adder, Half subtractor and full subtractor using K-map and realization using gates. 3.2 Design binary to gray and gray to binary convertor using K-map and realization using gates. 3.3 4 bit parallel binary adder (IC7483) 3.4 Comparator: 1 bit, 2 bit (design using K-map and realization using logic gates). 3.5 Multiplexer: Necessity of multiplexing, Types (2:1, 4:1, 8:1), multiplexer tree, Application 3.6 Demultiplexer: Necessity of demultiplexing, types (1:2, 1:4, 1:8), demultiplexer tree, Application 3.7 3 to 8 line decoder and 8 to 3 line encoder 3.8 BCD to seven segment decoder / driver(IC 7447) **Course Outcome: CO3**
4	**Sequential circuits** 4.1 Difference between combinational and sequential circuits 4.2 Flip flops: S-R flip-flop using NAND gates, clocked SR flip- flop with preset & clear, clocked J-K flip-flop with preset& clear, Master slave J-K flip-flop, D & T flip flops.(truth table, symbol and operation of all FFs) 4.3 Counters: basic concept of counters, classification (synchronous and asynchronous counter), concept of Up and Down counter. 4.4 Asynchronous counters- Ripple counter and Ring counter circuit and waveforms. Design example of MOD-N counter, 4.5 Synchronous counter- Implementation of 3-bit synchronous counter using k-map with waveforms. 4.6 Shift Registers: Definition, classification, circuit diagram, working and timing diagrams of SISO, SIPO, PISO, PIPO,bidirectional shift register. **Course Outcome:CO4**

Suggested Specifications Table (Theory):

----------NA----------

List of Experiments: Total 18-20 experiments(or turns) out of 27experiments(or turns)

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To convert the given numbers of number system into another number system.	2
2	2	CO2	To verify Truth Table of basic gate AND, OR, NOT, NAND, NOR, Ex-OR & Ex-NOR gates using ICS.	2
3	3	CO3	To construct Half Adder and Half subtractor & verify the Truth Table	2
4	4	CO4	To verify truth table of SR FF using ICs.	2
5	2	CO2	Implement simple Boolean equation using logic gates and verify output.	2
6	3	CO3	To construct Full Adder and verify the Truth Table	2
7	4	CO4	To verify truth table of D and T FF using ICs.	2
8	2	CO2	To implement basic logic gates using universal logic gate (NAND).	2
9	3	CO3	To construct Full subtractor & verify the Truth table	2
10	4	CO4	To verify truth table of JK FF using ICs.	2
11	2	CO2	To implement basic logic gates using universal logic gate (NOR).	2
12	2	CO2	Implement and verify truth table of De Morgan's theorem.	2
13	3	CO3	To construct Full subtractor & verify the Truth table	2
14	3	CO3	Design binary to gray convertor using K-map reduction techniques, realize it with using gates and verify the truth table.	2
15	3	CO3	Design gray to binary convertor using K-map reduction techniques, realize it with using gates and verify the truth table.	2
16	3	CO3	To verify truth table of 8:1 multiplexer using IC 74151.	2
17	3	CO3	To verify truth table of 3 line to 8 line decoder using IC.	2
18	4	CO4	Design 1-Bit comparator using k-map reduction technique. Realize it with using gates and verify the truth table.	2
19	4	CO4	To verify the truth table of Comparator (IC7485).	2
20	4	CO4	To construct 3 bit ripple counter using Flip Flop and verify its operation	2
21	4	CO4	To construct and test MOD-6 asynchronous counter using IC 7490.	2
22	2	CO2	Implement and verify truth table of Duality theorem.	2
23	3	CO3	To verify truth table of 4:1 multiplexer using logic gates	2
24	3	CO3	To verify truth table of 1:4 demultiplexer using logic gates	2
25	3	CO3	To design adder and subtractor circuit by using 4 bit parallel binary adder IC (IC7483)	4
26	3	CO3	To implement a circuit to convert BCD to seven segment display using decoder / driver IC. (IC 7447)	4
27	4	CO4	To develop a mini project based on applications of sequential circuits.	4
		Total		**60**

Note: Experiments No. 1 to 5and 27 are compulsory and should map all units and Cos. Remaining experiments are to be performed as per importance of the topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Modern Digital Electronics	R. P. Jain Tata McGraw Hill, Education 4th edition (2009)	978-0070669116
2	Principles of Digital Electronics	Donald P. leach , Malvino A. P. and Goutam Saha Tata McGraw Hill, Education 6th edition (2008)	978-0070601758
3	Fundamentals of Digital Circuits	Kumar A. Anand PHI learning private ltd. 4th Revised edition edition (2016)	978-8120352681
4	Digital Electronics	G.K. kharate Oxford; Reprint edition (2010)	978-0198061830

E-References:

1. https://www.tutorialspoint.com/digital_electronics/index.asp
2. https://www.nesoacademy.org/electronics
3. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
4. www.youtube.com "enter the name of topic"
5. https://drive.google.com/file/d/1tGb-DYogAwGBurLaxzMMWebru_2o8TA6/view
6. https://www.indiabix.com/electronics-circuits/ "select the circuit for simulation "

CO VsPO and CO Vs PSOMapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	-	-	-	-	2	1	-
CO2	1	2	2	-	-	-	2	2	-
CO3	-	3	3	-	1	-	3	3	-
CO4	-	3	3	-	1	-	3	3	-

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4	Mrs. S T Shinde	Lecturer in Instrumentation Engg.	Govt. Polytechnic Mumbai

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Head of Department
Department of Instrumentation Engg.

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Instrumentation Engineering**										
Course Code:IS19 312				Course Title: C and CPP						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2:30 Hrs)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4#**	**--**	**4**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Course Content Details:

Topics / Sub-topics
1. First C Program Outline: 1) First C Program -Header Files --example: #include <stdio.h> -main() - Curly braces -printf() -semicolon ; -Compiling a C program --example: gcc filen..
2. First Cpp Program Outline: First C++ Program -Header files --example: #include <iostream> -main() - Curly braces -cout<< -semicolon ; -Compiling a C++ program --example: g++ filen..
3. Tokens Outline: 3) Tokens in C and C++ -Data types, constants, identifiers -Keywords --example: if, break, else -Constants -Data types --example: int, float, char, double -F..
4. Functions Outline: Functions -What is a function -Syntax for declaration of a function - Function with arguments --example: return-type function-name(parameter); - Function without array.
5. Scope of Variables Outline: Scope of Variables -Introduction -Syntax of declaring a variable --example: data-type var-name; -Syntax for initializing a variable --example: data-type var-name .
6. If and Else If Statement Outline: Check the conditions in a program -What are Statements. -Syntax for if and -If-else Statement -Errors
7. Nested If and Switch Statement Outline: Nested if and switch statement -Nested if statement. -Switch statement. - Syntax for nested-if statement -Syntax for switch statement -break statement -Comparision
8. Increment and Decrement Operators Outline: Increment and Decrement Operators -Increment Operator --example: ++ - Postfix increment --example: a++ -Prefix increment --example: ++a -Decrement Operator ..
9. Arithmetic Operators Outline: Arithmetic Operators -Arithmetic Operators -Addition Operator --example: a + b -Subtraction Operator --example: a - b -Multiplication Operator --example: a *..
10. Relational Operators

Outline: Relational Operators -Double Equal to --example: a == b -Not Equal to -- example: a != b -Greater Than --example: a > b -Less Than --example: a < b -Gr.. 2/2

11. **Logical Operators**
    Outline: Logical Operators -And && -Or || -Not !
12. **Loops**
    Outline: Loops -Loops -Syntax for while and do-while loop -Comparison of while and do-while loop -Syntax for -for loop -Errors
13. **Arrays**
    Outline: Arrays -What are arrays -1-D Arrays -Syntax for Declaration of arrays -- example: data type array_name [size]; -Syntax for Initialization of arrays
14. **Working with 2D Arrays**
    Outline: Working with 2-D Arrays -What are 2-D Arrays. -Range of arrays -Syntax for Declaration of 2-D arrays --example: data type array_name[row][column]; -Syntax for integer.
15. **Strings**
    Outline: Strings -What is a string -Syntax for declaring a string -Syntax for initializing a string -To read a string from keyboard
16. **String Library Functions**
    Outline: String Library Functions What are string library functions. Types of string library functions -Strcpy -Strlen -Strcmp -Strcat
17. **Working with Structures**
    Outline: Working with Structures -Introduction -Syntax of structures -Declaration and initialization -Declaration of structure variable -Accessing structure variables
18. **Understanding Pointers**
    Outline: Understanding Pointers -Introduction -Syntax of Pointer --example: int *iptr; -Declaration --example: int a; (integer a) int *aptr; (pointer to an integer..
19. **Function Call**
    Outline: Function call -types of function calls -function pass by value -function pass by reference
20. **File Handling in C**
    Outline: Files in C -File handling functions -Opening a File closing a file --example: fopen, fclose -Reading data from a File.

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