Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Post S.S.C Diploma Courses

Programme Name	**: Diploma In Mechatronics**		
Programme Code	**: MK**	**With Effect From Academic Year**	**: 2023-24**
Duration Of Programme	**: 6 Semester**	**Duration**	**: 16 WEEKS**
Semester	**: Third** **NCrF Entry Level : 3.5**	**Scheme**	**: K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme											
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL Practical				Based on Self Learning		Total Marks
						CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
													Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
(All Compulsory)																							
1	PRODUCTION DRAWING	PDR	SEC	313311	-	2	-	4	2	8	4	4	30	70	100	40	25	10	25@	10	25	10	175
2	MECHANICAL ENGINEERING MATERIALS	MEM	DSC	313317	4	3	-	2	1	6	3	1.5	30	70*#	100	40	25	10	-	-	25	10	150
3	ANALOG AND DIGITAL ELECTRONICS	ADE	DSC	313318	-	4	-	4	-	8	4	3	30	70	100	40	25	10	25#	10	-	-	150
4	INDUSTRIAL MEASUREMENTS	IME	DSC	313319	-	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
5	ELEMENTS OF ELECTRICAL ENGINEERING	EEE	AEC	313320	-	3	-	2	1	6	3	3	30	70	100	40	25	10	-	-	25	10	150
6	ESSENCE OF INDIAN CONSTITUTION	EIC	VEC	313002	-	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-	50	20	50
7	FUNDAMENTALS OF PYTHON PROGRAMMING	FPP	AEC	313007	-	-	-	2	-	2	1	-	-	-	-	-	25	10	25@	10	-	-	50
Total					**4**	**17**	**0**	**16**	**7**		**20**		**150**	**350**	**500**		**150**		**100**		**150**		**900**

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment,SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends : @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

Course Category : Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)

Programme Name/s : **Mechanical Engineering/ Mechatronics/ Production Engineering**
Programme Code : **ME/ MK/ PG**
Semester : **Third**
Course Title : **PRODUCTION DRAWING**
Course Code : **313311**

I. RATIONALE

Production drawing is essential for communicating ideas in manufacturing industry as well as other engineering applications. Production drawings illustrate set of instructions to manufacture a product, providing information about dimensions, materials, finishes, tools required, methods of assembly and so on. Therefore, this course has been developed for interpretation and preparation of the production drawing.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Prepare Production drawing of a given part / component as per requirement.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Construct an auxiliary view of given object.
- CO2 - Use convention for representation of material and mechanical components.
- CO3 - Interpret and draw production drawing.
- CO4 - Prepare assembly drawing using given details.
- CO5 - Prepare detail drawing based on the given assembly drawing/data.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313311	PRODUCTION DRAWING	PDR	SEC	2	-	4	2	8	4	4	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Sem. : Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Construct an auxiliary view of a given object. TLO 1.2 Construct an incomplete principal view from the given auxiliary view.	**Unit - I Auxiliary View** 1.1 Auxiliary planes and views. 1.2 Draw Auxiliary view from the given orthographic views. 1.3 Complete the partial view from the given auxiliary and other principal view.	Lecture Using Chalk-Board Model Demonstration Video Demonstrations
2	TLO 2.1 Use IS SP-46 codes for preparing production drawing. TLO 2.2 Prepare production drawing using standard conventions.	**Unit - II Conventional representation** 2.1 Engineering Material Conventions 2.2 Conventional breaks in pipes, rod and shaft 2.3 Conventional representation of common features like slotted head, radial rib, knurling, serrated shaft, splined shaft, ratchet and pinion, repeated parts, square on shaft, holes on circular pitch, internal and external threads 2.4 Conventional representation of standard parts like ball and roller bearing, gears, springs 2.5 Pipe joints and valves 2.6 Counter sunk and counter bored holes 2.7 Tapers	Lecture Using Chalk-Board Model Demonstration Video Demonstrations
3	TLO 3.1 Calculate tolerances on the given machine components. TLO 3.2 Identify type of fit between mating parts of machine components based on given tolerance values. TLO 3.3 Prepare production drawing using suitable convention and codes.	**Unit - III Production Drawing** 3.1 Limits, Fits and Tolerances: Definitions, introductions to ISO system of Tolerance. Dimensional tolerances: Terminology, selection and representation of dimensional tolerance- number and grade method. Definitions concerning Tolerancing and Limits system, unilateral and bilateral tolerance, Hole and shaft basis systems, Types of fits- Clearance, transition and Interference, Selection of fit for engineering applications. Calculation of limit sizes and identification of type of fit from the given sizes like 50 H7/s6, 30 H7/d9 etc. 3.2 Geometrical Tolerances: Types of geometrical tolerances, terminology for deviation, representation of geometrical tolerance on drawing. 3.3 General welding symbols, length and size of weld, surface contour and finish of weld, all round and site weld, symbolic representation in Engineering practices and its interpretation. 3.4 Machining symbol and surface texture: Indication of machining symbol showing direction of lay, sampling length, roughness grades, machining allowances, manufacturing methods. Representation of surface roughness on drawing.	Lecture Using Chalk-Board Model Demonstration Video Demonstrations
4	TLO 4.1 Identify various components in given detail drawings. TLO 4.2 Identify sequence of assembling it. TLO 4.3 Prepare assembly drawing from given detailed drawing. TLO 4.4 Prepare bill of material.	**Unit - IV Details to assembly** 4.1 Introduction to assembly drawing, accepted norms to be observed for assembly drawings, sequence for preparing assembly drawing, Bill of Material (BOM). 4.2 Couplings: Oldham & Universal couplings. 4.3 Bearing: Foot Step & Pedestal Bearing. 4.4 Lathe: Single (pillar type) and square tool Post. 4.5 Bench vice & Pipe Vice. 4.6 Screw-jack 4.7 Drill Jig	Lecture Using Chalk-Board Model Demonstration Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Interpret various components in given assembly drawings. TLO 5.2 Identify sequence of dismantling in given assembly drawing. TLO 5.3 Prepare the detailed drawing from given assembly drawing.	**Unit - V Assembly to Details** 5.1 Basic principles of process of dismantling the assembly into components. 5.2 Couplings: Oldham & Universal couplings. 5.3 Bearing: Foot Step & Pedestal Bearing. 5.4 Lathe: Single (pillar type) and square tool Post. 5.5 Bench vice & Pipe Vice. 5.6 Screw-jack 5.7 Drill Jig	Lecture Using Chalk-Board Model Demonstration Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Draw an auxiliary view from given drawing.	1	*Draw an auxiliary view or complete given partial drawing. (any two)	4	CO1
LLO 2.1 Draw an auxiliary view from given drawing.	2	*Draw an auxiliary view or complete given partial drawing. (Continue Sr No 1)	4	CO1
LLO 3.1 Prepare drawing using convention and code as per IS-SP46.	3	*Draw various conventional representations as per IS SP-46	4	CO2
LLO 4.1 Use various tolerances and symbols in drawing.	4	*Draw Dimensional and Geometrical Tolerances, Welding Symbols, Surface Roughness and Machining Symbols on the given figures.	4	CO2 CO3
LLO 5.1 Use various tolerances and symbols in production drawing.	5	Develop Production drawing of machine components showing dimensional and geometrical Tolerance, surface finish etc. (any two)	4	CO2 CO3
LLO 6.1 Draw assembly drawing using standard procedure for assembly of components.	6	Draw an Assembly drawing from the given detailed drawing showing fits, part numbers, bill of material, assembly dimensions (Any one)	4	CO2 CO3 CO4 CO5
LLO 7.1 Draw assembly drawing using standard procedure for assembly of components.	7	Draw an Assembly drawing from the given detailed drawing showing fits, part numbers, bill of material, assembly dimensions. (Sr No 6 continue)	4	CO2 CO3 CO4 CO5
LLO 8.1 Draw assembly drawing using standard procedure for assembly of components.	8	Draw an Assembly drawing from the given detailed drawing showing fits, part numbers, bill of material, assembly dimensions. (Sr No 6 continue)	4	CO2 CO3 CO4 CO5
LLO 9.1 Draw assembly drawing using standard procedure for assembly of components.	9	*Draw an Assembly drawing from the given detailed drawing showing fits, part numbers, bill of material, assembly dimensions. (any one)	4	CO2 CO3 CO4 CO5
LLO 10.1 Draw assembly drawing using standard procedure for assembly of components.	10	*Draw an Assembly drawing from the given detailed drawing showing fits, part numbers, bill of material, assembly dimensions. (Sr No 9 continue)	4	CO2 CO3 CO4 CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Draw detail drawing using standard procedure for dismantling of given assembly drawing.	11	Draw detailed drawing from the given assembly drawing showing Conventional Representation, Dimensional and Geometrical Tolerances and Surface Finish symbols. (any one)	4	CO2 CO3 CO4 CO5
LLO 12.1 Draw detail drawing using standard procedure for dismantling of given assembly drawing.	12	Draw detailed drawing from the given assembly drawing showing Conventional Representation, Dimensional and Geometrical Tolerances and Surface Finish symbols. (Sr No 11 continue)	4	CO2 CO3 CO4 CO5
LLO 13.1 Draw detail drawing using standard procedure for dismantling of given assembly drawing.	13	Draw detailed drawing from the given assembly drawing showing Conventional Representation, Dimensional and Geometrical Tolerances and Surface Finish symbols. (Sr No 11 continue)	4	CO2 CO3 CO4 CO5
LLO 14.1 Draw detail drawing using standard procedure for dismantling of given assembly drawing.	14	*Draw detailed drawing from the given assembly drawing showing Conventional Representation, Dimensional and Geometrical Tolerances and Surface Finish symbols. (any one)	4	CO2 CO3 CO4 CO5
LLO 15.1 Draw detail drawing using standard procedure for dismantling of given assembly drawing.	15	*Draw detailed drawing from the given assembly drawing showing Conventional Representation, Dimensional and Geometrical Tolerances and Surface Finish symbols. (Sr No 14 continue)	4	CO2 CO3 CO4 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Prepare assembly drawing/detailed drawing of machine vice/ lathe tailstock/ tool post etc. by visiting Institute's workshop.
- Prepare report on various types of welding symbols used for fabrication work by Visiting nearby fabrication workshop.
- Any other micro-projects suggested by subject faculty on similar line.
- Prepare detailed drawings of Various IC Engine components using proper measuring instruments by visiting Institute's Power engineering Lab or any other.
- Students should collect Production drawings from nearby workshops/industries and establish item reference numbers on that drawing for convention or tolerance value. Prepare report showing item reference numbers and their meaning.
- Prepare report representing conventional representation of various piping joints by visiting nearby process industries like sugar factory, chemical industries, water treatment plant, etc.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Models, charts of objects for Auxiliary view.	1
2	Models/ Charts of Conventional representation and Production drawing.	3,4,5
3	Models, charts of assembly and details drawings.	6,7,8,9,10,11,12,13,14,15
4	Drawing equipment and instruments for classroom teaching-large size: a. T-square or drafter (Drafting Machine). b. Set square (45-45-90 and 30-60-90) c. Protector. d. Drawing instrument box (containing set of compasses and dividers). Drawing sheets, drawing pencils H,2H, Eraser, Drawing pins / clips	All
5	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
6	Set of various industrial drawings being used by industries.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Auxiliary View	CO1	4	0	0	8	8
2	II	Conventional representation	CO2	4	6	8	0	14
3	III	Production Drawing	CO3	6	4	8	4	16
4	IV	Details to assembly	CO4	8	0	0	16	16
5	V	Assembly to Details	CO5	8	0	0	16	16
Grand Total				**30**	**10**	**16**	**44**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- continuous assessment based on laboratory performance.

Summative Assessment (Assessment of Learning)

- End term exam- Theory
- End term exam- Practical (Lab performance)

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	1	-	-	-	-			
CO2	3	3	1	-	-	-	-			
CO3	3	3	1	-	-	-	-			
CO4	3	2	1	-	-	-	-			
CO5	3	2	1	-	-	-	-			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Bureau of Indian Standards.	Engineering Drawing Practice for Schools and Colleges IS: SP-46	October 2003, ISBN: 81-7061-091-2
2	Bhatt, N.D.	Engineering Drawing	Charotar Publishing House, 2011, ISBN: 978-93-80358-17-8
3	Bhatt, N.D.; Panchal, V. M	Machine Drawing	Charotar Publishing House, 2011, ISBN: 978-93-80358-11-6
4	Narayan, K. L. Kannaiah, P. Venkata Reddy, K.	Production Drawing	New Age International Publications, 2011, ISBN: 978-81-224-2288-7
5	Sidheswar, N. Kannaiah, P. Sastry, V.V.S.	Machine Drawing	Tata McGraw Hill Education Private Ltd, New Delhi, 2011, ISBN-13: 978-0-07-460337-6

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/599ThWCvMVA	Auxiliary View
2	https://youtu.be/k7-POcJfjAU	Auxiliary View
3	https://youtu.be/5Pj7vkcolXk	Introduction to working drawing.
4	https://youtu.be/VRi2LMm6jHU	Assembly
5	https://youtu.be/FqzplEaE4Z0	Details to Assembly

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s : **Mechanical Engineering/ Mechatronics/ Production Engineering**
Programme Code : **ME/ MK/ PG**
Semester : **Third / Fourth**
Course Title : **MECHANICAL ENGINEERING MATERIALS**
Course Code : **313317**

I. RATIONALE

Mechanical diploma technician works in the metal working industry. To meet current and future metal demands it is essential to get material knowledge. Materials like ferrous and non-ferrous metals, polymer, ceramics and composites are widely used in a variety of engineering applications. This course deals with these materials along with advanced materials, their metallurgical considerations, heat treatment processes, structure property relationship and applications. This course will enable diploma engineering students to identify a variety of material and their selection for various applications which is used in connection with smelting, welding, machining, bending, extruding, tapping, soldering, casting, pumping, structural work, crushing, and other industrial processes.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use relevant mechanical engineering materials & processes based on different applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Select suitable material(s) based on desired properties according to application.
- CO2 - Choose relevant alloy steel & Cast iron for mechanical components.
- CO3 - Select relevant non ferrous & powder material components for the engineering application.
- CO4 - Select relevant non metallic & Advanced material for the engineering application.
- CO5 - Use relevant heat treatment processes in given situations.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313317	MECHANICAL ENGINEERING MATERIALS	MEM	DSC	3	-	2	1	6	3	1.5	30	70*#	100	40	25	10	-	-	25	10	150

Total IKS Hrs for Sem. : 4 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Interpret the crystal structure of specified materials TLO 1.2 Identify microstructure of the given material with justification. TLO 1.3 Explain with sketches the procedure to prepare a given sample. TLO 1.4 Identify & Interpret the given equilibrium diagram & reactions with justification. TLO 1.5 Identify the given fields of steels on Iron carbon diagrams with justification. TLO 1.6 Choose a relevant hardness tester based on the given situation with justification.	**Unit - I Basics of Engineering Materials** 1.1 Classification of engineering materials 1.2 Crystal structure, Unit cell and space lattice 1.3 Microstructure, types of microscopes 1.4 Sample preparation, etching process, types of etchants. 1.5 Properties of metals Physical Properties, Mechanical Properties. 1.6 Concept of phase, pure metal, alloy and solid solutions. 1.7 Iron Carbon Equilibrium diagram various phases. Critical temperatures and significance. Reactions on Iron carbon equilibrium diagram 1.8 Hardness testing procedure on Brinell and Rockwell tester.	Lecture Using Chalk-Board Model Demonstration Video Demonstrations
2	TLO 2.1 Select relevant steel for the given application with justification. TLO 2.2 Select the relevant cast irons as white, gray cast iron for the given job with justification. TLO 2.3 Interpret the given material designations. TLO 2.4 Identify the properties of the given composition of cast iron with justification.	**Unit - II Steel & Cast Iron** 2.1 Broad Classification of steels. i. Plain carbon steels: Definition, Types and Properties, Compositions and applications of low, medium and high carbon steels. ii. Alloy Steels: Definition and Effects of alloying elements on properties of alloy steels. iii. . Tool steels: Cold work tool steels. Hot work tool steels, High speed steels (HSS) iv. Stainless Steels: Types and Applications v. Spring Steels: Composition and Applications. vi. Specifications of steels and their equivalents. 2.2 Steels for following components: Shafts, axles, Nuts, bolts, Levers, crank shafts, camshafts, Shear blades, agricultural equipment, household utensils, machine tool beds, car bodies, Antifriction bearings and Gears. 2.3 Types of cast irons as white. Gray, nodular, malleable 2.4 Specifications of cast iron. 2.5 Selection of appropriate cast iron for engineering applications. 2.6 Designation and coding (as per BIS, ASME, EN, DIN, TIS) of cast iron, plain and alloy steel. 2.7 Use of iron and steel in ancient India; Munda, Tikshna and Kanta types of iron and steels (IKS)	Lecture Using Chalk-Board Model Demonstration Presentations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Describe the properties and applications of the given copper alloy & aluminium alloy. TLO 3.2 Describe the properties and applications of the given bearing material TLO 3.3 Select relevant non-ferrous material for the specified application with justification. TLO 3.4 Explain various powder manufacturing processes.	**Unit - III Non Ferrous Materials & Powder Metallurgy** 3.1 Copper and its alloys - brasses, bronzes Chemical compositions, properties and Applications. 3.2 Use of copper in ancient India and its mention in Rigveda (IKS) 3.3 Aluminum alloys -Y-alloy, Hindalium, duralium with their composition and Applications. 3.4 Bearing materials like white metals (Sn based), aluminum, bronzes. Porous, Self -lubricating bearings. 3.5 Powder Metallurgy: Introduction, Advantages, limitations and applications. Preparation of Metal Powders, Basic Steps for Powder Metallurgy.	Model Demonstration Lecture Using Chalk-Board Presentations
4	TLO 4.1 Distinguish between metallic and non-metallic materials on the basis of given composition, properties and applications. TLO 4.2 Choose relevant non-metallic material for the given job with justification. TLO 4.3 Select relevant composite material for the given job with justification. TLO 4.4 Suggest relevant alternative materials for the given job with justification.	**Unit - IV Non Metallic Materials & Advanced Materials** 4.1 Polymeric Materials i. Polymers:- types, characteristics, ii. Properties and uses of Thermoplastics, Thermosetting Plastics and Rubbers. iii.Thermoplastic and Thermosetting Plastic materials 4.2 Characteristics and uses of ABS, Acrylics. Nylons and Vinyls, Epoxides, Melamines and Bakelites 4.3 Rubbers: Neoprene, Butadiene, Buna and Silicons - Properties and applications. 4.4 Ceramics -types of ceramics, properties and applications of glasses and refractories 4.5 Composite Materials - properties and applications of Laminated and Fiber reinforced materials 4.6 Advanced Engineering Materials: Properties and applications of Nanomaterials and smart materials & Biomedical materials.	Lecture Using Chalk-Board Presentations Demonstration
5	TLO 5.1 Describe with sketches the specified heat treatment processes. TLO 5.2 Select the relevant heat treatment processes for given material with justification. TLO 5.3 Explain with sketches the working principle of the given heat treatment furnace. TLO 5.4 Suggest the relevant heat treatment process for the given situation with justification.	**Unit - V Heat Treatment processes** 5.1 Overview of heat treatment. 5.2 Annealing: Purposes of annealing, Annealing temperature range, Types and applications. 5.3 Normalizing: Purposes of Normalizing, temperature range. Broad applications of Normalizing. 5.4 Hardening: Purposes of hardening, Hardening temperature range, applications 5.5 Tempering: Purpose of tempering Types of tempering and its applications 5.6 Case hardening methods like Carburizing, Nitriding, and Cyaniding. 5.7 Heat treatment Furnaces - Muffle, Box type.	Lecture Using Chalk-Board Video Demonstrations Site/Industry Visit Presentations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Use slitting machine to prepare sample of given dimension. LLO 1.2 Use grinding machine & polishing papers to prepare surface of given sample.	1	*Specimen preparation of a given material for microscopic examination.	2	CO1
LLO 2.1 Use suitable etchant for microscopic examination of given sample. LLO 2.2 Use a metallurgical microscope to observe micro structure of given specimen. LLO 2.3 Interpret the micro structure of given specimen.	2	*Interpretation of microstructure of steels and alloy steels using metallurgical microscope on standard specimens.	2	CO1
LLO 3.1 Use Brinell Hardness tester LLO 3.2 Determine hardness of given sample.	3	*Hardness testing on Brinell Hardness tester of given sample material.	2	CO1
LLO 4.1 Use a Rockwell Hardness tester. LLO 4.2 Determine hardness of given sample.	4	Hardness testing on Rockwell Hardness tester of given sample material.	2	CO1
LLO 5.1 Choose appropriate hardness tester for mild steel. LLO 5.2 Use an appropriate hardness tester for mild steel.	5	Hardness testing on relevant hardness testers of given untreated and heat treated Mild Steels.	2	CO1
LLO 6.1 Choose appropriate hardness tester for alloy steel. LLO 6.2 Use an appropriate hardness tester for alloy steel.	6	Hardness testing on relevant hardness testers of given untreated and heat treated Alloy Steels.	2	CO1
LLO 7.1 Use a metallurgical microscope LLO 7.2 Interpret the microstructure of Cast Iron.	7	*Microstructure of cast iron using metallurgical microscope on standard specimens.	2	CO1 CO2
LLO 8.1 Choose appropriate hardness testers for copper & Brass. LLO 8.2 Use appropriate hardness testers for copper & Brass.	8	Hardness testing on relevant hardness testers of given Copper and Brass specimens.	2	CO1 CO3
LLO 9.1 Choose the appropriate hardness tester for Aluminium. LLO 9.2 Use an appropriate hardness tester for aluminum.	9	Hardness testing on relevant hardness testers of given Aluminuim specimens.	2	CO1 CO3
LLO 10.1 Use an appropriate peel tester LLO 10.2 Determine the adhesive strength of cellophane tape and duct tape.	10	*Adhesive strength determination of cellophane tape and duct tape using a relevant peel tester.	2	CO3
LLO 11.1 Use an appropriate peel tester LLO 11.2 Determine the adhesive strength of scotch tape, electrical tape.	11	Adhesive strength determination of scotch tape, electrical tape and masking tape using relevant peel testers.	2	CO3
LLO 12.1 Perform flame tests. LLO 12.2 Identify different types of plastics. Identification of different types of plastics using flame tests.	12	*Identification of different types of plastics using flame tests.	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 13.1 Use a High-temperature oven or electrical current LLO 13.2 Identify behavior of the shape-memory alloy .	13	*Identification of behavior of the shape-memory alloy as a function with regards to temperature using High-temperature oven or electrical current.	2	CO4
LLO 14.1 Use a muffle /box type furnace LLO 14.2 Use various quenching mediums for mild steel. LLO 14.3 Compare the hardness of mild steel.	14	*Comparison of hardness of mild steel using quenching mediums like oil ,water & brine in a muffle /box type furnace .	2	CO1 CO5
LLO 15.1 Use a muffle /box type furnace LLO 15.2 Use various quenching mediums for alloy steel. LLO 15.3 Compare the hardness of alloy steel.	15	Comparison of hardness of alloy steel using quenching mediums like oil ,water & brine in a muffle /box type furnace .	2	CO1 CO5
LLO 16.1 List various ancient Indian material development processes. LLO 16.2 Compare Ancient Indian material development processes with recent processes.	16	Comparison of Ancient Indian material development processes with recent processes.	2	CO1 CO2 CO3 CO4 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Collect information related to Types, Properties and applications of smart materials from websites. Present the information in the form of a Chart.
- Collect samples of various types of plastics, ceramics, composites used in day-to-day applications and prepare charts containing properties, applications of the samples.
- Comparative study of various materials used in previous and current generation components of mechanical engineering equipment like IC Engine, Compressor, turbine, pumps, refrigerator, water cooler, Lathe Machine, Milling Machine, Drilling Machine grinding machine (any one) with proper justifications.
- Preparation of a chart of comparison of hardness of various materials.
- Prepare models showing various crystal structures.
- Prepare a puzzle game on Iron-carbon Equilibrium diagram.
- Determine the microstructure of different metallic components (minimum 5) using metallurgical Microscope and compare their microstructure in the given group.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Slitting machine Specifications: • Capacity: 18 gauge / 1.2mm • Throat Depth: 24 inch (600mm) • Motor: 1 Hp, 230V, 50 Hz. • Minimum Slitting Width: 1 inch (25.4mm)	1
2	Double Disk polishing machine. Two independent polishing units mounted on a common MS frame, Disc dia 200mm, made of Aluminum. Speed continuously variable upto 950 RPM. Rating - 0.25 HP single phase 220 Volt A.C. provided with sink and swing type laboratory water tap. Waterproof Formica table top.	1
3	Digital Brinell hardness Tester 1) Test loads - 500 to 3000 Kgf. in steps of 250 Kg. 2) Magnification of objective - 14 X 3) Maximum test height - 380 mm. 4) Least count - 0.001 mm. 5) Throat depth - 200 mm.	1,3,5,6,8,9,14,15
4	Digital Rockwell hardness Tester 1) Test loads - 60, 100 & 150 kgf 2) Minor load - 10 kg 3) Max test height - 230 mm 4) Throat depth - 133 mm along with essential accessories.	1,4,5,6,8,9,14,15
5	Digital Peel Strength Tester: Make: XEEPL • Load capacity: 0 - 5 kg; Resolution: 1 gram. • Load Indicator: Microprocessor based digital load indicator with memory facility of peak load. • Clear Distance between two plates: Maximum up to 250 mm. • Speed of testing: 300 mm/minute. • Motor: Synchronous Motor. • Grips: A pair of hard chrome plated grips for thin poly film samples would be supplied. • Paint: Powder coated. • Power requirement: Single phase 230 Volts, 50Hz.	10,11
6	Spring coil of Shape memory sample (NiTi alloy) Burner/ Lighter , Sample Holder	12,13
7	Laboratory box furnace Light weight with ceramic fiber wool insulation. Exterior made of G.I. sheets powder coated. Temperature Controlled by Microprocessor based Auto tune PID digital temperature controller with CR/AL Thermocouple. Temperature Range: 1100°C., Muffle Size (inside): Temperature Range: 1100°C., Muffle Size (inside): 6”x6”x12”, Power: 3.5 KW	14,15
8	Standard Samples of Metallurgical Microstructure Plain carbon steels, alloy steels and cast iron (before and after heat treatment) : 03 Each • Aluminum, Copper and Brass/Bronze (before and after heat-treatment): 03 Each Total 36 Specimens	2
9	Trinocular Upright Metallurgical Microscope: Coaxial Body • Body: Trinocular Head inclined at 45-degrees. • Focusing: Both side co-axial focusing knobs. • Nosepiece: Quadruple revolving nosepiece with accurate centering & amp; positive click stops. Trinocular Inverted Metallurgical Microscope (Magnification 100X, 200X, 400X & 800X) Eyepieces - WF 10X, 20X (Paired) Objectives - M 5x, M 10x, M 20x and M 40x (SL) Stage - Built-in graduated mechanical stage of size 165mm.x180mm. is controlled by convenient low coaxial positioned knobs for easy and smooth scanning of specimen.	2,7

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of Engineering Materials	CO1	10	4	4	6	14

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
2	II	Steel & Cast Iron	CO2	12	4	6	6	16
3	III	Non Ferrous Materials & Powder Metallurgy	CO3	10	4	4	6	14
4	IV	Non Metallic Materials & Advanced Materials	CO4	8	4	4	6	14
5	V	Heat Treatment processes	CO5	5	2	4	6	12
Grand Total				**45**	**18**	**22**	**30**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- For laboratory learning term work -25 Marks
- For Self Learning 25 Marks
- Two-unit tests of 30 marks and average of two-unit tests.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	-	1	-	1	1			
CO2	3	1	-	1	-	1	1			
CO3	3	1	-	1	-	1	1			
CO4	3	1	-	1	-	1	1			
CO5	3	1	-	1	-	1	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Dieter, G.D	Mechanical Metallurgy	McGraw Hill Edu. New Delhi, 2017, ISBN. 978-1259064791
2	Avner,S.H	Introduction to Physical Metallurgy	McGraw Hill Edu. New Delhi, 2017, ISBN. 978-0074630068
3	Rajput, R.K S.	Engineering Materials And Metallurgy	Chand and Company New Delhi,2006, ISBN 978-8121927093
4	Balasubramaniam R	Callister's Materials Science and Engineering	Wiley, New Delhi, 2014, ISBN 978-8131518052
5	Parashivamurthy,K. I.	Material Science and Metallurgy	Pearson Education India, 2012, ISBN. 978-8131761625

Sr.No	Author	Title	Publisher with ISBN Number
6	Fulay, P.P., Askeland D.R	Essentials of Materials Science and Engineering	Cengage India Private Limited, 2012 , ISBN 978-8131520703
7	Kodgire, V.D., Kodgire. S.V	Material Science and Metallurgy for Engineers	Everest Publishing House, 2017, ISBN. 978-8176314008

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=jn9cP6JJ7xA	Iron - Carbon diagram
2	https://www.youtube.com/watch?v=skQRLfU3plM	Heat Treatment Processes
3	https://www.youtube.com/watch?v=E6oCdckcwYQ&list=PLyqSpQzTE6M_ON8uXt-PP8uX6hMWJeYSJ&index=3	Crystal structure
4	https://www.youtube.com/watch?v=c1ZbiBIY6Sc&list=PLxQzQgOy_JvYd32Y6XOwFOnVc4_Dkv7v6&index=38	Ceramics
5	https://www.youtube.com/watch?v=04K0bLwCDdM	Composite materials
6	https://vedicheritage.gov.in/vedic-heritage-in-present-context/metallurgy/	IKS
7	https://www.youtube.com/watch?v=_eM49JlmFp0	Powder Metallurgy

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s : **Mechatronics**
Programme Code : **MK**
Semester : **Third**
Course Title : **ANALOG AND DIGITAL ELECTRONICS**
Course Code : **313318**

I. RATIONALE

This course aims to develop skills to test electronic circuits, that is vital for a diploma holder in mechatronics while working in an industry. After studying this course, it is expected that student will develop an insight to identify, build and troubleshoot analog and digital electronic circuits at a wider scale in mechatronics based systems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified outcome through various teaching learning experiences: • Test different electronic circuits for relevant system.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Build different electronic circuits using basic components and diodes.
- CO2 - Interpret working of transistor in electronic circuits.
- CO3 - Use logic gates and Boolean Logic for building digital circuits.
- CO4 - Use combinational and sequential logic circuits for different applications.
- CO5 - Use data converters in electronic systems.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313318	ANALOG AND DIGITAL ELECTRONICS	ADE	DSC	4	-	4	-	8	4	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Draw symbols of different semiconductor diodes. TLO 1.2 Explain V-I characteristic of PN junction diode. TLO 1.3 Explain characteristics of zener diode. TLO 1.4 Compare PN junction diode with zener diode. TLO 1.5 Describe working of rectifiers. TLO 1.6 Compare different parameters of rectifiers. TLO 1.7 Illustrate the working principle of filters. TLO 1.8 Explain zener diode as voltage regulator. TLO 1.9 Draw block diagram of DC regulated power supply. TLO 1.10 Build positive/ negative power supply using IC 7805/7905.	**Unit - I Semiconductor Diodes and Applications** 1.1 Symbol, construction and working principle of PN junction diode, zener diode, light emitting diode (LED), photo diode 1.2 Forward and reverse bias. VI characteristics of PN junction diode and zener diode 1.3 Types of rectifiers: Half wave, full wave, bridge rectifier, working principle, circuit diagram, Input and Output voltage waveform 1.4 Performance parameters of rectifier: PIV, ripple factor and efficiency 1.5 Need for filters: circuit diagram and working of L, C, and CLC filter 1.6 Zener diode working as voltage regulator 1.7 Working principle, block diagram of regulated power supply, IC 78XX and IC 79XX, complete DC power supply circuit	Lecture Using Chalk-Board Presentations Demonstration
2	TLO 2.1 Classify unipolar and bipolar devices. TLO 2.2 Describe working of transistor. TLO 2.3 Explain output characteristics of transistor. TLO 2.4 Determine the current gain of transistor. TLO 2.5 Explain working of transistor as switch TLO 2.6 Explain transistor as an amplifier. TLO 2.7 Draw the symbol of N channel JFET and P channel JFET. TLO 2.8 Explain working principle of N channel JFET.	**Unit - II Bipolar Junction Transistor and Applications** 2.1 Unipolar and bipolar devices 2.2 Types, symbol of BJT, construction and working principle of NPN transistor 2.3 Configurations of transistor CE, CB and CC 2.4 Transistor parameters: alpha beta, input and output resistance, relation between alpha and beta 2.5 Input and output characteristics of CE configuration, saturation active and cut off regions in output characteristics 2.6 Transistor as a switch 2.7 Single stage RC coupled amplifier, circuit diagram function of each component 2.8 JFET symbol, types, construction and working principle	Lecture Using Chalk-Board Presentations Demonstration

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Convert the given number into specified number system. TLO 3.2 Perform binary addition and multiplication. TLO 3.3 Perform subtraction using one's and two's compliment. TLO 3.4 Perform addition of decimal numbers using BCD code. TLO 3.5 Sketch symbols and truth tables of different logic gates. TLO 3.6 State different Boolean Laws. TLO 3.7 Prove De-Morgan's theorems.	**Unit - III Number Systems and Logic Gates** 3.1 Number system: base or radix of number system, binary, octal, decimal and hexadecimal number system 3.2 Binary addition and multiplication 3.3 Subtraction using 1's compliment and 2's compliment 3.4 Logic gates: Symbol, logic expression and Truth table of basic gates (AND, OR, NOT), universal gates (NAND and NOR) and derived gates (EX-OR, EX-NOR) 3.5 Boolean algebra: Laws of Boolean algebra, De-Morgan's theorems	Lecture Using Chalk-Board Presentations Demonstration
4	TLO 4.1 Implement adder/subtractor using logic gates. TLO 4.2 Explain working of multiplexer and demultiplexer using truth table. TLO 4.3 Draw the symbol and truth table of buffer. TLO 4.4 Draw RS Latch using NAND and NOR gate. TLO 4.5 Explain working of different flip-flops. TLO 4.6 Explain working of counter. TLO 4.7 Explain working of shift register.	**Unit - IV Combinational and Sequential Circuits** 4.1 Arithmetic circuits: Half and full Adder, half and full subtractor 4.2 Multiplexers and demultiplexers: block diagram working, truth table and applications of multiplexers and demultiplexers 4.3 Buffer: Tristate logic, symbol, truth table, unidirectional and bidirectional buffer 4.4 Basic memory cell: RS Latch using NAND and NOR gate 4.5 Block schematic and truth table of SR, JK, T, and D Flip Flop 4.6 Counters: Synchronous and asynchronous 3-bit 4.7 Shift resisters: Types, SISO- right and left shift registers	Lecture Using Chalk-Board Presentations Demonstration
5	TLO 5.1 Classify data convertors. TLO 5.2 Explain working principle of ADC/DAC. TLO 5.3 Draw pin diagram of ICs 0808/0809. TLO 5.4 Write broad specifications of ICs 0808/0809.	**Unit - V Data Convertors** 5.1 Data converters: Types, working of weighted resister and R-2R ladder circuit 5.2 DAC IC 0808 5.3 ADC: Block diagram, types and working of dual slope ADC, SAR ADC 5.4 ADC IC 0809	Lecture Using Chalk-Board Presentations Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify type of given diode. LLO 1.2 Identify terminals of given diode.	1	Identification of various types of diodes	2	CO1
LLO 2.1 Measure forward resistance of PN junction. LLO 2.2 Test the functionality of PN junction diode.	2	Testing of PN junction diode using multimeter	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Connect the circuit to plot VI characteristics of PN junction diode. LLO 3.2 Plot the VI characteristics of PN junction diode.	3	*Determination of VI characteristics of given PN junction diode	2	CO1
LLO 4.1 Connect the circuit to plot VI characteristics of zenor diode. LLO 4.2 Plot the VI characteristics of zener diode.	4	*Determination of VI characteristics of given zener diode	2	CO1
LLO 5.1 Develop the circuit of a half wave rectifier. LLO 5.2 Observe input-output waveforms and measure voltages.	5	Construction of half wave rectifier for observing input-output waveforms	2	CO1
LLO 6.1 Develop the circuit of a bridge type full wave rectifier. LLO 6.2 Observe input-output waveforms and measure voltages.	6	*Construction of bridge type full wave rectifier for observing input-output waveforms	2	CO1
LLO 7.1 Make circuit connections to determine the performance of zener diode as voltage regulator. LLO 7.2 Measure output voltage for change in input voltage and load current.	7	*Testing performance of given zener diode as voltage regulator	2	CO1
LLO 8.1 Make connection as per circuit diagram and measure output voltage for voltage regulator IC 7805. LLO 8.2 Make connection as per circuit diagram and measure output voltage for voltage regulator IC 7905.	8	Testing performance of regulated power supply IC 7805 and IC 7905	2	CO1
LLO 9.1 Identify terminals of NPN transistor. LLO 9.2 Identify terminals of PNP transistor.	9	Identification of NPN and PNP transistor using multimeter	2	CO2
LLO 10.1 Make circuit connections to plot input/output characteristics of transistor in CE mode. LLO 10.2 Measure voltages and current to plot input/output characteristics of transistor.	10	*Part I: Determination of input characteristics of NPN transistor in CE mode *Part II: Determination of output characteristics of NPN transistor in CE mode	4	CO2
LLO 11.1 Make connections as per circuit diagram to determine the performance of transistor as a switch. LLO 11.2 Verify transistor as ON and OFF switch.	11	*Testing performance of transistor as a switch	2	CO2
LLO 12.1 Make connections as per circuit diagram to determine the gain and bandwidth of single stage RC coupled amplifier. LLO 12.2 Calculate gain and bandwidth of transistor.	12	*Determination of gain and bandwidth of single stage RC coupled amplifier	2	CO2
LLO 13.1 Test functionality of different ICs using digital IC tester.	13	Testing of different digital IC's using IC tester	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Make circuit connections to verify truth table of of AND, OR, NOT, NAND and NOR logic gates. LLO LLO 14.2 Verify truth table of logic gates and measure the output voltage using multimeter for logic 0 and 1.	14	*Verification of truth table of AND, OR. NOT, NAND and NOR gates	2	CO3
LLO 15.1 Verify the truth table of EX-OR and EX-NOR gates. LLO 15.2 Measure the output voltage using multimeter for logic 0 and 1.	15	Verification of truth table of EX-OR and EX-NOR gates	2	CO3
LLO 16.1 Make connection to implement basic logic gates using NAND gate. LLO 16.2 Verify truth table of basic logic gates.	16	*Implemention of basic logic gates using NAND gate	2	CO3
LLO 17.1 Verify De-Morgan's theorem.	17	Verification of De-Morgan's theorem using logic gates	2	CO3
LLO 18.1 Make connections to develop half adder and half subtractor using logic gates. LLO 18.2 Verify truth table of Half Adder and half subtractor.	18	Implementation of half adder and half subtractor using logic gates	2	CO4
LLO 19.1 Construct full adder circuit. LLO 19.2 Verify truth table of full adder.	19	*Implementation of full adder using logic gates	2	CO4
LLO 20.1 Construct full subtractor circuit. LLO 20.2 Verify truth table of Full subtractor.	20	Implementation of full subtractor using logic gates	2	CO4
LLO 21.1 Identify the pins of IC 74151 and make connections as per circuit diagram. LLO 21.2 Verify the truth table of Multiplexer IC 74151.	21	*Implementiation of 8:1 multiplexer using IC 74151	2	CO4
LLO 22.1 Identify the pins of IC 74155/74154 and make connections as per circuit diagram. LLO 22.2 Verify the truth table of demultiplexer IC 74155/74154.	22	Verification of truth table of 1:8 demultiplexer using IC 74155/74154	2	CO4
LLO 23.1 Construct RS flip flop using NAND gate. LLO 23.2 Verify its truth table.	23	Implementation of RS flip flop using NAND gates	2	CO4
LLO 24.1 Verify truth table of D and T flip flop.	24	*Implementation of D and T flip flop using JK flip flop IC 7476	2	CO4
LLO 25.1 Test functionality of IC 7476 and make connections as per circuit diagram. LLO 25.2 Verify truth table of 3 bit counter.	25	*Implementation of 3 bit ripple/asynchronous counter using IC 7476/7473	2	CO4
LLO 26.1 Test functionality of IC 7474 and construct circuit diagram. LLO 26.2 Verify Serial in serial out right/ left shift operation .	26	Testing of 4 bit SISO shift register using IC 7474	2	CO4
LLO 27.1 Make connections of DAC circuit using R-2R resistive network. LLO 27.2 Measure analog voltage for corresponding digital input.	27	*Testing performance of R-2R resistive network for converting digital data input into analog output	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 28.1 Make connections of DAC circuit using weighted resister network. LLO 28.2 Measure analog voltage for corresponding digital input.	28	Testing of performance of weighted resister network for converting digital data input into analog output	2	CO5
LLO 29.1 Measure digital output for applied analog input voltage.	29	*Verification of operational features of ADC- IC 0809	2	CO5
LLO 30.1 Measure analog output voltage for corresponding digital input.	30	Verifcation of operational features of DAC- IC 0808	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Ammeter (0-25 mA), Voltmeter (0-5V, 0-10V DC)	1,2,3,4,5,6,7,8,9,10,11,12
2	Digital Multimeter: 3 1/2 Digit Display with R, V and I measurement and Diode, Transistor testing facility	1,2,3,4,5,6,7,8,9,10,11,12
3	Function Generator with TTL output: 20MHz	12
4	DC Regulated Fixed Power Supply: 5V Short Circuit protection display for voltage and current	13,14,15,16,17,18,19,20,21,22,23,24,25,26
5	Digital and Analog IC tester: To test wide range of ICs such as 74 series	13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30
6	Trainer kits for digital ICs: Trainer kit shall consist of Digital 1C's for logic gates, Flip-Flops, Shift Registers, counter along with toggle switches for inputs and bi-color LED at outputs and built in power supply	14,15,16,17,18,19,20,21,22,23,24,25,26
7	Dual Power Supply: +/- 15V	27,28,29,30
8	DC Regulated Power Supply: Variable DC Voltage 0-30V, 2A. Short Circuit protection display for voltage and current	3,4,7,8,9,10,11
9	Cathode ray Oscilloscope (CRO): 0-20 MHz Dual Trace, Dual Beam with Component Tester	5,6,12
10	Trainer kits/bread board, Logic IC's (7400, 7402, 7404, 7408, 7432, 7486, 74266, 7474, 7476, 74151, 741, 74155, 7805. 790 5) Electronic components (Rectifier Diode, LED, Zener Diode, Transistor, Resistors, Capacitors) for performing Practicals	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Semiconductor Diodes and Applications	CO1	14	4	4	8	16

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
2	II	Bipolar Junction Transistor and Applications	CO2	14	2	6	8	16
3	III	Number Systems and Logic Gates	CO3	12	4	4	4	12
4	IV	Combinational and Sequential Circuits	CO4	14	2	6	8	16
5	V	Data Convertors	CO5	6	2	4	4	10
Grand Total				**60**	**14**	**24**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks and average of two unit tests.

For laboratory learning 25 marks.
Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- End semester assessment of 25 marks for laboratory learning.

End semester assessment of 70 marks through offline mode of examination.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	-	1	2	-	2			
CO2	3	1	-	1	2	-	2			
CO3	3	1	-	1	1	-	2			
CO4	3	1	-	1	2	-	2			
CO5	3	1	-	1	2	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Sedha R. S	A text book of Applied Electronics	S. Chand, New Delhi, 2013, ISBN: 9788121928038
2	Mehta, V. K. , Mehta Rohit	Principles of Electronics	S. Chand, New Delhi, 2014, ISBN: 9788121924504
3	Bell, Devid	Fundamentals of Electronics Devices and Circuits	Oxford University Press, International edition, USA, 2015, ISBN: 9780195425239

Sr.No	Author	Title	Publisher with ISBN Number
4	B.L.Thereja	Basic Electronics Solid State	S. Chand New Delhi, ISBN: 9788121925556
5	Jain, R. P.	Modern Digital Electronics	McGraw-Hill Publishing, New Delhi. 2011, ISBN:978007066 9116
6	Maini, Anil K.	Digital Electronics Principles and Integrated Circuits	Wiley India, Delhi, 2016, ISBN: 9788126514663
7	Leach, D. P. Malvino A. P., Saha G.	Digital Principles and Applications	McGraw-Hill Publishing, New Delhi.2014, ISBN: 9789339203405
8	Charles H.Roth Jr|Larry L. Kinney Raghunandan G.H.	Analog Digital Electronics	Cenege Learning India Pvt.Ltd., ISBN: 9789353502355

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.tutorialspoint.com/basic_electronics/index.htm	Basic Electronics Components
2	https://www.tutorialspoint.com/digital_circuits/index.htm	Digital circuits
3	https://www.iitg.ac.in/cseweb/vlab/Digital-System-Lab/experiments.php	Digital electronics experiments
4	https://www.electronicshub.org/semiconductor-diodes	semiconductor-diodes
5	https://archive.nptel.ac.in/courses/108/105/108105132/	Digital electronics circuits
6	https://www.electronicshub.org/types-of-adc-circuit/	Analog to digital converter
7	https://www.circuitstoday.com/digital-to-analog-converters-da	Digital to analog converters
8	https://www.geeksforgeeks.org/shift-registers-in-digital-logic/	Shift registers

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s : **Mechatronics**
Programme Code : **MK**
Semester : **Third**
Course Title : **INDUSTRIAL MEASUREMENTS**
Course Code : **313319**

I. RATIONALE

Industrial measurement systems are crucial in monitoring and control applications. This course helps to measure industrial process parameters in given situation using suitable sensor or/and transducer.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Select suitable measuring instrument for required measurement process by knowing their working principle.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Apply various performance characteristics of measuring instruments.
- CO2 - Select relevant mechanical transducers for measuring required parameters.
- CO3 - Choose suitable transducers for measuring pressure and temperature.
- CO4 - Select relevant transducers for level and flow measurement.
- CO5 - Use suitable signal conditioning and data acquisition system.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313319	INDUSTRIAL MEASUREMENTS	IME	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe block diagram of an instrumentation system. TLO 1.2 Describe performance characteristics of measuring instruments. TLO 1.3 Classify types of error in measurement. TLO 1.4 Define the term Sensor and transducer. TLO 1.5 Select relevant sensor and transducer for a given application.	**Unit - I Introduction to measurement system** 1.1 Introduction to measurement system-Definition of measurement, Significance of measurement, block diagram of instrumentation system, Standard and calibration. 1.2 Instrument and its performance characteristics- Static characteristics: - Accuracy, Precision, Range, Span, Error, Linearity, Hysteresis, Reproducibility, Repeatability, Dead zone, Span, Range, Threshold. Dynamic Characteristics: - Speed of response, lag, Fidelity, Dynamic error. 1.3 Types of Error- Gross, Systematic and random errors. 1.4 Primary elements of measurement system – Sensors: Working principle and applications of proximity and optical sensor. Transducer -Need and classification a. Mechanical and Electrical b. Active and Passive c. Primary and secondary d. Analog and Digital. 1.5 Selection Criteria of transducer.	Lecture Using Chalk-Board Video Demonstrations Presentations
2	TLO 2.1 Explain construction and working principle of displacement. TLO 2.2 Describe the working principle of different strain measuring transducer. TLO 2.3 Explain construction and working of force measuring transducer with their applications. TLO 2.4 Explain working of dynamometers and torque measuring devices.	**Unit - II Displacement, strain, force and torque measurement** 2.1 Displacement Measurement- Working principle and construction of resistive transducer-potentiometer, Inductive transducer-LVDT, RVDT. Capacitive transducer. 2.2 Strain Measurement - Strain gauge types, construction and working principle of strain gauge transducer (Bonded and Unbonded). 2.3 Force measurement – Force transducer types, construction and working principle of strain gauge load cell and piezoelectric load cell. 2.4 Torque measurement construction and working principle of inline rotating torque sensor, inline stationary torque sensor, proximity torque sensor and eddy current dynamometer.	Model Demonstration Video Demonstrations Lecture Using Chalk-Board Hands-on

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Define absolute and atmospheric pressure. TLO 3.2 Classify different types of pressure measuring devices. TLO 3.3 Explain construction and working principle of different pressure measuring transducers. TLO 3.4 Classify different types of temperature measuring devices. TLO 3.5 Explain construction and working principle of different temperature measuring transducers. TLO 3.6 Differentiate between optical and radiation pyrometers. TLO 3.7 State applications of pressure and temperature measuring transducers.	**Unit - III Pressure and temperature measurement** 3.1 Pressure: Definition, units, Types - absolute, Gauge, atmospheric and Vacuum pressure. 3.2 Classifications of pressure measuring devices. 3.3 Elastic pressure transducers- Bourdon tube, Bellow, Diaphragm, Capsule. 3.4 Electrical pressure transducer- -Bourdon tube with LVDT -Piezoelectric Pressure Transducer -Photoelectric pressure transducer. 3.5 Vacuum pressure Measurement -Mc Leod gauge, Pirani gauge. 3.6 Temperature: units , temperature scales. 3.7 Classifications of temperature measuring transducers. 3.8 Electrical methods -Thermistor - RTD - Thermocouple. 3.9 Pyrometer: Optical and Radiation pyrometers.	Model Demonstration Video Demonstrations Lecture Using Chalk-Board Hands-on
4	TLO 4.1 Define types of flow. TLO 4.2 List various types of flow measuring devices. TLO 4.3 Explain construction and working principle of different flow measuring transducers. TLO 4.4 Classify different types of level measuring devices. TLO 4.5 Explain construction and working principle of different level measuring transducers. TLO 4.6 Compare direct and indirect methods of level measurement.	**Unit - IV Flow and Level measurement** 4.1 Flow: Definition, units, Types - laminar, turbulent Reynolds number. 4.2 Classifications of flow measuring transducers a. Variable head flowmeter - Venturi meter - Orifice plate meters b. Variable area flowmeter - Rotameter c. Electrical flow meter - Turbine flow meter -Electromagnetic flow meter - Ultrasonic flow meter (Time difference and Doppler type) -Hot wire anemometer d. Vortex flowmeter- Swirl meter. 4.3 Level, its units, classification of level measuring methods. 4.4 Direct methods -Sight glass - Float type with linear and rotary potentiometer. 4.5 Indirect measurement methods - Capacitive type - Ultrasonic type -Nuclear radiation type - optical level detectors.	Lecture Using Chalk-Board Model Demonstration Video Demonstrations Hands-on

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Classify speed measuring devices. TLO 5.2 Explain working principle of speed measuring transducers with application. TLO 5.3 Explain construction and working principle sound measuring transducer. TLO 5.4 Explain working principle of humidity measuring transducer with application.	**Unit - V Speed, sound and humidity measurement** 5.1 Speed measurement- Classification of speed transducers Mechanical Tachometer-Revolution Counter. Electrical tachometer-Eddy current tachometer, Tachogenerators (AC and DC). Magnetic Pick-up, Stroboscope. 5.2 Sound measurement- Sound Characteristics, Microphone and its types. 5.3 Construction, working and applications of- -Carbon microphone -Dynamic microphone. 5.4 Humidity measurement Hair hygrometer, Resistive hygrometer and capacitive hygrometer.	Lecture Using Chalk-Board Video Demonstrations Model Demonstration Hands-on
6	TLO 6.1 State the need of signal conditioning system. TLO 6.2 Describe block diagram of signal conditioning circuit. TLO 6.3 Describe block diagram of data acquisition system. TLO 6.4 State the need of non-Linear signal conditioning system.	**Unit - VI Signal conditioning system** 6.1 Basic signal conditioning-Definition. Need and function. 6.2 Linear signal conditioning-Adder, Subtractor, Instrumentation amplifier. 6.3 Non-Linear signal conditioning- Amplitude modulation-Demodulation, Filtering. 6.4 Data acquisition system-Introduction, Block diagram of DAS.	Video Demonstrations Lecture Using Chalk-Board Site/Industry Visit Hands-on

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify types of error in measurement. LLO 1.2 Apply procedure to find error in measurement.	1	Error measurement in a given instrument.	2	CO1
LLO 2.1 Prepare experimental set-up for displacement measurement. LLO 2.2 Use LVDT to measure displacement. LLO 2.3 Draw LVDT input-output characteristics.	2	*Linear displacement measurement using LVDT.	2	CO1 CO2
LLO 3.1 Prepare experimental set-up for weight measurement. LLO 3.2 Use strain gauge load cell to measure weight. LLO 3.3 Draw strain gauge load cell input-output characteristics.	3	*Weight measurement using strain gauge load cell.	2	CO1 CO2
LLO 4.1 Measure pressure using bourdon tube pressure gauge.. LLO 4.2 Draw input-output characteristics of bourdon tube pressure gauge.	4	*Pressure measurement using bourdon tube.	2	CO1 CO3
LLO 5.1 Measure temperature using RTD. LLO 5.2 Draw RTD input-output characteristics.	5	Temperature measurement using RTD.	2	CO1 CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Identify steps to calibrate RTD. LLO 6.2 Use NIST data values as standard and calibrate RTD.	6	*Calibration of RTD temperature measuring instruments (Prefer NIST data table as standard).	2	CO1 CO3
LLO 7.1 Use thermocouple to measure temperature. LLO 7.2 Draw thermocouple input-output characteristics.	7	*Temperature measurement using thermocouple.	2	CO1 CO3
LLO 8.1 Identify steps to calibrate thermocouple. LLO 8.2 Use NIST data values as standard and calibrate thermocouple.	8	Calibration of thermocouple temperature measuring instruments (Prefer NIST data table as standard).	2	CO1 CO3
LLO 9.1 Identify type of orifice meter LLO 9.2 Measure flow rate using orifice meter.	9	Flow rate measurement using orifice meter.	2	CO4
LLO 10.1 Identify type of variable area flowmeter. LLO 10.2 Measure flow rate using rotameter.	10	*Flow rate measurement using rotameter.	2	CO4
LLO 11.1 Identify type of level indicator. LLO 11.2 Measure level using float type level indicator.	11	Level measurement using float type level indicator.	2	CO4
LLO 12.1 Identify type of level transducer. LLO 12.2 Measure level using capacitive transducer.	12	Level measurement using capacitive transducer.	2	CO4
LLO 13.1 Identify type of speed measuring transducer. LLO 13.2 Measure speed using stroboscope.	13	*Speed measurement using stroboscope.	2	CO2
LLO 14.1 Identify type of sound measuring instrument. LLO 14.2 Measure level using sound meter.	14	Sound intensity measurement using sound meter.	2	CO2
LLO 15.1 Identify type of hygrometer. LLO 15.2 Measure humidity using hair hygrometer.	15	Humidity measurement using hair hygrometer.	2	CO2
LLO 16.1 Select the components to design of signal conditioning circuit. LLO 16.2 Use breadboard to implement signal conditioning circuit for RTD /thermistor/thermocouple. LLO 16.3 Measure output using designed signal conditioning circuit.	16	*Design and implement signal conditioning circuit for RTD /thermistor/thermocouple.	2	CO1 CO3 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Develop a quarter/ half / full bridge configuration of RTD for temperature measurement.

- Implement op-amp based linearizer for NTC thermistor.
- Develop set-up for force measurement using load cell.
- Build distance measurement set-up using IR sensor.

Assignment

- Evaluate drift in thermocouple.
- Thickness measurement using differential roller LVDT.
- Prepare a specification of sensors and transducers identified during visit to process industry.
- Discover real time applications of dynamometers used in industries.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Capacitive transducer for level measurement: Capacitive probe, Range 0-100mm, Digital Display.	12
2	Stroboscope: range up to 5000 rpm with digital display.	13
3	Sound level meter: Measuring range 30-130 dB, portable and easy to use.	14
4	Thermistor: Range 0- 120 deg. C.	16
5	LVDT displacement measuring kit:measurement range 0-50mm. Micrometer screw gauge assembly for displacement.	2
6	Strain gauge trainer-Strain/force measurement -Sensor-4 arm bridge with strain gauge mounted cantilever 2kg, with digital display.	3
7	Load cell: force measurement range 5-50N, Strain gauge capacity 2kg.	3
8	Bourdon tube pressure gauge: C type.	4
9	RTD(Pt-100) 0- 150 deg. C.	5,6,16
10	Dual-Well Dry-Well temperature calibrator 0 to 350 deg. C.	5,6,7,8,16
11	Glass thermometer: Range 0- 100 deg. C.	6,8
12	Thermocouple: Range 0- 1500 deg. C.	7,8,16
13	Flow measurement set-up (Venturi meter, orifice and rotameter).	9,10

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to measurement system	CO1	8	2	2	4	8
2	II	Displacement, strain, force and torque measurement	CO2	10	2	4	6	12
3	III	Pressure and temperature measurement	CO3	12	2	6	8	16
4	IV	Flow and Level measurement	CO4	10	2	4	6	12

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
5	V	Speed, sound and humidity measurement	CO2	12	2	4	6	12
6	VI	Signal conditioning system	CO5	8	2	2	6	10
Grand Total				**60**	**12**	**22**	**36**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- For laboratory learning 25 marks.
- Two unit tests of 30 marks and average of two unit tests.
- Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks through offline mode of examination.
- End semester assessment of 25 marks for laboratory learning.
- End semester assessment of 70 marks through offline mode of examination
- End semester assessment of 70 marks through offline mode of examination.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	-	2	2	-	2			
CO2	3	2	1	2	2	1	2			
CO3	3	2	1	2	2	1	2			
CO4	3	2	1	2	2	1	2			
CO5	3	2	1	2	2	1	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Kumar, D.S	Mechanical Measurements and Control	Metropolitan Book Co. Pvt. Ltd. 2015,ISBN: 9781200041246.
2	Singh, S.K.	Industrial Instrumentation and Control.	Mc Graw Hill Publishing House, 2013,ISBN:978-0-07-026222-5.
3	Nakra, BC Choudhary, KK	Instrument measurement and analysis.	Mc Graw Hill Publishing House, 2016, ISBN:978-9385880629,ISBN:9385880624.
4	Rajput, R.K.	Mechanical Measurement and Instrumentation.	S.K.Kataria and Sons, 2017, ISBN:81-88458-83-X.

Sr.No	Author	Title	Publisher with ISBN Number
5	Sawhney, A.K. , Sawhney,Puneet	Mechanical Measurements and Instrumentation and Control.	Dhanpat Rai Publication, 2013, ISBN:9786000598884.
6	Venketashan, S.P.	Mechanical Measurement.	Ane Books India,2022, ISBN:978-3-030-73619-4.

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/112/107/112107242/	Mechanical measurement system.
2	https://archive.nptel.ac.in/courses/108/105/108105064/	Industrial Instrumentation.
3	https://www.youtube.com/watch?v=T2C-19ZZhbg&t=7s	Strain gauge.
4	https://www.youtube.com/watch?v=AwZnWtkzuRQ	Dynamometer.
5	https://www.youtube.com/watch?v=qSRhstdL9WA	Pressure Measuring devices.
6	https://www.youtube.com/watch?v=2ABljUmax0w&t=1s	Temperature measuring devices.
7	https://www.youtube.com/watch?v=D_vbjofZl5E&t=1s	Flow measuring devices.
8	https://www.youtube.com/watch?v=hL2ofn12x_M	Introduction of signal conditioning circuit and operational amplifier.

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s : **Mechatronics**
Programme Code : **MK**
Semester : **Third**
Course Title : **ELEMENTS OF ELECTRICAL ENGINEERING**
Course Code : **313320**

I. RATIONALE

Any technical person is expected to have basic knowledge of electrical engineering as they have to work in different engineering fields that deals with various types of electrical machines and equipment. This course will enable the students to apply the fundamental concepts of electrical engineering for understanding of other higher semester courses as well as later in the world of work.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply basic principles of electrical engineering to solve the electrical engineering problems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Determine various parameters in a given electrical circuit.
- CO2 - Use principles of magnetic circuits in electrical devices.
- CO3 - Select DC motor and transformer for specific applications.
- CO4 - Select AC motor and special purpose motor for given application.
- CO5 - Select electrical measuring instruments and protective devices.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313320	ELEMENTS OF ELECTRICAL ENGINEERING	EEE	AEC	3	-	2	1	6	3	3	30	70	100	40	25	10	-	-	25	10	150

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the given terms of electric circuits. TLO 1.2 Compare AC and DC. TLO 1.3 Apply Ohms law, KCL, KVL to electrical circuits. TLO 1.4 Compare single phase and three phase circuits. TLO 1.5 Calculate equivalent resistance and other parameter of a given circuit.	**Unit - I Basic Fundamentals** 1.1 Introduction to voltage, current, EMF, potential difference, work, power, energy and its units 1.2 Direct current (DC), Alternating current (AC) 1.3 Resistor, Inductor, Capacitor 1.4 Ohms law, KCL, KVL 1.5 Definitions - Cycle, frequency, phase, period, maximum value, average value, R.M.S. value 1.6 Series and parallel circuit of resistance 1.7 Compare single phase and Three phase circuits 1.8 Numerical on KCL, KVL, series and parallel circuit	Lecture Using Chalk-Board Presentations Video Demonstrations
2	TLO 2.1 Interpret the terms related to a magnetic circuit. TLO 2.2 Compare of electric and magnetic circuit. TLO 2.3 Plot B-H curve and hysteresis loop of the given magnetic materials. TLO 2.4 Describe Faraday's laws of electromagnetic induction, Fleming's right-hand rule, Lenz's law.	**Unit - II Magnetic Circuit and Electromagnetism** 2.1 Definition of magnetic lines of force, magnetic flux, flux density, magneto-motive-forces (mmf), magnetic field strength, reluctance 2.2 Comparison of electric and magnetic circuit 2.3 Magnetization curve (B - H curve), hysteresis loop of the given magnetic materials 2.4 Faraday's laws of electromagnetic induction, Fleming's right-hand rule, Lenz's law 2.5 Statically and dynamically induced emf	Lecture Using Chalk-Board Presentations Video Demonstrations
3	TLO 3.1 Explain construction and working of DC motor. TLO 3.2 List different types of DC motor and its applications. TLO 3.3 Explain construction and working of transformer. TLO 3.4 Interpret the EMF equation and transformation ratio of two winding transformer. TLO 3.5 Calculate transformation ratio(K) of transformer. TLO 3.6 Compare auto transformer and two winding transformer.	**Unit - III DC Motors and Transformer** 3.1 DC motor construction and working principle of operation 3.2 Types of DC motor and its applications 3.3 Transformer construction and working principle of operation 3.4 EMF equations and transformation ratio of transformer 3.5 Numerical on EMF equations and transformation ratio of transformer 3.6 Losses in a transformer 3.7 Introduction of auto transformer and compare it with two winding transformers	Lecture Using Chalk-Board Presentations Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Explain construction and working of single-Phase induction motor. TLO 4.2 Classify single phase induction motors. TLO 4.3 Explain construction and working of three Phase induction motor. TLO 4.4 List the applications of single phase and three phase induction motors. TLO 4.5 Explain construction and working of different types of FHP motors and list its applications. TLO 4.6 Illustrate need of starters. TLO 4.7 Select the appropriate drives for the specified motor.	**Unit - IV AC Machine and Special purpose motor** 4.1 Single-phase induction motor – construction, working principle and application 4.2 Types of single-phase induction motor – split phase, capacitor start induction run, capacitor start capacitor run, permanent capacitor, shaded pole induction motor 4.3 Three phase induction motor – construction, operation and types and its application 4.4 Other Motors (FHP): Universal motor, servo motor, stepper motor – construction, working and applications 4.5 Need of starters 4.6 Classification of drives, factors for selection of drives for different motors	Lecture Using Chalk-Board Presentations Video Demonstrations
5	TLO 5.1 List of applications of different measuring instruments. TLO 5.2 List of applications of different measuring instruments. TLO 5.3 List the applications of MCB, MCCB and ELCB. TLO 5.4 Explain necessity of earthing.	**Unit - V Measuring Instruments and Protective Devices** 5.1 Use of AC and DC ammeter, voltmeter, wattmeter, digital multimeter, clip on meter, tachometer, megger, tachometer energy meter, (applications only) 5.2 Operation of fuses and its types 5.3 Operation and application of MCB, MCCB and ELCB 5.4 Necessity of earthing and types of earthing	Lecture Using Chalk-Board Presentations Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Connect the meter in the given circuit. LLO 1.2 Measure electrical parameters. LLO 1.3 Compare the readings of digital multimeter with that of analog meter.	1	* Measurement of various electrical quantities by using analog meters and digital multimeters	2	CO1
LLO 2.1 Connect the resistors in series and parallel. LLO 2.2 Find the equivalent resistance of series and parallel connection.	2	Measurement of equivalent resistance of series and parallel connection	2	CO1
LLO 3.1 Connect the DC / AC source with resistive load. LLO 3.2 Verify Ohm's Law equipment.	3	Verification of Ohm's law	2	CO1
LLO 4.1 Verify Kirchhoff’s laws.	4	*Verification of Kirchhoff’s current and voltage law	2	CO1
LLO 5.1 Verify of Faraday's law of electromagnetic induction (statically induced emf).	5	*Verification of Faraday's law of electromagnetic induction (statically induced emf)	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Verify of Faraday's law of electromagnetic induction (dynamically induced emf).	6	Verification of Faradays law of electromagnetic induction (dynamically induced emf)	2	CO2
LLO 7.1 Draw B-H curve for the given magnetic material.	7	Determination of B-H curve for the given magnetic material	2	CO2
LLO 8.1 Identify the various parts of DC motor.	8	Identification of various parts of DC motor	2	CO3
LLO 9.1 Measure speed control of DC motor.	9	* Speed control of DC series motor by armature resistance control method	2	CO3
LLO 10.1 Determine the transformation ratio.	10	*Determination voltage and current ratio of single-phase transformer	2	CO3
LLO 11.1 Identify the various parts of three- phase induction motor.	11	Identification of various parts of three phase induction motor and its function	2	CO4
LLO 12.1 Identify various parts of stepper motor.	12	*Dismantling/assembling /testing a stepper motor and its types	2	CO4
LLO 13.1 Experiment with speed reversal of three phase induction motors.	13	*Using phase sequence change the direction of rotation of three-phase induction motor	2	CO4
LLO 14.1 Determine the fusing current by operate fuse in an electrical circuit.	14	* Performance of fuse in electrical circuit	2	CO5
LLO 15.1 Investigate the operation of MCB at normal and abnormal condition.	15	Performance of MCB in electrical circuit	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Collect the different types of small rating fuses and make demonstration charts. (Collect different types of small rating fuse, distribute fuse according to types, mention the rating and application of fuse)
- Connect two small battery cells (AA size) make series and parallel connection. Measure the voltage of both connections. (Collect small battery cells, connect battery cells in series and parallel, connect the voltmeter to measure voltage)

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Single phase auto-transformer- Input: 0 to 230 V, 10 A, Output: 0 to 270 V (2 Qty)	1,2,3,4,5,6,7,10,14,15
2	Stripper, Hammer, Plier, Tester, Standard wire gauge etc.	1,2,3,4,5,6,7,9,10,12,13
3	DC and AC Ammeter, 0-10/20 A (5 Qty)	1,2,3,4,5,6,7,9,10,13,14,15
4	DC and AC Voltmeter, 0-150/300 V (5 Qty)	1,2,3,4,5,6,7,9,10,13,14,15
5	Digital Multimeter (2 Qty)	1,2,3,4,5,6,7,9,10,13,14,15
6	Connecting wires	1,2,3,4,5,6,7,9,10,13,14,15
7	Loading rheostat – 7.5 KW, 230 V (5 Qty), 3 Phase, 4 wire balanced load, (Each branch having equal load) (1 Qty), Load – wire wound fixed resisters	1,2,3,4,7,9
8	Lamp bank: 230 V, 0 to 20 A. (1 Qty)	1,2,3,9,10,14,15
9	Tachometer – Non contact type, (0-10000rpm) (1 Qty)	1,9
10	Single phase transformer: 1 KVA, 1 Phase, 230/115 V, Air closed, enclosed type. (2 Qty)	10
11	Stepper motor kit (1 Qty)	12
12	Three phase auto transformer – 15 KVA, Input: 0 to 415V, 3 Phase, 50Hz, output: 0 to 415 V, 30A per line, Air cooled (1 Qty)	13
13	3 Phase Induction motor, 3HP/5HP, 415 V, 50 H Z, 1140 RPM (1 Qty)	13
14	Fuse (5A/10A, 230V, 50Hz)	14
15	Fuse Wire	14
16	MCB(1A/2A/3A/4A/5A/6A)	15
17	DC Source (24 V)	3,9
18	DC series and shunt motor (up to 230V, 5 HP) (1 Qty)	8,9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basic Fundamentals	CO1	10	4	6	6	16
2	II	Magnetic Circuit and Electromagnetism	CO2	6	2	4	4	10
3	III	DC Motors and Transformer	CO3	10	4	4	6	14
4	IV	AC Machine and Special purpose motor	CO4	12	4	8	6	18
5	V	Measuring Instruments and Protective Devices	CO5	7	4	4	4	12
Grand Total				**45**	**18**	**26**	**26**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks will be conducted and average of two-unit tests considere
- For formative assessment of laboratory learning 25 marks
- Each practical will be assessed considering appropriate percentage weightage to process and product and other instructions of assessment

Summative Assessment (Assessment of Learning)

- End semester assessment of 70 marks through offline mode of examination
- For self learning assessment (SLA) of 25 marks

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	-	3	2	-	2			
CO2	3	1	-	2	2	-	2			
CO3	3	2	-	2	2	-	2			
CO4	3	2	-	2	2	-	2			
CO5	3	2	-	2	2	-	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	V. K. Mehta, Rohit Mahta	Basic Electrical Engineering	S. Chand Publication, ISBN:978-81-219-0871-9
2	P. V. Prasad, S. Sivanagaraju	Electrical Engineering Concepts and Application	Cengage Publication, ISBN:978-81-315-1787-1
3	V. K. Mehta, Rohit Mahta	Principles of Electrical Engineering and Electronics	S. Chand Publication, ISBN:978-81-219-4298-0
4	B. L. Theraja	Electrical Technology - Volume I	S. Chand and Co. New Delhi, ISBN:978-81-219-2440-5
5	B. L. Theraja	Electrical Technology - Volume II	S. Chand and Co. New Delhi, ISBN:978-81-219-2437-5

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/XT-UmPviH64?si=MLIZBB5BgOA2SWBk	Electromagnetic induction
2	https://youtu.be/M-QfX2fvpp4?si=xpZDAiX3-_7xrnnr	Basic magnetic circuits
3	https://archive.nptel.ac.in/courses/117/106/117106108/	Basic electrical circuits
4	https://archive.nptel.ac.in/courses/108/105/108105155/	Electrical machines-1
5	https://youtu.be/ivP_8w4FegE?si=5BLH_hvyhros570A	1 phase and 3 phase electrical system
6	https://youtu.be/9Xgn40eGcqY?si=YQy0vmxQ_yGR8-tz	Miniature circuit breaker
7	https://youtu.be/ikLhqUCQKkc?si=8VqRbV1zZlQUSYLd	Earth leakage circuit breaker
8	https://youtu.be/wgxcxOUjfro	Fuse

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s	**: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Hotel Management & Catering Technology/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Medical Electronics/ Production Engineering/ Printing Technology/ Polymer Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures**
Programme Code	**: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MU/ PG/ PN/ PO/ SE/ TC/ TE/ TR/ TX**
Semester	**: Third**
Course Title	**: ESSENCE OF INDIAN CONSTITUTION**
Course Code	**: 313002**

I. RATIONALE

This course will focus on the basic structure and operative dimensions of Indian Constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The Constitution of India is the supreme law of India. The document lays down the framework demarcating the fundamental political code, structure, procedures, powers, and sets out fundamental rights, directive principles, and the duties of citizens. The course on constitution of India highlights key features of Indian Constitution that makes the students a responsible citizen. In this online course, we shall make an effort to understand the history of our constitution, the Constituent Assembly, the drafting of the constitution, the preamble of the constitution that defines the destination that we want to reach through our constitution, the fundamental right constitution guarantees through the great rights revolution, the relationship between fundamental rights and fundamental duties, the futurist goals of the constitution as incorporated in directive principles and the relationship between fundamental rights and directive principles.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry /employer expected outcome – Abide by the Constitution in their personal and professional life.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - List salient features and characteristics of the constitution of India.
- CO2 - Follow fundamental rights and duties as responsible citizen of the country.
- CO3 - Analyze major constitutional amendments in the constitution.
- CO4 - Follow procedure to cast vote using voter-id.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313002	ESSENCE OF INDIAN CONSTITUTION	EIC	VEC	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-	50	20	50

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the meaning of preamble of the constitution. TLO 1.2 Explain the doctrine of basic structure of the constitution. TLO 1.3 List the salient features of constitution. TLO 1.4 List the characteristics of constitution.	**Unit - I Constitution and Preamble** 1.1 Meaning of the constitution of India. 1.2 Historical perspectives of the Constitution of India. 1.3 Salient features and characteristics of the Constitution of India. 1.4 Preamble of the Constitution of India.	Presentations Blogs Hand-outs Modules Flipped classrooms Case studies
2	TLO 2.1 Enlist the fundamental rights. TLO 2.2 . Identify fundamental duties in general and in particular with engineering field. TLO 2.3 Identify situations where directive principles prevail over fundamental rights.	**Unit - II Fundamental Rights and Directive Principles** 2.1 Fundamental Rights under Part-III. 2.2 Fundamental duties and their significance under part-IV-A. 2.3 Relevance of Directive Principles of State Policy under part-IV A.	Presentations Blogs Hand-outs Modules Case Study Flipped Classroom

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Enlist the constitutional amendments. TLO 3.2 Elaborate the elements of Centre-State Relationship TLO 3.3 Analyze the purposes of various amendments.	**Unit - III Governance and Amendments** 3.1 3.1 Amendment procedure of the Constitution and their types - simple and special procedures. 3.2 The Principle of Federalism and its contemporary significance along with special committees that were setup. 3.3 Major Constitutional Amendment procedure - 1st, 7th, 42nd, 44th, 73rd & 74th, 76th, 86th, 52nd & 91st, 102nd	Cases of Federal disputes with relevant Supreme court powers and Judgements Presentations Blogs Hand-outs Problem based learning
4	TLO 4.1 Explain the importance of electoral rights. TLO 4.2 Write the step by step procedure for process of registration TLO 4.3 Explain the significance of Ethical electoral participation TLO 4.4 Explain the steps to motivation and facilitation for electoral participation TLO 4.5 Enlist the features of the voter's guide TLO 4.6 Explain the role of empowered voter TLO 4.7 Write the steps of voting procedure TLO 4.8 Write steps to create voter awareness TLO 4.9 Fill the online voter registration form TLO TLO 4.10 Follow procedure to cast vote using voter-id.	**Unit - IV Electoral Literacy and Voter's Education** 4.1 Electoral rights , Electoral process of registration 4.2 Ethical electoral participation 4.3 Motivation and facilitation for electoral participation 4.4 Voter's guide 4.5 Prospective empowered voter 4.6 Voting procedure 4.7 Voter awareness 4.8 Voter online registration https:/ /www.ceodelhi.gov.in/ELCdetails.aspx	Presentations Hand-outs Modules Blogs Problem based Learning

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Outline the procedure to submit application for Voter-id
- Assignments are to be provided by the course teacher in line with the targeted COs.

A1. Prepare an essay on Constitution of India .
A2 Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA

- Assignments are to be provided by the course teacher in line with the targeted COs. A1. Prepare an essay on Constitution of India . A2 Prepare a comparative chart of Unique features of Indian Constitution of India and Constitution of USA A3. Self-learning topics: Parts of the constitution and a brief discussion of each part Right to education and girl enrollment in schools. GER of Girls and Boys. Right to equality. Social Democracy. Women Representation in Parliament and State Assemblies. LGBTQIA+

Micro project

- 1. Organize a workshop-cum discussions for spreading awareness regarding Fundamental Rights of the citizen of the country

2. Prepare elaborations where directive principle of State policy has prevailed over Fundamental rights with relevant Supreme Court Judgements.
3. Organize a debate on 42nd, 97th and 103rd Constitutional Amendment Acts of Constitution of India.

Seminar

- 1 Differences in the ideals of Social democracy and Political democracy.

2 Democracy and Women's Political Participation in India.
3 Khap Panchayat - an unconstitutional institution infringing upon Constitutional ethos.
4 Situations where directive principles prevail over fundamental rights.

Group discussions on current print articles.

-

- Art 356 and its working in Post-Independent India.
- Women's Resrvation in Panchayat leading to Pati Panchayats - Problems and Solutions.
- Adoption of Article 365 in India.
- Need of Amendments in the constitution.
- Is India moving towards a Unitary State Model ?

Activity

- Arrange Mock Parliament debates.

Prepare collage/posters on current constitutional issues.
i. National (Art 352) & State Emergencies (Art 356) declared in India.
ii. Seven fundamental rights.
iii. Land Reforms and its effectiveness - Case study of West-Bengal and Kerala.

Cases: Suggestive cases for usage in teaching:

- A.K. Gopalan Case (1950) :SC contented that there was no violation of Fundamental Rights enshrined in Articles 13, 19, 21 and 22 under the provisions of the Preventive Detention Act, if the detention was as per the procedure established by law. Here, the SC took a narrow view of Article 21.

Shankari Prasad Case (1951) : This case dealt with the amendability of Fundamental Rights (the First Amendment's validity was challenged). The SC contended that the Parliament's power to amend under Article 368 also includes the power to amend the Fundamental Rights guaranteed in Part III of the Constitution.
Minerva Mills case (1980) :This case again strengthens the Basic Structure doctrine. The judgement struck down 2 changes made to the Constitution by the 42nd Amendment Act 1976, declaring them to violate the basic structure. The judgement makes it clear that the Constitution, and not the Parliament is supreme.
Maneka Gandhi case (1978) :A main issue in this case was whether the right to go abroad is a part of the Right to Personal Liberty under Article 21. The SC held that it is included in the Right to Personal Liberty. The SC also ruled that the mere existence of an enabling law was not enough to restrain personal liberty. Such a law must also be "just, fair and reasonable."
Other cases:
1. Kesavananda Bharati Case (1973) : In this case the Hon. SC laid down a new doctrine of the 'basic structure' (or 'basic features') of the Constitution. It ruled that the constituent power of Parliament under Article 368 does not enable it to alter the 'basic structure' of the Constitution. This means that the Parliament cannot abridge or take away a Fundamental Right that forms a part of the 'basic structure' of the Constitution.
2. Mathura Rape Case(1979) : A tribal woman Mathura (aged 14 to 16 years) was raped in Police Custody. The case raised the questions on the idea of 'Modesty of Woman' and here it was was a tribal woman who succumbs to multiple pattiarchies. Custodial rape was made an offence and was culpable with the detainment of 7 years or more under Section 376 of Indian Penal Code. The weight of proofing the allegations moved from the victim to the offender, once sexual intercourse is established. The publication of the victim's identity was banned and it was also held that rape trials should be conducted under the cameras.
3. Puttswamy vs Union of India (2017) : In this landmark case which was finally pronounced by a 9-judge bench of the Supreme Court on 24th August 2017, upholding the fundamental right to privacy emanating from Article 21. The court stated that Right to Privacy is an inherent and integral part of Part III of the Constitution that guarantees

fundamental rights. The conflict in this area mainly arises between an individual's right to privacy and the legitimate aim of the government to implement its policies and a balance needs to be maintained while doing the same.

4. Navtej Singh Johar & Ors. v. Union of India (2018) : Hon. SC Decriminalised all consensual sex among adults, including homosexual sex by scrapping down section 377 of the Indian penal code (IPC). The court ruled that LGBTQ community are equal citizens and underlined that there cannot be discrimination in law based on sexual orientation and gender.

5. Anuradha Bhasin Judgement (2020) : The Supreme Court of India ruled that an indefinite suspension of internet services would be illegal under Indian law and that orders for internet shutdown must satisfy the tests of necessity and proportionality. The Court reiterated that freedom of expression online enjoyed Constitutional protection, but could be restricted in the name of national security. The Court held that though the Government was empowered to impose a complete internet shutdown, any order(s) imposing such restrictions had to be made public and was subject to judicial review.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED : NOT APPLICABLE

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Constitution and Preamble	CO1	4	0	0	0	0
2	II	Fundamental Rights and Directive Principles	CO2	4	0	0	0	0
3	III	Governance and Amendments	CO3	4	0	0	0	0
4	IV	Electoral Literacy and Voter's Education	CO4	3	0	0	0	0
Grand Total				**15**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Assignment, Self-learning and Terms work Seminar/Presentation

Summative Assessment (Assessment of Learning)

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	1	-	-	-	2	-	-			
CO2	1	-	-	-	2	-	-			
CO3	1	2	-	-	2	-	1			
CO4	-	-	-	1	-	-	-			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	P.M.Bakshi	The Constitution of India	Universal Law Publishing, New Delhi 15th edition, 2018, ISBN: 9386515105 (Check the new edition)
2	D.D.Basu	Introduction to Indian Constitution	Lexis Nexis Publisher, New Delhi, 2015, ISBN:935143446X
3	B. K. Sharma	Introduction to Constitution of India	PHI, New Delhi, 6thedition, 2011, ISBN:8120344197
4	MORE READS :	Oxford Short Introductions - The Indian Constitution by Madhav Khosla. The Indian Constitution: Cornerstone of a Nation by Granville Austin. Working a Democratic Constitution: A History by Garnville Austin Founding Mothers of the Indian Republic: Gender Politics of the Framing of the Constitution by Achyut Chetan. Our Parliament by Subhash C. Kashyap. Our Political System by Subhash C. Kashyap. Our Constitution by Subhash C. Kashyap. Indian Constitutional Law by Rumi Pal.	Extra Read
5	B.L. Fadia	The Constitution of India	Sahitya Bhawan,Agra, 2017, ISBN:8193413768

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.legislative.gov.in/constitution-of-india	Constitution overview
2	https://en.wikipedia.org/wiki/Constitution_of_India	Parts of constitution
3	https://www.india.gov.in/my-government/constitution-india	Constitution overview
4	https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/	Fundamental rights and duties
5	https://main.sci.gov.in/constitution	Directive principles
6	https://legalaffairs.gov.in/sites/default/files/chapter%203.pdf	Parts of constitution

Sr.No	Link / Portal	Description
7	https://www.concourt.am/armenian/legal_resources/world_constitutions/constit/india/india-e.htm	Parts of constitution
8	https://constitutionnet.org/vl/item/basic-structure-indian-constitution	Parts of constitution

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s	**: Architecture Assistantship/ Automobile Engineering./ Architecture/ Interior Design & Decoration/ Interior Design/ Mechanical Engineering/ Mechatronics/ Production Engineering/**
Programme Code	**: AA/ AE/ AT/ IX/ IZ/ ME/ MK/ PG**
Semester	**: Third / Fourth / Fifth**
Course Title	**: FUNDAMENTALS OF PYTHON PROGRAMMING**
Course Code	**: 313007**

I. RATIONALE

Comprehension of programming languages is crucial for diploma engineering graduates, especially as they engage with various software applications in the mechanical engineering domain. Python, being easy to code, potent, and stands out as an ideal language for introducing computing and problem-solving concepts to beginners. This course enables students to write Python programs and utilize various built-in functions/methods of Python modules/libraries to solve specific problems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

An ability to prepare python programs for solving simple engineering problems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Use program designing tools and IDE for python.
- CO2 - Employ python building blocks and data types in the programming.
- CO3 - Implement conditional and looping statements in the python programming.
- CO4 - Implement bult in functions and modules in the python programming.
- CO5 - Use NumPy for performing operations on list and array.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313007	FUNDAMENTALS OF PYTHON PROGRAMMING	FPP	AEC	-	-	2	-	2	1	-	-	-	-	-	25	10	25@	10	-	-	50

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the functions of different components of computers and peripherals. TLO 1.2 List the applications of computers in the domain of Mechanical Engineering. TLO 1.3 Create flow chart of given programming problem. TLO 1.4 Describe the given feature of Python programming language.	**Unit - I Introduction to Python Programming** 1.1 Revision of Computer Components (CPU, I/O devices) 1.2 Applications of computer and programming languages in Mechanical engineering domain. 1.3 Program Designing Tools: Algorithm, Flow Chart. 1.4 Introduction and Features of Python: Open source, Interactive, Interpreted, Object-oriented, Platform independent etc., Installation & working of IDEs.	Presentations Hands-on
2	TLO 2.1 Use different Python building blocks. TLO 2.2 Describe different data types of Python programming. TLO 2.3 Differentiate normal and container data types of Python programming language. TLO 2.4 Write simple Python programs by taking the user's input to solve expressions.	**Unit - II Python building blocks & data types** 2.1 Python building blocks: Identifiers, Indentation, Comments, Variables, Arithmetic and assignment operators and Expressions. 2.2 Data Types: Integers, float, complex, string and their declaration, data type conversion. 2.3 Accepting input from user: I/O functions. 2.4 Container Types: List, tuple, set and their declaration. 2.5 Write simple python program to display "Welcome" message.	Presentations Hands-on
3	TLO 3.1 Use basic relational and logical operators in python programs. TLO 3.2 Employ decision control statements in python programs. TLO 3.3 Employ looping statements in python programs.	**Unit - III Python operators and Control flow** 3.1 Relational and Logical operators. 3.2 Decision making statements: if, if-else, if- elif - else statements. 3.3 Looping statements: while loop, for loop, Nested loops. 3.4 Loop manipulation using continue, pass, break statements.	Demonstration Hands-on
4	TLO 4.1 Use built-in functions in Python programs. TLO 4.2 Use built-in modules in Python programs. TLO 4.3 Develop user-defined functions in Python for the given purpose.	**Unit - IV Python functions and modules** 4.1 Functions: Use of built-in functions, data conversion functions, abs, pow, min, max, round, ceil, floor etc. 4.2 Modules: Use of built-in modules- math cmath, random and statistics. 4.3 User-defined function: Function definition, function calling, function arguments and parameter passing, Return statement, scope of variables.	Demonstration Hands-on
5	TLO 5.1 Manipulate the given list. TLO 5.2 Perform different operations on list. TLO 5.3 Use NumPy arrays for faster operations.	**Unit - V List and arrays in python** 5.1 List: define list (one and multi-dimension), accessing, deleting and updating values in list. 5.2 Basic list operations: slicing, repeating, concatenation and iteration. 5.3 NumPy array: Generate NumPy arrays and construct multidimensional arrays.	Demonstration Hands-on

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Install python IDE. LLO 1.2 Explore the IDE's settings and preferences.	1	Install Python IDE.	2	CO1
LLO 2.1 Draw flow chart for the given problem. LLO 2.2 Write algorithm for the given problem.	2	*Prepare a flow chart and algorithm for simple problem.	2	CO1
LLO 3.1 Use print function to display the message.	3	Write a simple program to display a simple message. (Ex: “Welcome to Python programming”)	2	CO2
LLO 4.1 Write and execute a python program to solve a given expression.	4	Write a simple Python program by taking user’s input to - - find the area of rectangle - find the area or circle.	2	CO2
LLO 5.1 Write and execute a python program.	5	*Write a program to accept value of Celsius and convert it to Fahrenheit.	2	CO2
LLO 6.1 Use the if - else statement in the python program.	6	Write a python program to find whether the given number is even or odd using if - else statement.	2	CO3
LLO 7.1 Implement the if-elif-else statement in the python program.	7	*Write a python program to check whether a input number is positive, negative or zero using if – elif-else statement.	2	CO3
LLO 8.1 Use appropriate decision-making control statement to solve the given problem.	8	Write a program to accept the three sides of a triangle to check whether the triangle is isosceles, equilateral, right angled triangle.	2	CO3
LLO 9.1 Identify suitable loop and conditional statement for the problem. LLO 9.2 Inscribe the loop and conditional statement in the python program.	9	Write a program that allows the user to input numbers until they choose to stop, and then displays the count of positive, negative, and zero numbers entered (Use while loop).	2	CO3
LLO 10.1 Identify suitable looping statement for multiplication table. LLO 10.2 Implement the for loop for the multiplication table.	10	*Write a python program for printing multiplication table of a given number using for loop. (Ex. 12x1=12 12x2=24 …. 12x10=120)	2	CO3
LLO 11.1 Identify a suitable module for importing a given function. LLO 11.2 Use various mathematical functions available in cmath module.	11	*Write a Python program to demonstrate the use of different mathematical functions (Ex. ceiling, floor etc).	2	CO4
LLO 12.1 Use various functions available in statistics module.	12	*Write a python program to find mean, mode, median and standard deviation using statistics module.	2	CO4
LLO 13.1 Use list data type of Python.	13	Write a python program utilizing a list to display the name of a month based on a given month number.	2	CO5
LLO 14.1 Write programs using Multidimensional list in Python.	14	Write a python program to add or subtract two matrices using multidimensional list.	2	CO5
LLO 15.1 Write programs using Multidimensional list in Python.	15	*Write a python program to multiply two matrices using multidimensional list.	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 16.1 Perform metrics operation using NumPy Module	16	*Write a python program to multiply two matrices using NumPy.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Not Applicable

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer System with all necessary peripherals and internet connectivity.	All
2	Any relevant python IDE like IDLE/PyCharm/VSCode/Jupiter Notebook/Online Python Compiler.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table) : NOT APPLICABLE

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term Work

Summative Assessment (Assessment of Learning)

- Practical

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	2	3	-	-	2			
CO2	2	2	2	3	-	-	2			
CO3	2	2	2	3	-	-	2			
CO4	2	2	2	3	-	-	2			
CO5	2	2	2	3	-	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Kenneth A. Lambert	Fundamentals of Python : First Programs , 2E	Cengage Learning India Private Limited, ISBN: 9789353502898
2	Yashavant Kanetkar, Aditya Kanetkar	Let Us Python - 6th Edition	BPB Publications, ISBN: 9789355515414

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.w3schools.com/python/	Python Programming
2	https://www.tutorialspoint.com/python/index.htm	Python Programming
3	https://www.python.org/	Python Programming
4	https://spoken-tutorial.org/tutorial-search/?search_foss=Pyt	Python Programming

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