Maharashtra State Board Of Technical Education, Mumbai

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

Programme Name	: Diploma In Mechanical Engineering	
Programme Code	: ME	**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.	Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week	Credits	Paper Duration (hrs.)	Theory				Based on LL & TL				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	STRENGTH OF MATERIALS	SOM	DSC	313308	1	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125
2	FLUID MECHANICS AND MACHINERY	FMM	DSC	313309	1	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175
3	THERMAL ENGINEERING	TEG	DSC	313310	-	3	-	2	1	6	3	3	30	70	100	40	25	10	25@	10	25	10	175
4	PRODUCTION DRAWING	PDR	SEC	313311	-	2	-	4	2	8	4	4	30	70	100	40	25	10	25@	10	25	10	175
5	BASIC ELECTRICAL AND ELECTRONICS	BEE	AEC	312020	-	2	-	4	-	6	3	-	-	-	-	-	50	20	50@	20	-	-	100
6	ESSENCE OF INDIAN CONSTITUTION	EIC	VEC	313002	-	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-	50	20	50
7	COMPUTER AIDED DRAFTING	CAD	SEC	313006	-	-	-	4	-	4	2	-	-	-	-	-	25	10	25#	10	-	-	50
8	FUNDAMENTALS OF PYTHON PROGRAMMING	FPP	AEC	313007	-	-	-	2	-	2	1	-	-	-	-	-	25	10	25@	10	-	-	50
	Total				**2**	**15**		**20**	**5**		**20**		**120**	**280**	**400**		**200**		**175**		**125**		**900**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week	Credits	Paper Duration (hrs.)	Theory			Based on LL & TL				Based on Self Learning		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	

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	: Automobile Engineering./ Agricultural Engineering/ Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Production Engineering/
Programme Code	: AE/ AL/ CE/ CR/ CS/ LE/ ME/ PG
Semester	: Third
Course Title	: STRENGTH OF MATERIALS
Course Code	: 313308

I. RATIONALE

All civil & mechanical engineering components are subjected to different types of loads and behave in a specific way. Students can able to understand & analyze various types of loads, stresses & strains with regards to the structural behavior of components and materials. This course is a prerequisite for understanding elastic behavior of different engineering materials, structural analysis, machine design, principles and the strengths of various structural elements used in civil & mechanical industries.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Analyze the stresses & strains in the given structural elements using relevant methods.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Calculate the M.I. of the given object using relevant formulae & methods.
- CO2 - Analyze the structural behavior of the given structural components under various loading conditions.
- CO3 - Draw SFD and BMD for the given structural element under given loading conditions.
- CO4 - Determine the bending and shear stresses in beams under different loading conditions
- CO5 - Analyze the direct & bending stresses in the structural members under eccentric loading conditions.

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	
313308	STRENGTH OF MATERIALS	SOM	DSC	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125

STRENGTH OF MATERIALS   **Course Code : 313308**

Total IKS Hrs for Sem. : 1 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 Calculate Centroid, Moment of Inertia of Plane lamina and radius of gyration of a given lamina. TLO 1.2 Explain Parallel and Perpendicular axes theorems. TLO 1.3 Calculate Moment of inertia of standard solid shapes and hollow shapes. TLO 1.4 Calculate Moment of inertia of composite plane figures such as I, C, T & L sections. TLO 1.5 Understand Moment of inertia for built-up section.	**Unit - I Moment of Inertia** 1.1 Concept of Moment of Inertia, M.I. of plane lamina and radius of gyration of a given lamina. 1.2 Parallel and perpendicular axes theorems (without derivation). 1.3 M.I. of standard basic figures like square, rectangle, triangle, circle, semi-circle, quarter-circle and Hollow Rectangular & Circular sections. (without derivation). 1.4 M.I. of Composite plane figures such as symmetrical and unsymmetrical I-section, channel section, T-section, angle section. Numerical on composite figure consisting of maximum 03 standard shapes. 1.5 Introduction to M.I. for built-up sections. (No numerical). (IKS* Concept of Centre of Gravity & M.I.used in ancient constructions like temples, forts etc.)	Chalk-Board Hands-on Collaborative learning Video Demonstrations Presentations

STRENGTH OF MATERIALS   **Course Code : 313308**

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.
2	TLO 2.1 Understand concept of stresses and strains in deformable bodies. TLO 2.2 Understand Hook's law, elastic limit, Linear and lateral strain, Poisson's ratio. TLO 2.3 Determine modulus of elasticity, modulus of rigidity and bulk modulus for given material. TLO 2.4 Articulate practical significance of stress- strain curve for given material under given loading conditions for their relevant use. TLO 2.5 Concept of single shear, double shear & punching shear. TLO 2.6 Compute the total deformation for given homogeneous (compound) sections under axial load. TLO 2.7 Determine the stresses in each material for given composite section. TLO 2.8 Compute strain along x, y and z-direction for a given bi-axial or tri-axial stress system. TLO 2.9 Determine volumetric strain & change in volume for given cube or cuboid.	**Unit - II Simple Stresses, Strains & Elastic Constants** 2.1 Concept of elastic body ,definition of stress, strain, Type of stresses & strains. 2.2 Hook's law, elastic limit, Linear and lateral strain, Poisson's ratio. 2.3 Young's Modulus, Shear Modulus, Bulk Modulus & Relation between these three moduli. 2.4 Standard stress strain curve for mild steel bar and Tor steel bar under tension test, Yield stress, proof stress, ultimate stress, breaking stress, and working stress, strain at various critical points, percentage elongation and Factor of safety. 2.5 Shear stress and shear strain, Single shear, Double shear, Punching shear. 2.6 Deformation of body subjected to axial force for uniformed and stepped sections .Deformation of uniform body subjected to forces at its intermediate sections. 2.7 Concept of composite section, stresses induced and load shared by each material under axial loading only.(No numerical on stepped sections). 2.8 Uni-axial, Bi-axial and Tri-axial stress systems. 2.9 Strain in each direction, volumetric strain, change in volume.	- Chalk-Board - Hands-on Collaborative learning - Video - Demonstrations - Presentations
3	TLO 3.1 Enlist Types of Supports & Types of Beams TLO 3.2 Enlist types of loads acting on a beam. TLO 3.3 Understand the relation between SF, BM and rate of loading. TLO 3.4 Draw SFD and BMD for Simply supported beams ,Cantilever beams & overhanging beams. TLO 3.5 Locate point of maximum BM and point of contra-flexure.	**Unit - III Shear Force & Bending Moment** 3.1 Types of Supports: Simple, Hinge, Roller & Fixed and Beams: Cantilever, Simply supported, Roller, Hinge & overhanging beams. 3.2 Types of loads: Concentrated or Point load, Inclined point load & Uniformly Distributed load. 3.3 Meaning of SF and BM, Relation between them, Sign conventions. 3.4 SFD & BMD for Simply Supported, Cantilever and overhanging beams subjected to Vertical point load & UDL only. 3.5 Drawing SFD and BMD, Location of Point of Contra-Shear, maximum BM, Location of Point of Contra-flexure.	Chalk-Board Hands-on Collaborative learning Video Demonstrations Presentations

MSBTE Approval Dt. 02/07/2024   **Semester - 3, K Scheme**

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 Understand concept of pure bending , Neutral Axis and radius of gyration of a given lamina and section modulus. TLO 4.2 Determine Moment of Resistance (M.R.) & section modulus (Z) using Flexural Formula. TLO 4.3 Determine the Bending stresses at given location in simply supported & cantilever beams subjected to standard loading cases (Point load & UDL only). TLO 4.4 Compute & draw maximum and average shear stress for rectangular and circular section. TLO 4.5 Draw shear stress distribution diagram for given section across its depth. TLO 4.6 Determine shear stresses in hollow rectangular section.	**Unit - IV Bending and Shear Stresses in beams** 4.1 Theory of pure bending, assumptions in pure bending, Concept of Neutral Axis and section modulus. 4.2 Flexural Equation (without derivation) with meaning of each term used in equation, bending stresses and their nature, bending stress distribution diagram. 4.3 Bending stress variation diagram across depth of given cross section for cantilever and simply supported beams for symmetrical sections only. 4.4 Shear stress equation (without derivation), meaning of each term used in equation, relation between maximum and average shear stress for square, rectangular and circular section (numerical), shear stress distribution diagram. 4.5 Shear stress distribution diagram for square, rectangular, circle, hollow square, hollow rectangular, hollow circle, T- section & symmetrical I- section only. (no numericals) 4.6 Use of shear stress equation for determination of shear stresses in hollow rectangular section.	Chalk-Board Hands-on Collaborative Learning Demonstration Video Presentations
5	TLO 5.1 Explain effect of direct and eccentric loads on columns. TLO 5.2 Draw resultant stress distribution diagram for a compression member subjected to eccentric load about one of its principal axis. TLO 5.3 Write No tension condition for columns, Core of the section for rectangular & circular column. TLO 5.4 Identify the terms radius of gyration, slenderness ratio & effective length for given column with different end conditions. TLO 5.5 Understand the concept of buckling load in columns using Euler's Formula & Rankine's Formula.	**Unit - V Direct and Bending Stresses** 5.1 Introduction to direct and eccentric loads, Eccentricity about one principal axis, nature of stresses. 5.2 Maximum and minimum stresses, resultant stress distribution diagram. Condition for 'No tension' condition(Problems on Column subjected to Eccentric load about one axis only.) 5.3 Limit of eccentricity, core of section for circular cross sections, middle third rule for rectangular section. 5.4 Introduction to compression members, effective length, radius of gyration, slenderness ratio, type of end conditions for columns. 5.5 Buckling (or Crippling) load for columns by Euler's Formula & Rankine's Formula with meaning of each term in it.(No numericals.)	Chalk-Board Collaborative learning Presentations Demonstration Videos

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 different components of UTM .	1	*Conduct sample compressive and tensile tests on metal using Universal Testing Machine along with introduction to machine & other tests to be conducted on UTM.	2	CO2
LLO 2.1 Perform Tension test on mild steel as per IS:432(1) .	2	*Tension test on mild steel as per IS:432(1) .	2	CO2
LLO 3.1 Perform tension test on Tor steel as per IS:1608, IS:1139 .	3	Tension test on Tor steel as per IS:1608, IS:1139 .	2	CO2

STRENGTH OF MATERIALS   **Course Code : 313308**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Conduct compression test on sample test piece using Compression Testing Machine .	4	*Compression test on any two metals like Mild Steel, Brass, Al etc. using Compression Testing Machine .	2	CO2
LLO 5.1 Conduct Izod Impact test on given metals as per IS:1598 .	5	*Izod Impact test on any two metals like mild steel/ brass/aluminum/ copper /cast iron etc. as per IS:1598 .	2	CO2
LLO 6.1 Conduct Charpy Impact test on given metals as per IS:1598 .	6	Charpy Impact test on two metals like mild steel/ brass/aluminum/ copper /cast iron etc. as per IS:1757 .	2	CO2
LLO 7.1 Determine Compressive strength of dry and wet bricks .	7	Compressive strength of dry and wet bricks as per IS:3495 (part I), IS:1077 .	2	CO2
LLO 8.1 Perform Single Shear and double shear test on given metals as per IS:5242 .	8	*Single Shear and double shear test on any two metals like Mild steel/ brass/ Al / copper / cast iron etc. as per IS:5242 .	2	CO2 CO4
LLO 9.1 Conduct Compression test on timber section along the grain and across the grain .	9	Compression test on timber section along the grain and across the grain as per IS:2408 .	2	CO1 CO2
LLO 10.1 Plot Shear force and Bending Moment diagrams of beams subjected to different types of loads.	10	*Shear force and Bending Moment diagrams of cantilever, simply supported and overhanging beams for different types of loading . (02 problems on each type of beam) .	4	CO3
LLO 11.1 Conduct Flexural test on timber beam on rectangular section.	11	*Flexural test on timber beam on rectangular section in both orientations as per IS:1708, IS:2408 .	2	CO1 CO4
LLO 12.1 Prepare PPT on Strain Energy. LLO 12.2 Prepare PPT on Thermal Stresses & Thermal Strains.	12	a) Prepare PPT of minimum 05 slides on the concept of Strain Energy & instantaneous stress induced in a material due to gradual, Sudden & impact load. b) Prepare PPT of minimum 04 slides on Thermal Stresses & Thermal Strains.	2	CO2
LLO 13.1 Conduct Flexure test on floor tiles/roofing tiles.	13	Flexure test on floor tiles IS:1237, IS:13630 or roofing tiles as per IS:654, IS:2690 .	2	CO4
LLO 14.1 Determine hardness no. for given metal using Rockwell Hardness Tester.	14	Rockwell Hardness Test on any two Metals like Mild Steel, Brass Copper, Aluminum etc.	2	CO2
LLO 15.1 Determine hardness no for given metals using Brinell Hardness Tester.	15	Brinell hardens test on any two metals like Mild Steel, Brass Copper, Aluminum etc.	2	CO2

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 information of Indian Knowledge System (IKS) given in different units.
- Prepare charts of maximum bending moment and shear force values in standard beams.
- Two Numericals on Chimneys (of rectangular and circular cross section) subjected to wind pressure & also draw stress distribution diagram at base of it.

• Draw & identify difference between Bending stress distribution & Shear stress distribution diagrams for square, rectangular, circle, hollow square, rectangular, circle, T- section, & symmetrical I- section.

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	Extensometer with least count 0.01mm, maximum extension 25 mm with dial gauge/ digital display suitable for various gauge length.	1,2,3
2	Accessories: Vernier caliper, meter scale, weighing balance, weights, punch, file, hammer, screw driver, pliers, etc.	1,2,3,4,5,6,7,8,9,11,13
3	Universal Testing Machine of capacity 1000kN, 600 kN / 400 kN, analog type/digital type with all attachments and accessories.	1,2,3,8,11,13
4	Tile flexural testing machine confirming to IS:654, capacity 200 Kg with uniform loading rate of 45 to 55 Kg/minute provided with lead shots .	13
5	Brinell and Rockwell Hardness Test machine .	14,15
6	Compression Testing Machine of capacity 2000 kN / 1000 kN, analog / digital type with all attachments and accessories.	4,7,9
7	Izod/Charpy impact testing machine confirming to IS: 1757.	5,6
8	Hot Air Oven with thermostatic control having temp. range 100 to 105 degree celsius .	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	Moment of Inertia	CO1	10	2	4	6	12
2	II	Simple Stresses, Strains & Elastic Constants	CO2	16	6	8	4	18
3	III	Shear Force & Bending Moment	CO3	14	2	4	10	16
4	IV	Bending and Shear Stresses in beams	CO4	10	2	4	6	12
5	V	Direct and Bending Stresses	CO5	10	2	4	6	12
		Grand Total		**60**	**14**	**24**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

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

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STRENGTH OF MATERIALS   **Course Code : 313308**

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test)

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	3	2	2	1	--	2			
CO2	3	3	3	3	1	--	3			
CO3	3	3	2	1	1	--	2			
CO4	3	3	2	1	1	---	2			
CO5	3	3	2	1	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	Khurmi R.S., Khurmi N.	A Textbook of Strength of Materials	S. Chand and Co. Ltd. New Delhi, 2019, ISBN 9789352833979
2	Ramamrutham S.	Strength of Materials	Dhanpat Rai and sons, New Delhi, 2015, ISBN 9788187433545
3	Punmia B. C., Ashok Kumar Jain , Arun Kumar Jain .	Mechanics of Materials	Laxmi Publications (p) Ltd. New Delhi, 2017, ISBN-13: 978-8131806463
4	Rattan S.S.	Strength of Materials	McGraw Hill Education; New Delhi 2017, ISBN-13: 978-9385965517
5	Rajput R. K .	A Textbook of Strength of Materials	S. Chand Publishing 9789352533695, 9352533690

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/DzyIEz3dKXQ?si=beGDRqJ1olZ70LUe	Concept of Stress and Strain .
2	https://youtu.be/RSlmDKHDMUY?si=FHCxXE1QSaa0FqBn	Standard stress-strain curve for mild steel bar and Tor steel bar .
3	https://www.youtube.com/watch?v=MFZ18Ed4HI8	Field Test on TMT .
4	https://www.youtube.com/watch?v=C-FEVzI8oe8	Concept of SFD and BMD .
5	https://www.youtube.com/watch?v=yvbA4mk36Kk	Practical examples of SFD and BMD.
6	https://www.youtube.com/watch?v=f2eGwNUopws	Concept & Numerical on Point of Contraflexure .
7	https://www.youtube.com/watch?v=f08Y39UiC-o	Bending Stresses & Shear Stresses in Beams .
8	https://skyciv.com/structural-software/beam-analysis-software	Calculation & Drawing of SFD & BMD freeware Software .

Sr.No	Link / Portal	Description
Note :		

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

FLUID MECHANICS AND MACHINERY | **Course Code : 313309**

Programme Name/s	**: Mechanical Engineering**
Programme Code	**: ME**
Semester	**: Third**
Course Title	**: FLUID MECHANICS AND MACHINERY**
Course Code	**: 313309**

I. RATIONALE

The knowledge of fluid properties, fluid flow & fluid machinery is essential in many fields of engineering like in power generation, irrigation, water supply, etc. This course aims to develop the skills that will enable the students to select appropriate hydraulic devices and machines like pressure gauges, flow measuring devices, pipes, pumps, turbines, etc. for a particular application.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

This course will enable the students to Select appropriate hydraulic machine(s) based on its application for efficient functioning

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Determine different properties of fluid and pressure measurements
- CO2 - Apply Bernoulli's theorem to various flow measuring devices.
- CO3 - Calculate the various losses in flow through pipes
- CO4 - Select suitable hydraulic turbine and pump for the given application
- CO5 - Evaluate the performance of hydraulic turbines and pumps

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH			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		
313309	FLUID MECHANICS AND MACHINERY	FMM	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10		175

MSBTE Approval Dt. 02/07/2024 | **Semester - 3, K Scheme**

Total IKS Hrs for Sem. : 1 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 various properties of fluids TLO 1.2 Explain different types of fluids TLO 1.3 Compare given fluids based on the required physical properties TLO 1.4 Calculate pressure head using manometer. TLO 1.5 Calculate fluid pressure, total pressure and center of pressure on given immersed body for given position in specified liquid	**Unit - I Properties of Fluid and Fluid Pressure Measurement** 1.1 Properties of Fluid: Density, Specific gravity, Specific volume, Specific Weight, Dynamic viscosity, Kinematic viscosity, Surface tension, Capillarity, Vapor Pressure, Compressibility, Types of fluids, Simple numerical on properties of fluids 1.2 Fluid Pressure: Fluid pressure, Pressure head, Pressure intensity, Pascal's law, Concept of absolute vacuum, gauge pressure, atmospheric pressure, absolute pressure, Different units of pressure and their inter-relation, Simple numerical 1.3 Fluid Pressure Measurement Devices: Construction and working principle of piezometer, simple U-tube manometer and differential U-tube manometers, Numerical on above manometers, Construction and working principle of Bourdon tube pressure gauge 1.4 Hydrostatics: Total pressure, center of pressure- regular surface forces on immersed bodies in liquid in horizontal and vertical position, Simple Numerical	Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration

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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.
2	TLO 2.1 Classify different types of fluid flows TLO 2.2 Apply Continuity equation and Bernoulli's equation to the various flow measuring devices TLO 2.3 Describe procedure to calculate discharge using the given flow measuring device TLO 2.4 Calculate the flow rate using given flow measuring device	**Unit - II Fundamentals of Fluid Flow and Flow Measurement** 2.1 Types of Fluid Flows: steady, unsteady, uniform, non uniform, rotational, irrotational, 1-D, 2-D and 3-D flows, Laminar, turbulent, Concept of Reynold's number 2.2 Continuity equation, Bernoulli's theorem 2.3 Construction and working principle of Venturimeter, coefficient of discharge, simple numerical on it 2.4 Construction and working principle of Orifice meter, Hydraulic coefficients (Cd, Cc, Cv), simple numerical on it 2.5 Construction and working principle of Pitot Tube and numerical on it	Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration Hands-on
3	TLO 3.1 State laws of fluid friction for laminar and turbulent flow TLO 3.2 Calculate frictional losses using Darcy's equation and Chezy's equation TLO 3.3 Describe various minor losses in fluid flow TLO 3.4 Interpret hydraulic gradient line and total energy line TLO 3.5 Calculate hydraulic power transmission, hydraulic efficiency through pipes TLO 3.6 Describe water hammer phenomenon with remedial measures	**Unit - III Flow through Pipes** 3.1 Laws of fluid friction for laminar and turbulent flow 3.2 Darcy's equation and Chezy's equation for calculation of frictional losses, Numerical on above equations 3.3 Minor losses in fittings and valves (No numerical) 3.4 Hydraulic gradient line and total energy line 3.5 Hydraulic power transmission through pipes, Simple numerical 3.6 Water hammer phenomenon in pipes, causes and remedial measures	Lecture Using Chalk-Board Presentations Video Demonstrations Hands-on Role Play

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 Calculate the force exerted by a jet, work done and efficiency for the given vane condition TLO 4.2 Explain the working of hydroelectric power plant TLO 4.3 Explain the construction and working of given hydraulic turbine along with velocity diagrams TLO 4.4 Select the suitable hydraulic turbine for given application with justification TLO 4.5 Evaluate the performance of given hydraulic turbine	**Unit - IV Hydraulic Turbines** 4.1 Impact of jet on fixed vertical flat plate, moving vertical flat plate, curved vanes with special reference to turbines and pumps, Numerical on above conditions 4.2 Layout of hydroelectric power plant and function of each component, Water Storage systems used in Ancient India (IKS) 4.3 Classification of hydraulic turbines 4.4 Construction, working principle, velocity diagram and applications of Pelton wheel, Kaplan turbine and Francis turbine 4.5 Draft tubes: Types, Concept of cavitation in turbines 4.6 Calculation of Work done, Power output, efficiency of Pelton turbine only 4.7 Criteria for selection of hydraulic turbines and performance characteristics	Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration Case Study Hands-on
5	TLO 5.1 Describe the construction and working of different types of hydraulic pumps TLO 5.2 Select the suitable hydraulic pump for given application with justification TLO 5.3 Evaluate the performance of given hydraulic pump TLO 5.4 Apply the troubleshooting procedure to rectify identified fault in centrifugal pump TLO 5.5 Distinguish between centrifugal and reciprocating pump	**Unit - V Centrifugal and Reciprocating Pumps** 5.1 Centrifugal Pumps: Water lifting devices used in Ancient India (IKS), Classification, Construction and working principle of Centrifugal pump, Types of casings and impellers, Priming methods, Static head, Manometric head, NPSH, Work done, Manometric efficiency, Overall efficiency, Numerical on above parameters, Performance Characteristics of Centrifugal pumps, Troubleshooting, Construction, working and applications of multistage pump 5.2 Reciprocating Pump: Construction, working principle and applications of single and double acting reciprocating pumps, Slip, Negative slip, Cavitation and Separation, Use of air vessels, Indicator diagram with effect of acceleration head & frictional head, Pump selection criteria based on head and discharge (No numerical on reciprocating pumps)	Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration Case Study 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 Use Bourdon tube pressure gauge for pressure measurement LLO 1.2 Use U-tube Manometer for pressure measurement	1	*Measurement of water pressure by using Bourdon tube pressure gauge and U-tube Manometer	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Calculate discharge of water using a measuring tank and stopwatch	2	Measurement of discharge of water by using a measuring tank and stopwatch	2	CO2
LLO 3.1 Calculate total energy available at different sections of a pipe layout LLO 3.2 Verify Bernoulli's theorem	3	Measurement of total energy available at different sections of a pipe layout to verify Bernoulli's theorem	2	CO2
LLO 4.1 Apply Bernoulli's theorem to Venturimeter LLO 4.2 Measure discharge through pipe using Venturimeter	4	*Measurement of discharge through pipe using Venturimeter	2	CO2
LLO 5.1 Measure discharge using sharp edged circular orifice	5	Measurement of discharge through a pipe provided with sharp edged circular orifice	2	CO2
LLO 6.1 Apply Bernoulli's theorem to Orifice meter LLO 6.2 Measure discharge through pipe using orifice meter	6	Measurement of discharge through pipes using orifice meter	2	CO2
LLO 7.1 Calculate Reynolds number at given flow rate of water LLO 7.2 Interpret the type of flow based on calculated Reynolds number	7	Interpretation of the type of flow using Reynolds apparatus	2	CO2
LLO 8.1 Calculate Darcy's friction factor 'f' in pipe of different diameters LLO 8.2 Interpret effect of material and diameter of pipe, flow rate of water on Darcy's friction factor 'f'	8	*Calculation of Darcy's friction factor 'f' in pipes of different diameters for different discharges	2	CO3
LLO 9.1 Calculate minor frictional losses due to sudden expansion in a pipe LLO 9.2 Calculate minor frictional losses due to sudden contraction in a pipe	9	*Determination of minor frictional losses in sudden expansion and sudden contraction in a pipe	2	CO3
LLO 10.1 Calculate minor frictional losses due to bend provided in a pipe LLO 10.2 Calculate minor frictional losses due to elbow provided in a pipe	10	Determination of minor frictional losses in elbow and bend in a pipe	2	CO3
LLO 11.1 Calculate the force exerted by a jet on flat plate LLO 11.2 Calculate the work done by a jet on flat plate	11	Determination of the force exerted and work done by a jet on flat plate	2	CO5
LLO 12.1 Measure the power output of Pelton wheel at different flow rates LLO 12.2 Calculate overall efficiency of Pelton wheel LLO 12.3 Plot performance characteristics of Pelton wheel based on results	12	*Determination of overall efficiency of Pelton turbine using Pelton wheel test rig	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 13.1 Identify various components of centrifugal pump LLO 13.2 Assess the condition of various components of centrifugal pump LLO 13.3 Suggest remedial action to be taken	13	*Dismantling and Assembly of a Centrifugal pump	2	CO4
LLO 14.1 Measure the manometric head (Hm) at different flow rates LLO 14.2 Calculate overall efficiency of centrifugal pump LLO 14.3 Plot performance characteristics based on the results	14	*Determination of overall efficiency of Centrifugal pump using Centrifugal pump test rig	2	CO5
LLO 15.1 Identify various components of available reciprocating pump LLO 15.2 Assess the condition of various components of reciprocating pump LLO 15.3 Suggest remedial action to be taken	15	Dismantling and Assembly of a Reciprocating pump	2	CO4
LLO 16.1 Calculate overall efficiency of reciprocating pump LLO 16.2 Calculate percentage slip of reciprocating pump	16	*Determination of overall efficiency and percentage slip of Reciprocating pump using Reciprocating pump test rig	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)

Assignment

- Prepare a chart showing the various units of pressure and interrelation among them.

Micro project

- Prepare a detailed report based on locations and specifications of Pelton wheel/ Kaplan/ Francis/ any other turbine used in India or Abroad from the internet.
- Prepare a detailed report based on the range of products, manufacturer and technical specifications of Centrifugal/ reciprocating/ multistage pumps/ submersible pumps/any other pump from the local market or internet.
- Visit a hydroelectric power plant and prepare a report on layout of plant, components of plant and specifications of turbines used in the plant.

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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	Centrifugal pump test rig along with necessary pipe fittings and accessories comprising of: Centrifugal pump with motor: Variable speed, 2800 RPM Supply tank: 80 Ltrs. made of Mild steel with FRP lining Bourdon tube pressure gauge: Range-0-12 bar Venturimeter: 13 mm (Mild steel) U-tube manometer: Wall/ Stand mounted thick walled Borosilicate glass tube Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm Any other measuring device like rotameter/ flow meter of suitable specifications	1,2
2	Impact of jet test rig with necessary pipe fittings and accessories comprising of: Plexiglass cylindrical tank, 5 mm diameter nozzle, 8 mm diameter nozzle, impact object of flat shape having 30 mm diameter, Nozzle distance-impact object- 20 mm, Set of stainless steel weights Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	11
3	Pelton wheel test rig with necessary pipe fittings and accessories comprising of: Pelton wheel: Speed- 750-900 rpm, Output power- 3.7 kW (5 HP), Head- 45-50 m, Discharge- 700-900 LPM Centrifugal pump, Venturimeter, U-tube differential manometer, Water storage and supply arrangement as per requirement	12
4	Working model of centrifugal pump having technical Specifications: Power: 1HP (0.75 kW) Max. head: Up to 34 meters Max. discharge: Up to 2700 LPH OR Any other suitable centrifugal pump which can be dismantled and assembled using spanner set and tool kit	13

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
5	Centrifugal pump test rig with necessary pipe fittings and accessories comprising of: Centrifugal pump with motor: Variable speed, 2800 RPM Vacuum gauge Bourdon type: Range- 0-760 mm of Hg Pressure gauge Bourdon type: Range- 0-4 kg/cm2 Compound gauge Bourdon type: 760 mm of Hg to 2 kg/cm2 Supply tank: 80 Ltrs. made of Mild steel with FRP lining Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	14
6	Working model of reciprocating pump having technical Specifications: Reciprocating Pump: 1.02HP/0.8KW, 2900 RPM, Single phase OR Any other suitable centrifugal pump which can be dismantled and assembled using spanner set and tool kit	15
7	Reciprocating pump test rig with necessary pipe fittings and accessories comprising of: Reciprocating Pump: 1 HP, 700 RPM Motor: 1 HP, 1500 RPM Supply tank: 80 Ltrs. made of Mild steel with FRP lining Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Tachometer: 10-10,000 RPM, Accuracy- 0.5% Full scale Energy meter for motor input measurement Pressure & Vacuum gauge for measurement of head Dimmer to vary the speed Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	16
8	Bernoulli's theorem Test rig along with necessary pipe fittings and accessories comprising of: Pump with Motor: Mono-block pump- Single phase, 0.5 HP Differential Venturi of 300 mm length made out of Acrylic square bar Supply tank: 80 Ltrs. made of Mild steel with FRP lining Piezometer tubes: Range- 0 to 12 bar Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	3
9	Venturimeter and orifice meterTest Rig along with necessary pipe fittings and accessories comprising of: Centrifugal pump with motor: Variable speed, 2800 RPM Supply tank: 80 Ltrs. made of Mild steel with FRP lining Venturimeter: 13 mm (Mild steel) , Orifice meter of suitable specifications) U-tube manometer: Connected to pipe and throat of Venturimeter , connected to pipe and vena contracta of orifice meter Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	4,6

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
10	Sharp edged circular orifice test rig along with necessary pipe fittings and accessories comprising of: Centrifugal pump with motor of suitable specifications Supply tank: 80 Ltrs. made of Mild steel with FRP lining Sharp edged circular orifice of suitable specifications U-tube manometer: Connected to pipe and Orifice meter Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	5
11	Reynolds apparatus Test rig with necessary pipe fittings and accessories comprising of: Tube: Clear acrylic 800 mm Length, 32mm Outer Dia. and 25mm Inner Dia. Dye Vessel: Material Stainless Steel, 1 liter capacity Constant Head Tank: 300mm x 300mm x 450mm Measuring Tank: 300mm x 300mm x 300mm Supply Tank: 600mm x 300mm x 300mm Valves (Gunn Metal): 2 Nos. for Drain, 1 No. for Water Control, 1 No. for Bye pass Stop watch: Electronic with least count of 0.01 sec Pump: Single phase, 0.5 HP	7
12	Flow through pipe Test rig with necessary pipe fittings and accessories comprising of: Pipes: 03 nos. Made of GI ½", 1", 1.5" diameter or equivalent diameters and length 1m, 1.5m, 2m or equivalent length Large bend: Made of GI Sudden enlargement fitting of suitable size Sudden contraction fitting of suitable size Pump: 1HP Centrifugal pump Supply tank: 80 Ltrs. made of Mild steel with FRP lining U-tube manometer: Connected to pipe at required locations using plastic tubing Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Gate valves to regulate the flow of water Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	8,9,10

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	Properties of Fluid and Fluid Pressure Measurement	CO1	8	2	4	6	12
2	II	Fundamentals of Fluid Flow and Flow Measurement	CO2	6	2	4	4	10
3	III	Flow through Pipes	CO3	6	2	4	4	10
4	IV	Hydraulic Turbines	CO4,CO5	14	2	8	12	22
5	V	Centrifugal and Reciprocating Pumps	CO4,CO5	11	4	4	8	16
		Grand Total		**45**	**12**	**24**	**34**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

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Formative assessment (Assessment for Learning)

• Continuous assessment based on process and product related performance indicators. Each practical will be assessed considering
1) 60% weightage is to process
2) 40% weightage to product

Summative Assessment (Assessment of Learning)

• Continuous Assessment based on Process and Product related performance indicators. Each practical will be assessed considering
60% weightage to Process
40% weightage to Product

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	2	1	1	-	-	1			
CO4	3	2	2	-	1	-	2			
CO5	3	3	2	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	Er. R.K. Rajput	A Textbook of Fluid Mechanics and Hydraulic Machines	S. Chand and Company Pvt. Ltd., New Delhi ISBN: 9789385401374
2	Dr. R.K. Bansal	Fluid Mechanics and Hydraulic Machines	Laxmi Publications Pvt. Ltd., New Delhi ISBN: 9788131808153
3	Dr. P.N. Modi, Dr. S.M. Seth	Hydraulics and Fluid Mechanics including Hydraulic Machines	Standard Book House, New Delhi ISBN: 13: 9788189401269
4	S. Ramamrutham	Hydraulic, Fluid Mechanics and Fluid Machines	Dhanpat Rai Publishing Company (P) Ltd. ISBN: 9789384378271

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Sr.No	Author	Title	Publisher with ISBN Number
5	Victor Streeter, K.W. Bedford, E. Benjamin Wylie	Fluid Mechanics	McGraw-Hill Education ISBN: 9780070701403
6	K. Subramanya	Fluid Mechanics and hydraulic Machines: Problems and Solutions	Tata McGraw-Hill Co. Ltd., New Delhi ISBN: 9789353163426
7	R.S. Khurmi, N. Khurmi	A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines	S. Chand and Company Pvt. Ltd., New Delhi ISBN: 9788121901628
8	Som S.K., Biswas G.	Introduction to Fluid Mechanics and Fluid Machines	Tata McGraw-Hill Co. Ltd., New Delhi ISBN: 9780071329194
9	Dr. Jagdish Lal	Fluid Mechanics and Hydraulic Machines	Metropoliton ISBN: 9788120004221
10	C.S.P. Ojha, P.N. Chandramouli, and R. Berndtsson	Fluid Mechanics and Machinery	Oxford University Press, New Delhi ISBN: 9780195699630
11	Raikar R.V.	Laboratory Manual Hydraulics and Hydraulic Machines	PHI Learning Pvt. Ltd., New Delhi ISBN: 9788120346642

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.aboutmech.com/2016/08/total-pressure-and-centre-of-pressure.html	Total Pressure and Centre of Pressure
2	https://www.youtube.com/watch?v=UJ3-Zm1wbIQ	Bernoulli's Principle
3	https://www.youtube.com/watch?v=_bfcdRhY7Rw	Working Principle of Venturimeter
4	https://www.youtube.com/watch?v=iRdJHPFVHwM	Orifice Meter Working Principle
5	https://www.youtube.com/watch?v=3zEdtkuNYLU	Pitot Tube Working Animation
6	https://www.youtube.com/watch?v=Rwl1mu0TJmE	Types of Notches
7	https://www.youtube.com/watch?v=FHTVmKdS_Lk&list=PLdoIhVhbPQV5z6g7aT_LpC8mJb31hNiBx&index=2	Impact of Jet on Fixed Vertical Plate
8	https://www.youtube.com/watch?v=tOoBx4-ieyU&list=PLdoIhVhbPQV5z6g7aT_LpC8mJb31hNiBx&index=3	Impact of Jet on Moving Vertical Flat Plate
9	https://www.youtube.com/watch?v=cpM6hF23eeQ&list=PLdoIhVhbPQV5z6g7aT_LpC8mJb31hNiBx&index=11	Impact Of Liquid Jet on Series of Flat Plate Mounted on a Wheel
10	https://www.youtube.com/watch?v=Jd5BN7SPkqI	Pelton Wheel
11	https://www.youtube.com/watch?v=0p03UTgpnDU	Kaplan Turbine Working and Design
12	https://www.youtube.com/watch?v=3BCiFeykRzo	Working of Francis Turbine
13	https://www.youtube.com/watch?v=IiE8skW8btE	Centrifugal Pump
14	https://www.youtube.com/watch?v=41vb6T42_Tk	Reciprocating Pump animation
15	https://www.youtube.com/watch?v=xqGyPdxLlRg	Jet Pump Working Animation
16	https://www.energy.gov/eere/water/types-hydropower-turbines	Types of Hydropower Turbines

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Sr.No	Link / Portal	Description
17	https://www.realpars.com/blog/manometer#:~:text=Measuring%20pressure,-The%20tube%20is&text=When%20the%20pressures%20are%20equal,side%20because%20P1%20equals%20P2	Manometer working principle
18	https://tameson.com/pages/bourdon-tube-pressure-gauge	Bourdon Tube Pressure Gauge
19	http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1086	Major and Minor Hydraulic Losses Through Pipes And Fitting
20	http://ecoursesonline.iasri.res.in/course/view.php?id=27	Fluid Mechanics Course
21	https://theconstructor.org/fluid-mechanics/types-fluid-flow-pipe/38078/	Types of Fluid Flows
22	https://www.chaitanyaproducts.com/blog/ancient-indian-water-conservation-techniques-part-1/	Water Storage Systems used in Ancient India (IKS)
23	https://www.youtube.com/watch?v=hQr5Op4S5q4&t=83s	Water Lifting Devices (Araghatta) used in Ancient India (IKS)
24	https://www.youtube.com/watch?v=uTrajIJ79ME&t=49s	Water Lifting Devices (Chadas) used in Ancient India (IKS)

Note :

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

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THERMAL ENGINEERING	**Course Code : 313310**

Programme Name/s	**: Mechanical Engineering/ Production Engineering**
Programme Code	**: ME/ PG**
Semester	**: Third / Fourth**
Course Title	**: THERMAL ENGINEERING**
Course Code	**: 313310**

I. RATIONALE

Diploma holders in Mechanical Engineering are expected to take the responsibility for maintaining IC engines, steam boilers, steam turbines, steam condensers, cooling towers and other equipment in steam power plants. Understanding the fundamentals of thermodynamics is crucial to comprehending the operation and maintenance of these devices. This course emphasizes to build the foundation needed for this.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Maintain thermal engineering devices for various industrial / field applications using relevant knowledge & skills related to thermal engineering.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Apply fundamental concepts of thermodynamics to various thermodynamic systems.
- CO2 - Determine various properties of steam using steam table.
- CO3 - Use suitable strategies to maintain steam boiler,steam turbine, steam condenser & cooling towers efficiently.
- CO4 - Select proper heat exchanger for given application.
- CO5 - Identify different components of an I.C. Engine.

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	
313310	THERMAL ENGINEERING	TEG	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	25@	10	25	10	175

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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 various thermodynamic systems & its properties with suitable example. TLO 1.2 Interpret various laws of thermodynamics. TLO 1.3 Maintain various thermodynamic devices by using laws of thermodynamics.	**Unit - I Fundamentals of Thermodynamics** 1.1 Thermodynamic system, Types of systems- Open, closed & isolated system, Extensive and Intensive properties, Process and Cycle. Thermodynamic definition of work, heat, difference between heat and work, flow work, concepts of enthalpy and entropy. 1.2 Laws of Thermodynamics - Zeroth law, first law and second law of thermodynamics. Kelvin Planks, Clausius statements. Concept of Heat engine, Heat pump and Refrigerator. 1.3 Application of Laws of Thermodynamics - Steady flow energy equation and its application to boiler, turbine, and condenser. (No Numerical Treatment on above)	Lecture Using Chalk-Board Presentations Video Demonstrations
2	TLO 2.1 Illustrate Ideal gas processes on P-V & T-S diagram. TLO 2.2 Determine work done, heat transfer, internal energy, enthalpy change for various ideal gas processes. TLO 2.3 Calculate different properties of steam using steam table.	**Unit - II Ideal Gases and Steam Fundamentals** 2.1 Characteristics gas constant and universal gas constant. Derivation of characteristics gas equation. 2.2 Ideal gas processes – Isobaric, Isochoric, Isothermal, Isentropic, Polytropic and their representation on P-V and T-S diagrams. Determination of work, heat, internal energy, enthalpy change. (only simple numerical based on above). 2.3 Steam fundamentals - Applications of steam, generation of steam at constant pressure with representation on T-H & T-S chart. Types of steam: Wet, dry, superheated steam. Properties of steam: Sensible, latent , total heat, specific Volume, dryness fraction. use of steam table. (Only simple numericals based on above). Rankine Cycle & its representation on P-V & T-S chart. (No numerical on Rankine cycle)	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.
3	TLO 3.1 Draw layout of steam power plant. TLO 3.2 Explain construction and working of steam turbines. TLO 3.3 Select condensers for the given situation with justification. TLO 3.4 Explain effective maintenance procedure of steam boiler, steam turbine, steam condenser and cooling tower.	**Unit - III Components of Steam Power Plant** 3.1 Introduction to steam power plant ,Components & layout of steam power plant. Steam Boiler- Definition as per IBR, function , Classification of boilers, Introduction to high pressure boiler , Construction & working of Lamont boiler & Benson Boiler. 3.2 Steam nozzle & Steam Turbines - Function , types , applications of steam nozzles. Steam turbine - Classification , Construction and working of Impulse and Reaction turbine. Need of compounding. Regenerative feed heating & bleeding of steam. 3.3 Steam condensers - Dalton's law of partial pressure, function, classification of condensers, construction and working of surface Condenser. Sources of air leakage and its effect. 3.4 Cooling Towers - Classification of cooling towers, Construction and working of natural, forced and induced draught cooling tower. (No numerical Treatment for this unit)	Lecture Using Chalk-Board Presentations Model Demonstration Video Demonstrations Site/Industry Visit
4	TLO 4.1 Explain modes of heat transfer. TLO 4.2 Calculate heat transfer by conduction through slab & composite walls. TLO 4.3 Select suitable heat exchanger for given application.	**Unit - IV Heat Transfer & Heat Exchangers** 4.1 Modes of heat transfer - Conduction, convection and radiation. Conduction - Fourier's law, conduction through slab & composite wall. Convection - Newton's law of cooling, natural and forced convection. Radiation - absorptivity, transmissivity, reflectivity, emissivity, black body, gray body, Stefan Boltzmann law . (Only simple numerical based on heat transfer by conduction through slab & composite wall.) 4.2 Heat Exchangers - Classification, construction and working of shell and tube, plate type heat exchanger and its applications.	Lecture Using Chalk-Board Presentations Video Demonstrations
5	TLO 5.1 Represent various air standard cycles on P-V & T-S diagram. TLO 5.2 Classify I. C. Engines. TLO 5.3 Explain construction and working of two strokes & four Stroke I.C. engine.	**Unit - V Introduction to I.C. Engine & Power Cycles** 5.1 Power Cycles – Carnot Cycle, Otto cycle, Diesel cycle, Dual Cycle and its representation on P-V and T-S diagram. (No numerical on above) 5.2 Basics of I.C. Engine – Engine terminology, Classification and application of IC engines, Construction & working of two stroke & four stroke I.C. engines (S.I. and C.I.)	Lecture Using Chalk-Board Presentations 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

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Measure temperature, pressure, energy, discharge, using instruments such as contact type thermometer, U tube manometer, Rotameter, energy meter.	1	* Use thermometer, pressure gauge, rotameter, energy meter to measure temperature, pressure, discharge and energy.	2	CO1
LLO 2.1 Measure parameters required to determine air flow rate. LLO 2.2 Calculate actual volume of air at the suction of reciprocating air compressor.	2	* Measurement of discharge of air using air box.	2	CO2
LLO 3.1 Identify various components of fire tube boiler. LLO 3.2 Show the path of flue gases and water steam circuit.	3	* Trace the path of flue gases and water steam circuit with the help of Fire Tube boiler - Cochran Boiler	2	CO3
LLO 4.1 Identify various components of water tube boiler. LLO 4.2 Show the path of flue gases and water steam circuit.	4	*Trace the path of flue gases and water steam circuit with the help of Water Tube boiler - Babcock & Wilcox Boiler.	2	CO3
LLO 5.1 Identify various components of Boiler Mountings. LLO 5.2 Show the path of flue gases and water steam circuit.	5	*Demonstration & working of Boiler Mountings (Any Two)	2	CO3
LLO 6.1 Identify various components of Boiler accessories. LLO 6.2 Show the path of flue gases and water steam circuit.	6	*Demonstration & working of Boiler Accessories (Any Two)	2	CO3
LLO 7.1 Select turbine model for demonstration. LLO 7.2 Demonstrate the construction and working.	7	Demonstration & working of Impulse & Reaction steam turbine.	2	CO3
LLO 8.1 Select condenser model for demonstration. LLO 8.2 Identify various components of condensers.	8	Demonstration & working of condensers a. Water Cooled condensers. b. Air cooled condensers.	2	CO3
LLO 9.1 Use simulation software. LLO 9.2 Select input parameters to observe the output.	9	Observe simulation of Thermal Power Plant and write specifications of boilers, turbines, condensers and electrical generators.	2	CO3
LLO 10.1 Demonstrate the process of compounding.	10	Illustrate the methods of compounding used in steam turbine.	2	CO3
LLO 11.1 Measure parameters required to determine thermal conductivity. LLO 11.2 Determine the thermal conductivity of metallic rod .	11	*Conduct a trial on conduction set up of metallic rod and calculate thermal conductivity.	2	CO4
LLO 12.1 Measure parameters required to determine Stefan Boltzmann constant. LLO 12.2 Determine Stefan Boltzmann constant .	12	Conduct a trial on Stefan Boltzmann set up and calculate Stefan Boltzmann constant.	2	CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 13.1 Identify different heat exchangers available in laboratory. LLO 13.2 Demonstrate the construction and working.	13	Identify different equipments in laboratory having heat exchangers and classify heat exchangers. Write construction and working any 03 of above heat exchangers.	2	CO4
LLO 14.1 Select the proper tools. LLO 14.2 Identify various subassemblies and accessories of engine.	14	*Assembling and dismantling of single cylinder I.C Engine.	2	CO5
LLO 15.1 Locate different components of multicylinder I.C. Engine.	15	Identify different components of multicylinder I.C. Engine and write function of each component.	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)

Assignment

- Collect an information about Indian Boiler Regulation act.
- Collect an information about high pressure boilers used in steam power plants. Write a specification and compare each other.
- "High pressure boilers are used in steam power plants" Justify.
- Carry out comparative study of conventional cooling towers, cooling towers used in power plants and upcoming cooling tower.
- Make power point presentation including videos on heat exchangers commonly used.
- Collect an information about manufacturers of I.C. Engine with their specifications.
- Prepare a report on applications of I.C. Engine (S.I/C.I.) in various sectors.

Micro project

- Prepare a model of any one boiler / mounting/accessories with the help of suitable material.
- Prepare charts on compounding, regenerative feed heating processes of steam boiler.
- Collect various components of an I.C. engine and prepare a board model with its details.
- Prepare and present a seminar on boiler instrumentation using appropriate source of information.
- Prepare a report on a visit to Steam Power Plant on the basis of following parameters- a. Layout of power plant b. Specifications & type of – Steam boiler, steam turbine, Steam condenser & cooling tower. c. Construction & working of - Steam boiler, steam turbine, Steam condenser & cooling tower. d. Maintenance procedure of - Steam boiler, steam turbine, Steam condenser & cooling tower. e. List of various parameters controlled for smooth functioning.
- Prepare a model of any one heat exchanger with the help of suitable material.

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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	Mercury or alcohol filled Thermometer, Pressure Gauge Range max up to 8 bars, U- Tube Manometer, Rotameter – Maximum up to 20 LPM .	1
2	Charts / Models demonstrating process of compounding.	10
3	Experimental set up for determination of thermal conductivity of metallic rod consisting of Metallic rod of suitable length adequately insulated with heating arrangements at one end, Voltage regulator, Six thermocouples on metallic rod, Arrangement for cooling other end of rod, Stop watch, Measuring Jar.	11
4	Experimental set up to verify Stefan Boltzmann law.	12
5	Different equipment in power engineering laboratory having heat exchangers.	13
6	Single cylinder I.C. engine suitable for Dismantling and assembling with necessary tool set .	14
7	Test rig of multicylinder I.C. Engine available in laboratory.	15
8	Two stage Reciprocating air compressor with intercooler test rig.	2
9	Cut section models of fire tube boilers.	3
10	Cut section models of water tube boilers.	4
11	Cut section models of various boiler mountings.	5
12	Cut section models of various boiler accessories.	6
13	Cut section models of Impulse & Reaction turbine.	7
14	Cut section models of various water cooled & air-cooled condensers.	8
15	Relevant simulation software.	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	Fundamentals of Thermodynamics	CO1	8	2	4	6	12
2	II	Ideal Gases and Steam Fundamentals	CO2	12	4	4	8	16
3	III	Components of Steam Power Plant	CO3	13	4	6	8	18
4	IV	Heat Transfer & Heat Exchangers	CO4	6	2	4	6	12
5	V	Introduction to I.C. Engine & Power Cycles	CO5	6	2	4	6	12

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Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
		Grand Total		**45**	**14**	**22**	**34**	**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 • For Self Larning 25 Marks

Summative Assessment (Assessment of Learning)

- • End semester assessment of 25 marks for laboratory 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	R.K. Rajput	Engineering Thermodynamics	Laxmi Publications, New Delhi 2007, ISBN: 978-0-7637-8272-63678
2	Mahesh M. Rathore	Thermal Engineering	Tata McGraw-Hill Education, New Delhi 2010, ISBN: 978-0-07068113-2
3	P.K. Nag	Basic and Applied Thermodynamics	Tata McGraw-Hill Education, New Delhi ISBN: 978-0070151314
4	S. Domkundwar, C.P. Kothandaraman, A. Domkundwar	A course in Thermal Engineering	Dhanpat Rai and company, New Delhi, 2004, ISBN:9788177000214
5	R.S.Khurmi & J.K.Gupta	A Textbook of Thermal Engineering	S.Chand Limited New Delhi 2022 , ISBN: 978-93-550-1054-4

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Sr.No	Author	Title	Publisher with ISBN Number
6	V. Ganeshan	Internal Combustion Engines	Tata McGraw Hills, New Delhi. ISBN: 978-1-25-900619-7

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://onlinecourses.nptel.ac.in/noc24_me63/pr view	Fundamentals of thermodynamics
2	https://www.youtube.com/watch?v=3dyxjBwqF-8	Ideal Gas laws & Processes
3	https://www.youtube.com/watch?v=hoQ_hEweT_Y	Fundamentals of steam & steam formation
4	https://www.youtube.com/watch?v=-cr5vfV4YAI	Types of Boilers, Different Cycles in Boiler Operation, Boiler attachment.
5	https://www.youtube.com/watch?v=7w3Qu9KkPvo	Steam Turbine working
6	https://www.youtube.com/watch?v=IcBTfEtS84s	Surface and Jet Condensers
7	https://www.youtube.com/watch?v=Kj_NEUu2xvw	Types and Components of Cooling Tower
8	https://www.youtube.com/watch?v=TsdV_os3N40	Modes of Heat Transfer
9	https://www.youtube.com/watch?v=qO9BrKLKiLE	Types of Heat Exchangers
10	https://www.youtube.com/watch?v=H_RgFXjg-5s	Introduction & classification of I.C. Engine.

Note :

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

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PRODUCTION DRAWING   **Course Code : 313311**

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	Paper Duration	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH			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		
313311	PRODUCTION DRAWING	PDR	SEC	2	-	4	2	8	4	4	30	70	100	40	25	10	25@	10	25	10	175

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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

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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 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
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.

PRODUCTION DRAWING   **Course Code : 313311**

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
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

PRODUCTION DRAWING				Course Code : 313311

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

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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	-	-	-	-			

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| 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	: Automobile Engineering./ Agricultural Engineering/ Chemical Engineering/ Mechanical Engineering/ Production Engineering/ Polymer Technology
Programme Code	: AE/ AL/ CH/ ME/ PG/ PO
Semester	: Second / Third / Fourth
Course Title	: BASIC ELECTRICAL AND ELECTRONICS
Course Code	: 312020

I. RATIONALE

Modern engineering systems, irrespective of the field, are increasingly incorporating smart technologies that rely on electrical and electronics components. Many engineering projects involve the integration of mechanical, electrical and electronic components. A well-rounded education in electrical and electronics principles enables engineers to work seamlessly across disciplines. In Chemical Engineering, Agricultural Engineering and Polymer Technology, precise measurement and control of variables are crucial. The fourth industrial revolution emphasizes the integration of digital technologies into manufacturing and engineering processes. Electrical and electronics knowledge is fundamental for implementing Industry 4.0 concepts in Engineering fields .This course will develop skills in handling tools and equipment related electrical and electronics engineering and provide the necessary foundation for understanding, maintaining and implementing advanced systems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified outcomes through various teaching learning experiences: Use Electrical and Electronics equipment safely in mechanical engineering applications

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Use Principles of electrical and magnetic circuits to solve mechanical engineering broadly defined problems.
- CO2 - Use of Transformer and Electric motors for given applications.
- CO3 - Suggest suitable electronic component for given mechanical engineering application.
- CO4 - Use of diodes and transistors as a relevant component in given electric circuits of . mechanical engineering application

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	
312020	BASIC ELECTRICAL AND ELECTRONICS	BEE	AEC	2	-	4	-	6	3	-	-	-	-	-	50	20	50@	20	-	-	100

BASIC ELECTRICAL AND ELECTRONICS   **Course Code : 312020**

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 technical terms related to Electric and Magnetic circuits . TLO 1.2 Identify analogy between Electric and Magnetic Circuits. TLO 1.3 Apply Fleming's right hand rule and Lenz's law for determination of direction of induced emf in the given situation. TLO 1.4 Explain attributes of the given AC quantities. TLO 1.5 Find currents and voltages in the given series and parallel AC circuits.	**Unit - I Electric and Magnetic Circuit** 1.1 1 Electric circuits E.M.F, Potential difference, power, Magnetic circuits M.M.F, magnetic force, permeability. 1.2 Electromagnetic induction, Faraday's laws of electromagnetic induction, Lenz's law, dynamically induced emf. 1.3 Statically induced emf. (a) Self induced emf (b) Mutually induced emf; Equations of self and mutual inductance. 1.4 A .C. Signal terms: Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor, Peak Factor, impedance, phase angle, and power factor. 1.5 Voltage and Current relationship in Star and Delta connections. Working of Batteries, wiring specifications and IS electrical standards for safety and appliances.	Chalk-Board Presentations Videos on Flemings Right hand rule and Lenz Law

BASIC ELECTRICAL AND ELECTRONICS   **Course Code : 312020**

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.
2	TLO 2.1 Explain with sketches the construction and working principle of the given type of single phase transformer. TLO 2.2 Explain with sketches the working principle of the given autotransformer. TLO 2.3 Describe with sketches the construction of the given single phase motor. TLO 2.4 Explain with the sketches the working principle of the given single phase induction motors.	**Unit - II Transformer and single phase induction motor** 2.1 General construction and principle of different type of transformers, EMF equation and transformation ratio of transformers. 2.2 Auto transformers. Working Principle and applications 2.3 Construction and Working principle of single phase AC. motor. Types of single phase motors, applications of single phase motors. 2.4 Applications of Induction motors	Chalk-Board Demonstration Hands-on
3	TLO 3.1 Differentiate between the given active and passive components. TLO 3.2 Determine the value of given resistor and capacitor using color code and printed information on components . TLO 3.3 Explain the given signal parameters with sketches. TLO 3.4 Identify the given type of ICs based on the IC number	**Unit - III Electronic Components and Signals** 3.1 Electronic Components : Passive and Active components: Resistor, Capacitor, Inductor, symbols color codes, specifications. 3.2 Voltage and current sources, signals: Waveform (Sinusoidal, triangular and square). 3.3 Time and frequency domain representation of signals.Amplitude, frequency, phase, wavelength. 3.4 Integrated circuits - Analog and Digital.	Chalk-Board Demonstration of components Hands-on
4	TLO 4.1 Explain with the sketches the working of given type of diode using its V-I characteristics. TLO 4.2 .Explain with the sketches the working of given type of rectifier using circuit diagram. TLO 4.3 Justify the given selection of power supply and LEDs for the given circuit. TLO 4.4 Explain with the sketches the application of the given type of transistor as a switch. TLO 4.5 Compare the performances of the given transistor configurations.	**Unit - IV Diodes and Bipolar Junction Transistor** 4.1 Diodes and its Applications: P-N junction diode: symbol, construction working and applications ,Zener diode: working, symbol, voltage regulator. 4.2 Rectifiers: Half wave, Full wave, Bridge rectifier Performance parameters: PIV, ripple factor, efficiency. 4.3 Light Emitting Diodes: symbol, construction, working principle and applications. 4.4 BJT Symbol, construction, working principle Transistor as switch and amplifier. 4.5 Input and Output characteristics: CE configurations, Operating regions: Cut-off, saturation Active Region.	Chalk-Board 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
LLO 1.1 Measure voltage and current in single phase circuits with resistive load using appriopriate meters	1	* Voltage and Current measurement	2	CO1

BASIC ELECTRICAL AND ELECTRONICS   **Course Code : 312020**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Measure power required by single phase circuit with resistive load.	2	* Power measurement of single phase circuit	2	CO1
LLO 3.1 Measure Energy consumed by given equipment using energy meter.	3	Energy measurement	2	CO1
LLO 4.1 Measure average value, peak value and RMS value of AC waveform using CRO./ DSO LLO 4.2 Measure time and frequency of AC waveform using CRO./ DSO	4	AC signal parameters	2	CO1
LLO 5.1 Make a star and delta connection to measure line and phase voltage	5	* Line and Phase voltage measurement of star - delta connection circuit	2	CO1
LLO 6.1 Test given battery using digital multimeter.	6	* Battery Testing	2	CO1
LLO 7.1 Connect Single phase transformer for measuring input and output quantities LLO 7.2 Determine its turns ratio	7	* Input and output quantities of Single phase transformer	2	CO2
LLO 8.1 Test primary and secondary winding to measure continuity of transformer.	8	Continuity test of transformer-primary and secondary windings	2	CO2
LLO 9.1 Measure output voltage of auto transformer	9	Auto transformer	2	CO2
LLO 10.1 Identify parts of single phase induction motor.	10	* Single phase induction motor	2	CO2
LLO 11.1 Select the suitable gauge of wire for given electrical application.	11	* Electrical wire specifications	2	CO2
LLO 12.1 Build the switch board for given requirement by connecting suitable coloured wire to respective terminals .	12	* Electrical Swichboard assembly	2	CO2
LLO 13.1 Identify Passive electronic components on given electronics circuit	13	* Passive electronic components	2	CO3
LLO 14.1 Connect the capacitors in series combination on bread board to measure its value using multimeter. LLO 14.2 Connect the capacitors in parallel combination on bread board to measure its value using multimeter.	14	* Resistors in series and parallel connections	2	CO3
LLO 15.1 Connect the capacitors in series combination on bread board to measure its value using multimeter. LLO 15.2 Connect the capacitors in parallel combination on bread board to measure its value using multimeter.	15	Capacitors in series and Parallel connections	2	CO3
LLO 16.1 Use LCR-Q meter for measuring the value of given Inductor and Capacitors.	16	* LCR-Q meter	2	CO3
LLO 17.1 Identify various active electronic components in given circuit.	17	* Active electronic components	2	CO3
LLO 18.1 Test the given P N junction diode using multi meter	18	* P N Junction diode	2	CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 19.1 Multi colour LEDs.	19	Multi colour LEDs	2	CO4
LLO 20.1 Identify type of seven segment display (Common anode / Common cathode)) LLO 20.2 Testing of seven- segment display.	20	* Seven- segment display	2	CO4
LLO 21.1 Built/ Test Half Wave Rectifier.	21	Half Wave Rectifier	2	CO4
LLO 22.1 Test Full Wave Rectifier using virtual Lab.	22	Full Wave Rectifier	2	CO4
LLO 23.1 Build/Test Bridge Rectifier constructed using four diodes LLO 23.2 Test bridge rectifier package	23	Bridge Rectifier	2	CO4
LLO 24.1 Identify three terminals of transistors using multimeter.	24	Three terminals of transistors	2	CO4
LLO 25.1 Test the performance of NPN transistor.	25	Testing of NPN transistor	2	CO4
LLO 26.1 Soldering and de- soldering given passive active components on PCB	26	* Soldering and De soldering	2	CO4
LLO 27.1 Test the performance of zener diode	27	Zener diode	2	CO4
LLO 28.1 Identify components of flasher circuits	28	Electronic flasher circuit	2	CO4
LLO 29.1 Identify terminals of three terminal positive and negative voltage regulator	29	* Three terminal voltage regulators	2	CO4
LLO 30.1 Build and test + 5 V regulated D C power supply using three terminal voltage regulator .	30	Regulated Power Supply	2	CO4

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	Single Phase Autotransformer: Single phase, Input 0-230,10 A, Output:0-270 Volts	1,2
2	Clamp on Meter: 750 V, 2000 Counts	1,2
3	Single Phase Induction Motor - 230 V 50 Hz AC supply	11
4	LCR Q Meter: Parameter L-Q, C-D, R-Q and Z-Q Frequency 00 Hz, 120 Hz and 1 KHz Accuracy Basic Accuracy : 0.3% Display 5 digits display for both primary and secondary parameters L 100 Hz, 120 Hz 1 mH - 9999 H 1 KHz 0.1 mH - 999.9 H Measurement C 100 Hz, 120Hz 1 pF – 9999 mF Range 1 KHz 0.1 pF - 999.9 mF R, |Z| 0.0001V- 999.9 MV D, Q 0.0001 – 9999 D% 0.0001% - 9999% Test Level 120 Hz 0.3 Vrms (1 ±15%) (Range Auto 1 KHz and Open 100 Hz 0.42 Vrms (1±15%) Circuit) Ranging Mod Auto and Hold Equ	15

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
5	Function Generator: Frequency range 0.1Hz to 30 MHz sine, square, triangular, ramp and pulse generator, Output amplitude 20V open circuited, Output impedance 50 ohms. Facility to indicate output frequency and amplitude on display	22,23,24,29
6	Simulation software: Multisim, Proteus	23
7	CRO: Dual Channel, 4 Trace CRT / TFT based Bandwidth 20 MHz/30 MHz X10 magnification 20 nS max sweep rate, Alternate triggering Component tester and with optional features such as Digital Readout , USB interface or CRO with higher specifications	26,27,28,30
8	Digital Storage Oscilloscope: 25MHz/60MHz/70MHz/100MHz Dual Channel, 4 Trace TFT based X10 magnification 20 nS max sweep rate, Alternate triggering Component tester and with optional features such as Digital Read out, USB interface. Any other Oscilloscope with additional features is also suitable with magnifying probe at least two probes, if possible isolated probe	27,28,30
9	Single Phase Direct Measuring Energy Meter :100A 176 to 276V AC	3
10	Measurement Digital Multimeter: Minimum 3 ½ digit 4 ½ digit display, multimeter measures Vac, Vdc (1000V max), Adc, Aac (10-amp max), Resistance (0-100 Mohm), diode and transistor testing mode	4,6,12,14,17,18,19,20,21,25,13,9
11	Lamp Bank - 230 V 0-20 A	5
12	Single phase auto transformer-Single Phase Input 0-230,10A,output: 0-270Volts	7,8

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	Electric and Magnetic Circuit	CO1	7	0	0	0	0
2	II	Transformer and single phase induction motor	CO2	8	0	0	0	0
3	III	Electronic Components and Signals	CO3	7	0	0	0	0
4	IV	Diodes and Bipolar Junction Transistor	CO4	8	0	0	0	0
		Grand Total		**30**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- For FA PR ,Formative (Continuous) assessment shall be based on process and product related performance indicators. Course teacher may assign 60%, weightage for process and 40% weightage for product related LL work .

Summative Assessment (Assessment of Learning)

- For SA PR At the end of semester PR examination will be conducted by course teacher and based on PR exam performance marks out of 50 will be allocated

XI. SUGGESTED COS - POS MATRIX FORM

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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	1	-	1	-	-	1			
CO2	2	-	-	2	-	-	1			
CO3	1	-	-	1	-	-	1			
CO4	1	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	Mittle and Mittal	Basic Electrical Engineering	McGraw Education, New Delhi, edition 2017, ISBN-13 978-0070593572
2	Jegathesan, V	Basic Electrical and Electronics Engineering	Wiley India, New Delhi, edition-2015 ISBN 978-8126529513
3	Sedha, R.S.	A Text book of Applied Electronics	S.Chand New Delhi, edition-2008 ISBN-13: 978-8121927833
4	Mehta, V.K. Mehta, Rohit	Principles of Electronics	S. Chand and Company, New Delhi, edition-2014, ISBN-13-9788121924504
5	Bell Devid	Fundamental of Electronic Devices and Circuits	Oxford University Press, New Delhi edition-2015 ISBN 978-0195425239
6	Susan S Mathew Saji T Chacko	Fundamental of Electrical and Electronics Engineering	Khanna Book Publishing Co (P) Ltd. New Delhi 978-93-91505-59-2

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://fossee.in/ (Open Source Electronics Simulation software) https://cloud.scilab.in/ (Open Source Scilab Cloud for Electronics Simulation)	Smulation
2	https://www.electrical4u.com/fleming-left-hand-rule-and-fleming-right-hand-rule/	Flemings Right hand and left hand rule
3	https://www.electrical4u.com/lenz-law-of-electromagnetic-induction/	Lenz's Law
4	https://www.animations.physics.unsw.edu.au/jw/	Electronic components, A.C. circuits, transformer, Electric motors.
5	https://en.wikipedia.org/wiki/Transformer	Transformer
6	http://www.alpharubicon.com/altenergy/understandingAC.htm	A.C. Current
7	https://www.learningaboutelectronics.com/Articles/	Electronic components
8	https://learn.sparkfun.com/tutorials/transistors	Transistors

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Sr.No	Link / Portal	Description
9	https://www.technologystudent.com/elec1/transis1.htm	Transistors
10	https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/get_is_list_by_category_id/5	IS standards for electrical safety and appliances

Note :

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

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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 and Electronics Engineering/ 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/ EK/ 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

ESSENCE OF INDIAN CONSTITUTION	Course Code : 313002

- 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						Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH	Credits	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

ESSENCE OF INDIAN CONSTITUTION | **Course Code : 313002**

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.
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
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

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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)

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Sr.No	Author	Title	Publisher with ISBN Number
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
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

COMPUTER AIDED DRAFTING	Course Code : 313006

Programme Name/s	**: Mechanical Engineering/ Production Engineering**
Programme Code	**: ME/ PG**
Semester	**: Third**
Course Title	**: COMPUTER AIDED DRAFTING**
Course Code	**: 313006**

I. RATIONALE

With the advent of technology, the process of drafting and design has transitioned from manual techniques to digital methods. The study of Computer Aided Drawing and Drafting (CADD) is representing the forefront of this evolution, providing designers with powerful tools to streamline the creation, modification, and visualization of technical drawings.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Create technical drawings using CADD software accurately and efficiently according to industry standards in multidisciplinary teams.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Use basic commands in CADD software.
- CO2 - Draw complex 2D drawings in CADD software using draw and modify tools.
- CO3 - Draw isometric drawings using CADD software.
- CO4 - Use software to dimension and write text on 2D geometric entities.
- CO5 - Plot given 2D entities using proper plotting parameters in CADD.

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	
313006	COMPUTER AIDED DRAFTING	CAD	SEC	-	-	4	-	4	2	-	-	-	-	-	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 importance of computer in drafting and designing. TLO 1.2 Set the CADD workspace and interface. TLO 1.3 Prepare drawing using User Coordinate System (UCS) and World Coordinate System (WCS) TLO 1.4 Apply different object selection methods in a given situation. TLO 1.5 Use various commands in application menu bar.	**Unit - I Fundamentals of CAD Drawing** 1.1 Fundamentals of Computer Aided Drafting and its applications, Various Software for Computer Aided Drafting. 1.2 CADD Interface: Application Menu, Quick Access Toolbar, Ribbons, InfoCenter, Command Window, Graphical Area, Status Bar 1.3 CADD initial setting commands: Snap, grid, Ortho, Osnap, Dynamic input, Limits, Units, Ltscale, Object tracking. 1.4 Co-ordinate System- Cartesian and Polar, Absolute and Relative mode, Direct Distance Entry, UCS, WCS. 1.5 Object Selection methods- picking, window, crossing, fence, last and previous. 1.6 Opening, saving and closing a new and existing drawing.	Video Demonstrations Presentations Hands-on
2	TLO 2.1 Use viewing commands. TLO 2.2 Apply formatting commands. TLO 2.3 Draw simple 2D entities using given draw commands. TLO 2.4 Determine coordinates, distance, area, length, centroid of the given 2D entity.	**Unit - II Zoom, Draw, Formatting and Enquiry Commands** 2.1 Zoom Commands – all, previous, out, in, extent, Realtime, dynamic, window, pan. 2.2 Draw Command - Line, Polyline, arc, circle, rectangle, polygon, ellipse, spline, block, hatch. 2.3 Formatting commands - Layers, block, linetype, lineweight, color. 2.4 Enquiry commands – distance, area.	Video Demonstrations Presentations Hands-on

COMPUTER AIDED DRAFTING   Course Code : 313006

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 Draw given complex 2D entities using modify commands. TLO 3.2 Use grip command to manipulate given 2D entity.	**Unit - III Modify and Edit Commands** 3.1 Modify Command - Erase, trim, extend, copy, move, mirror, offset, fillet, chamfer, array, rotate, scale, lengthen, stretch, measure, break, divide, explode, align. 3.2 Editing Objects by Using Grips - Moving, Rotating, Scaling, Mirroring and Stretching.	Video Demonstrations Presentations Hands-on
4	TLO 4.1 Draw isometric entities. TLO 4.2 Draw isometric object from given orthographic views. TLO 4.3 Use Layers for 2D drawings. TLO 4.4 Draw and modify blocks for given 2D entities. TLO 4.5 Use blocks in same and in another given file.	**Unit - IV Isometric Drawings, Layers, and Blocks** 4.1 Isometric drafting- Isometric grid & snap, Isometric axis & plane, Polyline, Isocircle. 4.2 Dimensioning Isometric drawings. 4.3 Text writing on Isometric drawing. 4.4 Layer, Layer properties and applications. 4.5 Blocks: create, modify and use in same file and in another file.	Video Demonstrations Presentations Hands-on
5	TLO 5.1 Use various dimensioning styles to drawn 2D entities. TLO 5.2 Apply Geometric and dimension tolerance symbols on the given entity. TLO 5.3 Write text on given 2D entity. TLO 5.4 Insert table in drawing. TLO 5.5 Prepare new template for drawing as per requirement. TLO 5.6 Plot given 2D entities using proper plotting parameters.	**Unit - V Dimensioning, Text and Plot Commands** 5.1 Dimensioning commands - Dimension styles, Dimensional Tolerances and Geometrical Tolerances, Modify dimension style. 5.2 Text commands - dtext, mtext command. 5.3 Insert table – table, tablestyle command. 5.4 Template Drawing- Standard template, loading template, create new template. 5.5 Plotting a drawing – adding plotter/printer, page setup, plot style commands.	Video Demonstrations Presentations 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 Use basic commands in CADD software. LLO 1.2 Draw 2D entities in CADD software.	1	*Drawing 2-D entities like Line, Polyline, Circle, Rectangle, Polygon and Ellipse by using CADD software.	4	CO1 CO2
LLO 2.1 Use basic commands in CADD software. LLO 2.2 Draw 2D entities in CADD software using Draw commands individually.	2	Drawing simple 2-D objects using any combination of 2 or more commands, like polygon+circle, line+circle, etc.	4	CO1 CO2
LLO 3.1 Use basic commands in CADD software. LLO 3.2 Draw 2D entities in CADD software using Draw, Edit and Modify commands.	3	Drawing complex 2-D objects like pulley/ gear.	4	CO1 CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Use basic commands in CADD software. LLO 4.2 Draw 2D entities in CADD software using Draw, Edit and Modify commands. LLO 4.3 Apply dimension and write text on 2D geometric entities.	4	*Drawing complex 2-D object like coupling/joints.	4	CO1 CO2 CO4
LLO 5.1 Use basic commands in CADD software. LLO 5.2 Draw 2D entities in CADD software. LLO 5.3 Apply dimension and write text on 2D geometric entities.	5	* Drawing any two problems of orthographic projections using first angle method of projection.	4	CO1 CO2 CO4
LLO 6.1 Use basic commands in CADD software. LLO 6.2 Draw 2D entities in CADD software. LLO 6.3 Apply dimension and write text on 2D geometric entities.	6	Drawing any two problems of orthographic projections using third angle method of projection.	4	CO1 CO2 CO4
LLO 7.1 Use basic commands in CADD software. LLO 7.2 Draw 2D entities in CADD software. LLO 7.3 Apply dimension and write text on 2D geometric entities.	7	* Drawing any two problems of sectional orthographic projections using First angle method of projection.	4	CO1 CO2 CO4
LLO 8.1 Use basic commands in CADD software. LLO 8.2 Draw 2D entities in CADD software. LLO 8.3 Apply dimension and write text on 2D geometric entities.	8	Drawing any two problems of sectional orthographic projections using third angle method of projection.	4	CO1 CO2 CO4
LLO 9.1 Use basic commands in CADD software. LLO 9.2 Draw 2D entities in CADD software. LLO 9.3 Apply dimension and write text on 2D geometric entities.	9	Drawing any two problems of development of solids.	4	CO1 CO2 CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 10.1 Use basic commands in CADD software. LLO 10.2 Draw 2D entities in CADD software. LLO 10.3 Apply dimension and write text on 2D geometric entities.	10	Drawing any two problems on Auxiliary views.	4	CO1 CO2 CO4
LLO 11.1 Use basic commands in CADD software. LLO 11.2 Draw 2D entities in CADD software. LLO 11.3 Apply dimension and write text on 2D geometric entities.	11	*Drawing an assembly drawing from the given detailed drawing showing assembly dimensions, part number and bill of Material.	8	CO1 CO2 CO4
LLO 12.1 Use basic commands in CADD software. LLO 12.2 Draw 2D entities in CADD software. LLO 12.3 Apply dimension and write text on 2D geometric entities.	12	Drawing working drawings from given assembly drawing showing conventional representation, dimensions, geometrical tolerances and machining symbols.	8	CO1 CO2 CO4
LLO 13.1 Use basic commands in CADD software. LLO 13.2 Draw isometric drawings using CADD software.	13	Drawing isometric views of given two objects containing lines, arcs, circles, holes, ribs and slots.	8	CO1 CO3
LLO 14.1 Use basic commands in CADD software. LLO 14.2 Draw isometric drawings using CADD software	14	*Drawing Isometric drawings from given Isometric views and dimension it.	8	CO1 CO3 CO4
LLO 15.1 Use basic commands in CADD software. LLO 15.2 Write text in title block.	15	*Prepare a template for your institute of predefined paper size with title block and institute logo.	4	CO1 CO4
LLO 16.1 Use basic commands in CADD software. LLO 16.2 Take printout by using plot option	16	*Plot the drawings from Sr. 3 to 13 on Paper with title block and institute logo	4	CO1 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

- 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	Networked Licensed latest version of Computer Aided Drafting software.	All
2	CAD workstation with latest configurations for each student.	All
3	Plotter/Printer with latest versions.	All
4	LCD projector and Screen/ Interactive board.	All

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

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Termwork Each practical will be assessed considering - - 60% weightage to process and - 40% weightage to product Continuous assessment based on process and product related performance indicators, laboratory experience.

Summative Assessment (Assessment of Learning)

- Practical Exam of 25 marks

XI. SUGGESTED COS - POS MATRIX FORM

COMPUTER AIDED DRAFTING   **Course Code : 313006**

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	-	-	1	-	-	1			
CO2	2	1	1	-	-	-	1			
CO3	2	1	1	-	-	-	1			
CO4	2	-	-	-	-	-	1			
CO5	1	-	-	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	Prof. Sham Tickoo	AutoCAD 2021 for Engineers & Designers, Basic & Intermediate	Publisher: BPB Publications, 21 February 2021, ISBN-10: 9389898986, ISBN-13: 978-9389898989
2	Sankar Prasad Dey	Autocad 2014 for Engineers Volume 1	Publisher: Vikas, 21 December 2021, ISBN-13: 978-9325983373
3	Prof. Sham Tickoo	AutoCAD 2024: A Problem-Solving Approach, Basic and Intermediate	Dreamtech Press publication, August 20, 2023, ISBN-10 1640571779, ISBN-13 978-1640571778
4	Kulkarni D.M	Engineering Graphics with AutoCAD	Publisher: Prentice Hall India Learning Private Limited, 1 January 2010, ISBN-10: 8120337832, ISBN-13: 978-8120337831
5	Cadfolks	AutoCAD 2021 For Beginners	Publication: Kishore, 5 May 2020, ISBN-10 819419539X ISBN-13: 978-8194195399
6	Luke Jumper, Randy H. Shih	AutoCAD 2024 Tutorial First Level 2D Fundamentals	SDC Publication, June 27, 2023, ISBN-10 1630575852, ISBN: 978-1-63057-585-4
7	Sharad K. Pradhan, K K Jain	Engineering Graphics , AICTE Prescribed Textbook	Khanna Book Publishing; First Edition, 1 January 2023, ISBN-10 9391505503, ISBN-13 978-9391505509

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.autodesk.com/education/online-learning	Tutorials, courses, and resources for AutoCAD
2	https://www.cadtutor.net/	Tutorials, articles, forums and downloadable resources covering various CAD software applications.
3	https://www.cadin360.com/	Video tutorials, articles, and downloadable resources to enhance CAD skills.

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Sr.No	Link / Portal	Description
4	https://ocw.mit.edu/courses/mechanical-engineering/	Lectures, assignments and projects covering topics such as engineering design, CAD/CAM, and product development.
5	https://www.engineering.com/LearningCenter/CAD.aspx	Tutorials, articles, and videos covering CAD software, simulation tools, and engineering design concepts.
6	https://www.youtube.com/watch?v=cmR9cfWJRUU	Introductory tutorial for beginners to AutoCAD, covering topics such as interface navigation, basic drawing commands and setting up units and layers.
7	https://www.youtube.com/watch?v=QuR-VKis3jU	2D mechanical drawings in AutoCAD, including drawing parts, adding dimensions, annotations and creating detailed technical drawings.
8	https://www.youtube.com/watch?v=IWYKfzx-M1E	2D mechanical drawings in AutoCAD, including drawing parts, adding dimensions and annotations, and creating detailed technical drawings.
9	https://www.youtube.com/watch?v=RA0O6AZewTc	Isometric drawings in AutoCAD
10	https://www.youtube.com/playlist?list=PLYEkKxSL5Gt1hR6Jg0ZiQSlc7vn-HTd7h	Isometric drawings in AutoCAD
11	https://www.youtube.com/watch?v=PHSmwXQriIc	Isometric drawings in AutoCAD

Note :

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

MSBTE Approval Dt. 02/07/2024   **Semester - 3, K Scheme**

FUNDAMENTALS OF PYTHON PROGRAMMING	Course Code : 313007

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 built 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

FUNDAMENTALS OF PYTHON PROGRAMMING | **Course Code : 313007**

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

MSBTE Approval Dt. 02/07/2024 | **Semester - 3 / 4 / 5, K Scheme**

	FUNDAMENTALS OF PYTHON PROGRAMMING		Course Code : 313007

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 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
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

FUNDAMENTALS OF PYTHON PROGRAMMING **Course Code : 313007**

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

FUNDAMENTALS OF PYTHON PROGRAMMING	Course Code : 313007

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			

FUNDAMENTALS OF PYTHON PROGRAMMING   **Course Code : 313007**

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

Note :

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

MSBTE Approval Dt. 02/07/2024   **Semester - 3 / 4 / 5, K Scheme**

Maharashtra State Board Of Technical Education, Mumbai

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

Programme Name	: Diploma In Mechanical Engineering		
Programme Code	: ME	With Effect From Academic Year	: 2023-24
Duration Of Programme	: 6 Semester	Duration	: 16 WEEKS
Semester	: Fourth NCrF Entry Level : 3.5	Scheme	: K

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Actual Contact Hrs./Week CL	Actual Contact Hrs./Week TL	Actual Contact Hrs./Week LL	Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week	Credits	Paper Duration (hrs.)	Theory FA-TH Max	Theory SA-TH Max	Theory Total Max	Theory Total Min	Based on LL & TL Practical FA-PR Max	Based on LL & TL Practical FA-PR Min	Based on LL & TL Practical SA-PR Max	Based on LL & TL Practical SA-PR Min	Based on Self Learning SLA Max	Based on Self Learning SLA Min	Total Marks
(All Compulsory)																							
1	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	314301	2	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
2	THEORY OF MACHINES	TOM	DSC	313313	-	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125
3	METROLOGY AND MEASUREMENT	MAM	DSC	313316	1	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175
4	MECHANICAL ENGINEERING MATERIALS	MEM	DSC	313317	4	3	-	2	1	6	3	1.5	30	70*#	100	40	25	10	-	-	25	10	150
5	PRODUCTION PROCESSES	PPR	DSC	314340	2	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125
6	ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS	EDS	AEC	314014	-	1	-	2	1	4	2	-	-	-	-	-	50	20	25@	10	25	10	100
7	BASICS OF MECHATRONICS	BOM	AEC	314017	-	-	-	2	-	2	1	-	-	-	-	-	25	10	25@	10	-	-	50
8	CNC PROGRAMMING	CNC	SEC	314018	-	-	-	4	-	4	2	-	-	-	-	-	25	10	25#	10	-	-	50
	Total				9	19		16	5		20		150	350	500		200		100		100		900

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week	Credits	Paper Duration (hrs.)	Theory			Based on LL & TL		Based on Self Learning	Total Marks
						CL	TL	LL					FA-TH	SA-TH	Total	Practical		SLA	
																FA-PR	SA-PR		
													Max	Max	Max Min	Max Min	Max Min	Max Min	

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	: 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 and Electronics Engineering/ 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/ Surface Coating 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/ EK/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MU/ PG/ PN/ PO/ SC/ SE/ TC/ TE/ TR/ TX
Semester	: Fourth / Sixth
Course Title	: ENVIRONMENTAL EDUCATION AND SUSTAINABILITY
Course Code	: 314301

I. RATIONALE

The survival of human beings is solely depending upon the nature. Thus, threats to the environment directly impact on existence and health of humans as well as other species. Depletion of natural resources and degradation of ecosystems is accelerated due to the growth in industrial development, population growth, and overall growth in production demand. To address these environmental issues, awareness and participation of individuals as well as society is necessary. Environmental education and sustainability provide an integrated, and interdisciplinary approach to study the environmental systems and sustainability approach to the diploma engineers.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Resolve the relevant environmental issue through sustainable solutions

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify the relevant Environmental issues in specified locality.
- CO2 - Provide the green solution to the relevant environmental problems.
- CO3 - Conduct SWOT analysis of biodiversity hotspot
- CO4 - Apply the relevant measures to mitigate the environmental pollution.

- CO5 - Implement the environmental policies under the relevant legal framework.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week			SLH	NLH			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			
314301	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10			125

Total IKS Hrs for Sem. : 2 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.

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	Course Code : 314301

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 need of studying environment and its components. TLO 1.2 Investigate the impact of population growth and industrialization on the relevant environmental issues and suggest remedial solutions TLO 1.3 Explain the Concept of 5 R w.r.t. the given situation TLO 1.4 Elaborate the relevance of Sustainable Development Goals in managing the climate change TLO 1.5 Explain the concept of zero carbon-footprint with carbon credit	**Unit - I Environment and climate change** 1.1 Environment and its components, Types of Environments, Need of environmental studies 1.2 Environmental Issues- Climate change, Global warming, Acid rain, Ozone layer depletion, nuclear accidents. Effect of population growth and industrialization 1.3 Concept of 5R, Individuals' participation in i) 5R policy, ii) segregation of waste, and iii) creating manure from domestic waste 1.4 Impact of Climate change, Factors contributing to climate change, Concept of Sustainable development, Sustainable development Goals (SDGs), Action Plan on Climate Change in Indian perspectives 1.5 Zero Carbon footprint for sustainable development, (IKS-Enviornment conservation in vedic and pre-vedic India)	Lecture Using Chalk-Board Presentations
2	TLO 2.1 Justify the importance of natural resources in sustainable development TLO 2.2 Explain the need of optimum use of natural resources to maintain the sustainability TLO 2.3 Differentiate between renewable and non-renewable sources of energy TLO 2.4 Suggest the relevant type of energy source as a green solution to environmental issues	**Unit - II Sustainability and Renewable Resources** 2.1 Natural Resources: Types, importance, Causes and effects of depletion. (Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources), (IKS-Concepts of Panchmahabhuta) 2.2 Impact of overexploitation of natural resources on the environment, optimum use of natural resources 2.3 Energy forms (Renewable and non-renewable) such as Thermal energy, nuclear energy, Solar energy, Wind energy, Geothermal energy, Biomass energy, Hydropower energy, biofuel 2.4 Green Solutions in the form of New Energy Sources such as Hydrogen energy, Ocean energy & Tidal energy	Lecture Using Chalk-Board Presentations
3	TLO 3.1 Explain the characteristics and functions of ecosystem TLO 3.2 Relate the importance of biodiversity and its loss in the environmental sustainability TLO 3.3 Describe biodiversity assessment initiatives in India TLO 3.4 Conduct the SWOT analysis of the biodiversity hot spot in India TLO 3.5 Explain the need of conservation of biodiversity in the given situation	**Unit - III Ecosystem and Biodiversity** 3.1 Ecosystem - Definition, Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem 3.2 Biodiversity - Definitions, Levels, Value, and loss of biodiversity 3.3 Biodiversity Assessment Initiatives in India 3.4 SWOT analysis of biodiversity hot spot in India 3.5 Conservations of biodiversity - objects, and laws for conservation of biodiversity	Lecture Using Chalk-Board Presentations Video Demonstrations

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY | **Course Code : 314301**

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 Classify the pollution based on the given criteria TLO 4.2 Justify the need of preserving soil as a resource along with the preservation techniques TLO 4.3 Maintain the quality of water in the given location using relevant preventive measures TLO 4.4 State the significance of controlling the air pollution to maintain its ambient quality norms TLO 4.5 Compare the noise level from different zones of city with justification TLO 4.6 Describe the roles and responsibilities of central and state pollution control board	**Unit - IV Environmental Pollution** 4.1 Definition of pollution, types- Natural & Artificial (Man- made) 4.2 Soil / Land Pollution – Need of preservation of soil resource, Causes and effects on environment and lives, preventive measures, Soil conservation 4.3 Water Pollution - sources of water pollution, effects on environment and lives, preventive measures, BIS water quality standards for domestic potable water, water conservation 4.4 Air pollution - Causes, effects, prevention, CPCB norms of ambient air quality in residential area 4.5 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city 4.6 Pollution Control Boards at Central and State Government level: Norms, Roles and Responsibilities	Lecture Using Chalk-Board Presentations
5	TLO 5.1 Explain Constitutional provisions related to environmental protection TLO 5.2 Explain importance of public participation (PPP) in enacting the relevant laws TLO 5.3 Use the relevant green technologies to provide sustainable solutions of an environmental problem TLO 5.4 Explain the role of information technology in environment protection	**Unit - V Enviornmental legislation and sustainable practices** 5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental protection and prevention acts 5.2 Public awareness about environment. Need of public awareness and individuals' participation. Role of NGOs 5.3 Green technologies like solar desalination, green architecture, vertical farming and hydroponics, electric vehicles, plant-based packaging 5.4 Role of information technology in environment protection and human health	Lecture Using Chalk-Board Presentations Video Demonstrations

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

•

Suggest the steps to implement (or improve the implementation) of the 5R policy in your home/institute stating your contribution
Draft an article on India's Strategies to progress across the Sustainable Development Goals
Make a chart of Renewable and non-renewable energy sources mentioning the advantages and disadvantages of each

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

source

Conduct the SWOT analysis of biodiversity hotspot in India

Prepare a mind-mapping for the zero carbon footprint process of your field

Prepare a chart showing sources of pollution (air/water/ soil), its effect on human beings, and remedial actions

Any other assignment on relevant topic related to the course suggested by the facilitator

UNICEF Certification(s)

- Students may complete the self-paced course launched by Youth Leadership for climate Exchange under UNICEF program on portal www.mahayouthnet.in . The course encompasses five Modules in the form of Units as given below: -

Unit 1: Living with climate change

Unit 2 : Water Management and Climate Action

Unit 3: Energy Management and Climate Action

Unit 4 : Waste Management and Climate Action

Unit 5 : Bio-cultural Diversity and Climate Action

If students complete all the five Units they are not required to undertake any other assignment /Microproject/activities specified in the course. These units will suffice to their evaluations under SLA component

Micro project

•

Technical analysis of nearby commercial RO plant.

Comparative study of different filters used in Household water filtration unit

Evaluate any nearby biogas plant / vermicomposting plant or any such composting unit on the basis of sustainabilityand cost-benefit

IKS-Study and prepare a note on Vedic and Pre-Vedic techniques of environmental conversion

Visit a local polluted water source and make a report mentioning causes of pollution

Any other activity / relevant topic related to the course suggested by the facilitator

Activities

•

Prepare a report on the working and functions of the PUC Center machines and its relavance in pollution control.

Prepare and analyse a case study on any polluted city of India

Prepare a note based on the field visit to the solid waste management department of the municipal corporation / local authority

Record the biodiversity of your institute/garden in your city mentioning types of vegetation and their numbers

Visit any functional hall/cultural hall /community hall to study the disposal techniques of kitchen waste and prepare a report suggesting sustainable waste management tool

Watch a video related to air pollution in India and present the summary

Any other assignment on relevant topic related to the course suggested by the facilitator

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ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	Course Code : 314301

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	Nil	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	Environment and climate change	CO1	8	4	4	4	12
2	II	Sustainability and Renewable Resources	CO2	10	4	4	8	16
3	III	Ecosystem and Biodiversity	CO3	8	4	4	4	12
4	IV	Environmental Pollution	CO4	12	4	8	6	18
5	V	Enviornmental legislation and sustainable practices	CO5	7	4	4	4	12
		Grand Total		45	20	24	26	70

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two-unit tests (MCQs) of 30 marks will be conducted and average of two-unit tests considered. Formative assessment of self learning of 25 marks should be assessed based on self learning activity such as UNICEF Certification(s)/Microproject/assignment/activities. (60 % weightage to process and 40 % to product)

Summative Assessment (Assessment of Learning)

- Online MCQ type Exam

XI. SUGGESTED COS - POS MATRIX FORM

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY   **Course Code : 314301**

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	-	-	3	2	3			
CO2	-	2	2	-	3	2	3			
CO3	-	-	-	-	3	1	2			
CO4	1	-	-	-	3	2	2			
CO5	1	-	2	-	3	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	Y. K. Singh	Environmental Science	New Age International Publishers, 2006, ISBN: 81-224-2330-2
2	Erach Bharucha	Environmental Studies	University Grants Commission, New Delhi
3	Rajagopalan R.	Environmental Studies: From Crisis to Cure.	Oxford University Press, USA, ISBN: 9780199459759, 0199459754
4	Shashi Chawla	A text book of Environmental Science	Tata Mc Graw-Hill New Delhi
5	Arvind Kumar	A Text Book of Enviornmental science	APH Publishing New Delhi (ISBN 978-8176485906)

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://sdgs.un.org/goals	United Nation's website mentioning Sustainability goals
2	http://www.greenbeltmovement.org/news-and-events/blog	Green Belt Movement Blogs on various climatic changes and other issues
3	http://www.greenbeltmovement.org/what-we-do/tree-planting-fo r-watersheds	Green Belt Movement's work on tree plantation, soil conservation and watershed management techniques
4	https://www.youtube.com/@ierekcompany/videos	International Experts For Research Enrichment and Knowledge Exchange – IEREK's platform to exchange the knowledge in fields such as architecture, urban planning, sustainability
5	www.mahayouthnet.in	UNICEF Intiative for youth leadership for climate action

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY   **Course Code : 314301**

Sr.No	Link / Portal	Description
6	https://eepmoefcc.nic.in/index1.aspx?lsid=297&lev=2&lid=1180 &langid=1	GOI Website for public awareness on enviornmetal issues
7	https://egyankosh.ac.in/handle/123456789/61136	IGNOU's Intiative for online study material on Enviornmental studies
8	https://egyankosh.ac.in/handle/123456789/50898	IGNOU's Intiative for online study material on sustainability
9	https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf	Final list of proposed Sustainable Development Goal indicators
10	https://sustainabledevelopment.un.org/memberstates/india	India's Strategies to progress across the SDGs.
11	https://www.un.org/en/development/desa/financial-crisis/sustainable-development.html	Challenges to Sustainable Development
12	https://nptel.ac.in/courses/109105190	NPTEL course on sustainable development
13	https://onlinecourses.swayam2.ac.in/cec19_bt03/preview	Swayam Course on Enviornmetal studies (Natural Resources, Biodiversity and other topics)
14	https://onlinecourses.nptel.ac.in/noc23_hs155/preview	NPTEL course on enviornmental studies which encomopasses SDGs, Pollution, Cliamate issues, Energy, Policies and legal framework
15	https://www.cbd.int/development/meetings/egmbped/SWOT-analysis-en.pdf	SWOT analysis of Biodiversity
16	https://www.sanskrit.nic.in/SVimarsha/V2/c17.pdf	Central sanskrkit university publication on Vedic and pre vedic enviornmetal conservation

Note :

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

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MSBTE Approval Dt. 21/11/2024   **Semester - 4 / 6, K Scheme**

Programme Name/s	: Automobile Engineering./ Mechanical Engineering/ Mechatronics/ Production Engineering/
Programme Code	: AE/ ME/ MK/ PG
Semester	: Third / Fourth
Course Title	: THEORY OF MACHINES
Course Code	: 313313

I. RATIONALE

Diploma Engineer should be able to identify and interpret various elements of machines in day-to-day life when they come across various machines in practice. In maintaining various machines, a Diploma Engineer should have sound knowledge of fundamentals of machine and mechanism. TOM subject imparts the kinematics involved in different machine elements and mechanisms like I.C. engine, cam-follower, belt-pulley, gear, flywheel etc. This course serves as a prerequisite for other courses such as Machine Design of higher semester etc.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

This course will enable the students to: Apply the knowledge & skills related to machine, mechanism & motions according to field applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Apply knowledge and skill related to different mechanisms and its motion in given situation.
- CO2 - Determine velocity and acceleration for given mechanism.
- CO3 - Develop a Cam profile for given type of Follower and its motions in given situation.
- CO4 - Select the suitable power transmission devices for the given field/industrial application.
- CO5 - Use knowledge and skills related to balancing of masses and vibration for various applications.

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	
313313	THEORY OF MACHINES	TOM	DSC	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125

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 Identify various links and pairs in the given mechanism. TLO 1.2 Identify various type motion in the given pair. TLO 1.3 Identify various kinematic chain in the given configuration. TLO 1.4 Estimate degree of freedom for given configuration. TLO 1.5 Explain different inversion of mechanism. TLO 1.6 Select suitable inversion of mechanism for different application.	**Unit - I Fundamentals and Types of Mechanism** 1.1 Kinematics of Machines: - Definition of statics, Dynamics, Kinematics, Kinetics, Kinematic link and its types, Kinematic pair and its types, constrained motion and its types 1.2 Kinematic chain (locked chain, constrained chain and unconstrained chain with equation), Degree of freedom (Kutzbach equation) 1.3 Mechanism and Inversion: Mechanism and Inversion of Mechanism, Difference between machine and structure. 1.4 Inversion of Kinematic Chain a) Inversion of four bar chain: Beam engine, Coupling rod of Locomotive, Watt's indicator mechanism. b) Inversion of single slider Crank chain: Reciprocating I.C. engine, Whitworth quick return mechanism, Rotary Engine, Oscillating cylinder engine, Crank and slotted lever quick return Mechanism, Hand Pump mechanism c) Inversion of Double Slider Crank Chain: Elliptical trammel, Scotch Yoke Mechanism, Oldham's Coupling	Classroom Lecture Model Demonstration Video Demonstrations Hands-on Presentations

THEORY OF MACHINES   **Course Code : 313313**

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.
2	TLO 2.1 Describe velocity and acceleration in mechanism. TLO 2.2 Draw velocity and acceleration diagram/polygon by relative velocity/ Klein's construction method following standard procedure . TLO 2.3 Determine linear and angular velocity of links in the given mechanism. TLO 2.4 Determine linear and angular acceleration of links in the given mechanism.	**Unit - II Velocity and Acceleration in Mechanism** 2.1 Concept of relative velocity and acceleration of a point on a link, Inter-relation between linear and angular velocity and acceleration. 2.2 Drawing of velocity and acceleration diagram of a given configuration, diagrams of simple Mechanisms: four bar chain and single slider crank chain (Limited up to 4 Links). 2.3 Determination of velocity and acceleration of point on link by relative velocity method (Excluding Coriolis component of acceleration) . 2.4 Klein's construction to identify velocity and acceleration of different links in single slider crank mechanism (When crank rotates with uniform velocity only).	Lecture Using Chalk-Board Video Demonstrations
3	TLO 3.1 Explain Cam and its terminology with field application. TLO 3.2 Identify the type of motion of Follower. TLO 3.3 Classify Cams and Followers. TLO 3.4 Draw Cam profile as per the given condition of Follower.	**Unit - III Cam and Follower** 3.1 Introduction to Cams and Followers, definition and applications of Cams and Followers, Cam terminology. 3.2 Classification of Cams and Followers. 3.3 Different follower motions and their displacement diagrams - Uniform velocity, simple harmonic motion, uniform acceleration and retardation. 3.4 Drawing of profile of radial Cam with knife-edge and roller Follower with and without offset (reciprocating motion only).	Lecture Using Chalk-Board Model Demonstration Video Demonstrations Presentations
4	TLO 4.1 Identify the different drives for power transmission. TLO 4.2 Select suitable drive for a particular application. TLO 4.3 Calculate various quantities like velocity ratio, belt tensions, angle of contact, power transmitted in belt drives. TLO 4.4 Enlist advantages and disadvantages of chain drive. TLO 4.5 Identify the different types of gear trains. TLO 4.6 Compare belt drive, chain drive and gear drive for given parameters.	**Unit - IV Power transmission (Belt, Chain and Gear)** 4.1 Belt Drive: a) Type of belts, flat belt, V-belt & its applications, material for flat and V-belt, Selection of belts b) Angle of lap, length of belt (No derivation), Slip and creep, Determination of velocity ratio of tight side and slack side tension, Power transmitted by belt. (numerical on power transmission by belt) 4.2 Chain Drives: Types of chains and sprockets, Advantages & Disadvantages of chain drive over other drives (No numerical on Chain drive). 4.3 Gear Drives: a) Classification of gears, Law of gearing, Concept of Conjugate profile (Involute only) Spur gear terminology. b) Types of gear trains, Train value & velocity ratio for simple, compound, reverted and epicyclic gear trains. (No numerical on Gear drive). Comparison between Belt drive, Chain drive and Gear drive	Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration

THEORY OF MACHINES   Course Code : 313313

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 Explain the concept of balancing. TLO 5.2 Find balancing mass and position of plane analytically and graphically in single plane. TLO 5.3 Explain the basic vibrating system with causes and remedies.	**Unit - V Balancing of Masses and Vibration** 5.1 Balancing of Rotating Masses: Concept of balancing: Need and types of balancing, Balancing of single rotating mass. 5.2 Analytical and Graphical methods for balancing of several masses revolving in same plane and different plane (Numerical on single plane only). 5.3 Vibration: Fundamentals of Vibration: Definition and concept of Free, Forced, Undamped, Damped vibrations. (no numerical) 5.4 Advantages and Disadvantages of Vibration, Causes and remedies of Vibration, Vibration isolators. Forced vibrations of longitudinal and torsional systems (Concepts only, No numerical and No derivation on vibration).	Lecture Using Chalk-Board Presentations Video Demonstrations Case Study

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 different mechanisms available in laboratories/institute premises LLO 1.2 Sketch the identified mechanism.	1	Identification of Mechanisms in the different laboratory and institute premises.	2	CO1 CO3 CO4
LLO 2.1 Identify number of links and pairs of given mechanism LLO 2.2 Identify input link and its motion. LLO 2.3 Identify output link and its motion	2	*Estimation of kinematic data for mechanism available in the laboratory (any one from Group A and any one from Group B) Group A: i) Beam Engine ii) Coupling rod of Locomotive, iii) Watt's indicator mechanism. Group B: i) Reciprocating engine ii) Whitworth quick return mechanism. iii) Rotary Engine iv) Crank and slotted lever quick return Mechanism v) Hand Pump mechanism	2	CO1

MSBTE Approval Dt. 02/07/2024   **Semester - 3 / 4, K Scheme**

THEORY OF MACHINES   **Course Code : 313313**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Identify number of links and pairs of given mechanism. LLO 3.2 Identify input link and its motion. LLO 3.3 Identify Output link and its motion.	3	Estimation of kinematic data for mechanism available in the laboratory (any one from Group A and any one from Group B) Group A: i) Elliptical trammel, ii) Scotch Yoke Mechanism, iii) Oldham's Coupling Group B: i) Bicycle free wheel sprocket mechanism ii) Geneva mechanism iii) Ackerman's steering gear mechanism iv) Foot operated air pump mechanism	2	CO1
LLO 4.1 Determine degree of freedom of given mechanism	4	*Degree of Freedom of given mechanism by using Kutzbach equation. (Any five mechanisms available in the Laboratory)	2	CO1
LLO 5.1 Measure the ratio of time of cutting stroke to the return stroke in shaping operation.	5	*Quick return mechanism used in a shaper machine	2	CO1
LLO 6.1 Draw velocity and acceleration polygon of four bar chain. LLO 6.2 Calculate angular velocity and linear velocity of a link using given data.	6	Velocity and Acceleration of four bar chain by relative velocity method. (Two Problem on A2 size Sheet.)	2	CO2
LLO 7.1 Draw velocity and acceleration polygon of single slider crank chain. LLO 7.2 Calculate angular velocity and linear velocity of a link using given data.	7	*Velocity and Acceleration of single slider crank chain by relative velocity method. (Two Problem on A2 size Sheet.)	2	CO2
LLO 8.1 Draw a space diagram of a single slider crank mechanism LLO 8.2 Measure the velocity and acceleration of links using Klien's construction method.	8	Velocity and Acceleration of Slider crank chain by Klien's Construction Method.	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Generate cam profile for given follower to obtain desired follower motion	9	Cam profile for knife edge Follower. (Two problem on A2 size sheet, at least one problem on offset follower)	2	CO3
LLO 10.1 Generate cam profile for given follower to obtain desired follower motion	10	Cam Profile for roller follower. (Two Problem on A2 size sheet, at least one problem on offset follower)	2	CO3
LLO 11.1 Identify displacement of follower with cam rotation	11	*Measurement of follower displacement with Cam rotation for knife edge follower and roller follower	2	CO3
LLO 12.1 Measure the angular speed using tachometer. LLO 12.2 Compute the length of belt and slip	12	*Estimation of slip, length of belt, angle of contact in an open and cross belt drive.	2	CO4
LLO 13.1 Identify the type of gears and gear train.	13	Identification of gears and gear train in Lab and Machine shop.	2	CO4
LLO 14.1 Identify the type of gears and gear train. LLO 14.2 Construct gear train for desirable velocity ratio	14	*Preparation of different Gear trains from the given gears.	2	CO4
LLO 15.1 Construct balanced system for rotating masses.	15	*Balancing of rotating unbalanced system	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)

NA

- NA

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

THEORY OF MACHINES   **Course Code : 313313**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Working Model of Beam Engine, Coupling rod of Locomotive, Watt's indicator mechanism, Reciprocating engine, Whitworth quick return mechanism, Rotary Engine, Crank and slotted lever quick return Mechanism, Hand Pump mechanism	1,2,4
2	Shaper machine available in institute workshop	1,2,4,5
3	Working Models of Elliptical trammel, Scotch Yoke Mechanism, Oldham's Coupling, Bicycle free wheel sprocket Mechanism, Geneva mechanism, Ackerman's steering gear Mechanism, Foot operated air pump mechanism	1,3,4
4	Working models of Flat belt and V belt arrangement for demonstration	1,4,12
5	Experimental cam follower set up: Machine consist of a cam shaft driven by a D.C. motor/Manual operated. The shaft runs in a double ball bearing. At the free end of the cam shaft a cam can be easily mounted. The follower is properly guided in bushes and the type of the follower can be changed to suit the cam under test. A graduated circular protractor is fitted coaxial with the shaft and a dial gauge can be fitted to note the follower displacement for the angle of cam rotation. A spring is used to provide controlling force to the follower system.	11
6	Tachometer: optical type of tachometer (digital Tachometer) Range speed minimum 0 to 2000RPM or more	12
7	Belt drive test benchA test bench comprising of following pulleys, belts, electrical motor, arrangement for adjusting belt tensions and regulating speed of the driving motor and a suitable mounting frame	12
8	Working Model of Gear Trains: i) Simple Gear Train ii) Compound Gear train iii) Reverted Gear Train iv) epicyclic Gear Train	13
9	Different types of Gears with different modules : al least 5 quantity of each gear Spur gearHelical gear (Single /double)Spiral gearBevel gear	13
10	Experimental set up to arrange gears and shaft such that desired gear train can be obtained for given velocity ratio.	14
11	Static & Dynamic Balancing MachineSingle phase motor connected to a shaft, containing 4 rotating masses. Each rotating masshas a facility to insert. Pulley is provided to add weights to balance the unbalance shaft	15
12	Working models of various Cam follower arrangements for demonstration (Radial cam with knife edge and Roller follower models are mandatory)	4,9,10,11

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	Fundamentals and Types of Mechanism	CO1	16	6	8	4	18
2	II	Velocity and Acceleration in Mechanism	CO2	10	2	4	6	12
3	III	Cam and Follower	CO3	10	4	4	6	14
4	IV	Power transmission (Belt, Chain and Gear)	CO4	16	4	8	4	16
5	V	Balancing of Masses and Vibration	CO5	8	4	4	2	10
		Grand Total		**60**	**20**	**28**	**22**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

THEORY OF MACHINES | **Course Code : 313313**

Formative assessment (Assessment for Learning)

- Laboratory Performance and Term work, Class Test I & II
- Term work (Lab Manual and drawing sheet), Question and Answers in class room as well as at the time of Practical. Note: Each practical will be assessed considering 60% and 40 % weightage.

Summative Assessment (Assessment of Learning)

- End Semester Board exam- Theory

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			
CO2	3	2	1	-	-	-	-			
CO3	3	2	3	2	-	-	1			
CO4	3	2	1	2	1	-	2			
CO5	3	2	1	2	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	A. Ghosh, A. K. Malik	Theory Of Mechanisms and Machines	Affiliated East west press ISBN: 978-8185938936
2	S. S. Rattan	Theory Of Machines	Tata McGraw Hill Edu. New Delhi, 2010, ISBN: 978-9353166281
3	R.S. Khurmi, J. K. Gupta	Theory of Machines	S. Chand and Company New Delhi, ISBN: 978-8121925242
4	J. E. Shigely, J. J. Uicker	Theory Of Machines and Mechanisms	Tata McGraw Hill Edu. New Delhi, 2010, ISBN: 978-0198062325
5	R. K. Bansal, Brar J. S.	A text book of Theory of Machine	Khanna Book Publishing CO(P) LTD, New Delhi, ISBN: 9788170084181
6	P. L. Ballaney	Theory Of Machines	Khanna Book Publishing CO(P) LTD, New Delhi, ISBN: 978-8174091222
7	Sadhu Singh	Theory of Machines	Pearson Education ISBN: 978-8131760697
8	S.S. Rao	Mechanical Vibrations	Pearson Education 2018 ISBN: 978-9353062569
9	G.K. Grover	Mechanical Vibration	978-8185240565

THEORY OF MACHINES   **Course Code : 313313**

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.mechanalyzer.com/downloads.html	Mech Analyzer is a free software developed to simulate and analyze the mechanisms
2	https://www.youtube.com/watch?v=oTcC_xXfdrA	Coupling Rod Locomotive
3	https://www.youtube.com/watch?v=8shK6kbu7Xk	Piston cylinder animation showing application of cam and gear train
4	https://www.youtube.com/watch?v=yHHeicPbEzg	Simple Beam Engine
5	https://www.youtube.com/watch?v=yHHeicPbEzg	Knife edge follower and Radial Cam
6	https://www.youtube.com/watch?v=Rib-_ZK8KfE	Roller follower with Radial Cam
7	https://www.youtube.com/watch?v=AODiJYtxuSw	Grear train animation
8	https://www.youtube.com/watch?v=klVYeSlxucU	Types of Belt drives
9	https://www.udemy.com/course/theory-of-machines-determine-de grees-of-freedom-in-a-system/	Degree of freedom
10	https://archive.nptel.ac.in/courses/112/106/112106270/	Online NPTL lectures of Theory of machine
11	https://play.google.com/store/apps/details?id=com.pinjara_im ran5290.Belt_Length_Calculator&hl=en&gl=US&pli=1	Belt length calculator Application (play store app)
12	https://psmotion.com/mechdesigner/feature/cam-design-analysi s	Design of Cam software
13	https://www.vlab.co.in/broad-area-mechanical-engineering	Virtual Lab
14	https://opac.library.iitb.ac.in/	Digital Central Library

Note :

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

MSBTE Approval Dt. 02/07/2024   **Semester - 3 / 4, K Scheme**

METROLOGY AND MEASUREMENT	Course Code : 313316

Programme Name/s	: Mechanical Engineering/ Production Engineering
Programme Code	: ME/ PG
Semester	: Third / Fourth
Course Title	: METROLOGY AND MEASUREMENT
Course Code	: 313316

I. RATIONALE

The Diploma Mechanical Engineer should understand, use and select various measuring instruments as they often come across measuring different parameters of machined components and the appropriate fitment of interchangeable components in the assemblies. Students should also be familiar with the principles of instrumentation, transducers and measurement of non-electrical parameters like, force and sound.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The diploma technician will be able to Use relevant measuring instruments for various conditions of measurement efficiently.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Select relevant linear measuring instrument for measurement.
- CO2 - Select different gauges and comparators for measurement of given components.
- CO3 - Use relevant instrument for measurement of different parameters of engineering components.
- CO4 - Select relevant instrument for measuring the physical parameters of given system.
- CO5 - Use relevant instrument for measurement of operating parameters of system.

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	
313316	METROLOGY AND MEASUREMENT	MAM	DSC	4	-	2	2	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

METROLOGY AND MEASUREMENT   **Course Code : 313316**

Total IKS Hrs for Sem. : 1 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 Define various parameters of Metrology and Measurement. TLO 1.2 Explain characteristics of measuring instruments. TLO 1.3 Explain different types of standards. TLO 1.4 Describe working principle of Linear measuring instruments. TLO 1.5 Identify errors in given instrument. TLO 1.6 Select relevant measuring instrument for the given job with justification.	**Unit - I Overview of Metrology and Linear Measurement** 1.1 Definition of Metrology, objective and types of Metrology, Need of inspection, Methods of measurements. 1.2 Characteristics of instruments – Static characteristics: Least count (resolution), Range and Span, Accuracy and Precision, Reliability, Calibration, Hysteresis, Dead Zone, Drift, Sensitivity, Threshold, Repeatability, Reproducibility, Linearity, Amplification, Magnification. Dynamic characteristics: Speed of response, Fidelity, Overshoot. 1.3 Standards: Definition and characteristics of Line standard, End standard and Wavelength standard. 1.4 Linear measuring Instruments: Working principle of Vernier caliper, micrometer, height gauge and depth gauge. 1.5 Types of Errors and its sources in Measurements, Factors affecting on accuracy. 1.6 Selection of instrument, Precautions while using an instrument for getting higher precision and accuracy.	Lecture Using Chalk-Board Presentations Video Demonstrations Demonstration
2	TLO 2.1 Explain construction and working of given comparators. TLO 2.2 Use gauges for given job with justification. TLO 2.3 Select slip gauges for building specific dimensions.	**Unit - II Gauges and Comparators** 2.1 Comparators: Definition, Requirement of a good comparator, Classification, Use of comparators, Working principle (Merits and Demerits) of Dial indicator and Pneumatic Comparator (Air Gauge), Selective Assembly, Interchangeability. 2.2 Gauges: Limit gauges. Taylor's principle of Gauge design, Plug, Ring Gauges, Snap gauges. 2.3 Slip gauges: Wringing of Slip Gauges (Numerical). Precautions	Lecture Using Chalk-Board Presentations Video Demonstrations Demonstration

METROLOGY AND MEASUREMENT | **Course Code : 313316**

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 Select Angular measuring instrument for given component and calculate unknown angle. TLO 3.2 Calculate screw thread parameters using given method. TLO 3.3 Explain procedure of measuring the given parameters of gear. TLO 3.4 Describe procedure for examining surface finish of the given component. TLO 3.5 Explain procedure for Measurement by CMM.	**Unit - III Angular, Screw Thread, Gear and Surface Finish Measurements** 3.1 Angle measurement: Instruments used in Angular Measurements: Angle Gauges (No Numerical), Bevel Protractor, sine bar. Principle of Working of Angle Dekkor. 3.2 Screw thread Measurements: Screw thread terminology, measurement of different elements such as major diameter, minor diameter, effective diameter, pitch, thread angle. Best wire size, Two wire method, Working principle of floating carriage micrometer. 3.3 Gear Measurement: Parkinson Gear tester, Gear tooth Vernier, Profile projector. 3.4 Surface Roughness Measurement: Meanings of surface texture and definitions, methods of surface measurement - Ra, Rz and RMS values (No Numerical), Principle of Interferometry, Taylors Hobsons Talysurf. 3.5 CMM: Introduction to Coordinate Measurement Machine (CMM) and its merits.	Lecture Using Chalk-Board Presentations Video Demonstrations Demonstration
4	TLO 4.1 Classify transducers for the given application. TLO 4.2 Identify the given transducer with justification. TLO 4.3 Explain displacement measuring instrument. TLO 4.4 Explain temperature measuring instruments. TLO 4.5 Interpret principles of flow measuring instruments for given system.	**Unit - IV Displacement, Temperature and Flow Measurement** 4.1 Generalized measuring system and its components. 4.2 Transducers: Classification of transducers- active and passive, contact, non-contact, Mechanical, Electrical, analog, digital. Applications of transducers. 4.3 Displacement Measurement: Specification, selection and application of displacement transducer, LVDT, RVDT, Potentiometer. 4.4 Temperature Measurement: Non-electrical methods- Bimetal and Liquid in glass thermometer. Electrical methods- RTD, Thermistor, Thermocouple. 4.5 Flow measurement: Types of flow meters. Selection criteria for flow meters. Variable area meter- Rota meter. Vane type Anemometer.	Lecture Using Chalk-Board Presentations Video Demonstrations Demonstration
5	TLO 5.1 Explain principles and constructional features of sound measuring device. TLO 5.2 Explain principles and constructional features of force measuring device. TLO 5.3 Choose speed measuring instrument for a given system with justification.	**Unit - V Miscellaneous Measurements** 5.1 Acoustics Measurement: Sound characteristics - intensity, frequency, pressure, power, sound level meter. 5.2 Force Measurement: Load cell- Hydraulic, Pneumatic and Strain Gauge 5.3 Speed Measurement: Tachometers: Eddy current Drag Cup Tachometer, Contact less Electrical tachometer - Inductive Pick Up, Capacitive Pick Up and Stroboscope.	Lecture Using Chalk-Board Presentations Video Demonstrations Demonstration

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

METROLOGY AND MEASUREMENT   **Course Code : 313316**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Use ancient measurement system for measurement of length and weight.	1	*Measurement of Length and weight by using ancient measurement system (IKS)	2	CO1 CO5
LLO 2.1 Measure dimensional parameters by using linear measuring instruments. LLO 2.2 Operate different linear measuring instruments.	2	*Measurement of dimensions of component using vernier caliper, vernier height gauge, vernier depth gauge, micrometer and inside micrometer.	2	CO1
LLO 3.1 Check the geometrical parameters of a component with the help of mechanical comparators. LLO 3.2 Operate dial gauge for different applications.	3	Roundness checking of the given component using dial indicator / dial gauge.	2	CO2
LLO 4.1 Use Bevel Protractor and Sine bar for measurement of unknown angle. LLO 4.2 Operate Bevel Protractor and Sine bar for angle measurement.	4	*Measurement of unknown angle of a component using Bevel Protractor and verification by Sine bar.	2	CO3
LLO 5.1 Use floating carriage micrometer for measurement of major, minor and effective diameter of screw threads. LLO 5.2 Operate optical profile projector for checking thread profile.	5	*Measurement of the screw thread elements by using floating carriage micrometer and verification by optical profile projector	2	CO3
LLO 6.1 Measure face width and tooth thickness of a gear by using gear tooth vernier caliper. LLO 6.2 Operate optical profile projector for measuring gear profile.	6	*Measurement of the gear tooth elements using gear tooth vernier caliper and verification by optical profile projector.	2	CO3
LLO 7.1 Examine the machined surface using surface roughness tester.	7	*Measurement of the surface roughness of machined surface by using surface roughness tester.	2	CO3
LLO 8.1 Use different optical flats for measurement of surface flatness. LLO 8.2 Identify the types of observed fringe patterns of optical flats.	8	Measurement of flatness of given component by using optical flats.	2	CO3
LLO 9.1 Use Autocollimator / Angle Dekkor for measurement of angle or taper of given component.	9	Measurement of the unknown angle of a given component by Autocollimator / Angle Dekkor.	2	CO3
LLO 10.1 Measure displacement of micrometer by using LVDT. LLO 10.2 Use LVDT for measurement of linear displacement.	10	*Measurement of displacement by using Linear Variable Displacement Transducer (LVDT).	2	CO4
LLO 11.1 Measure temperature of a system by using thermometer. LLO 11.2 Use Thermocouple for measurement of temperature of given system.	11	Measurement of temperature by thermocouple and Verification by thermometer.	2	CO4

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METROLOGY AND MEASUREMENT **Course Code : 313316**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 12.1 Measure the flow rate of liquid by rotameter.	12	Measurement of flow rate of liquid by rotameter.	2	CO4
LLO 13.1 Measure given weights by using Load Cell.	13	*Measurement of weight by using a load cell.	2	CO5
LLO 14.1 Measure sound level using sound meter	14	Sound intensity measurement using sound meter	2	CO5
LLO 15.1 Measure the speed of rotating shaft by stroboscope or inductive pick up. LLO 15.2 Use stroboscope or inductive pick up for measurement of speed of rotating shaft.	15	Measurement of speed of rotating shaft by stroboscope or inductive pick up.	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

- 1)Comparative study of various linear measuring instruments like steel rule, Inside-outside micrometer, Vernier caliper and Digital caliper with proper justification.
2)Comparative study of surface finish of various samples machined by various machining / finishing processes using surface roughness tester.
3)Prepare a report on calibration procedure of Vernier Caliper and Micrometer followed by NABL Lab.
4)Prepare a visit report on measurement systems used in near by industries / SME / Workshops / Fabrication shops.
5)Perform comparative study of different contact and non contact type transducers / sensors.
6)Visit to Automobile service station, observe the different sensors used in cars and prepare a report of the same. (Name, Use, Location, Working, Applications)

Assignment

- 1)Prepare a report to interpret effect of errors on the accuracy of instrument and measurement.
2)Visit to any nearby shop or industry and list out different gauges used for inspection along with its purpose.
3)Prepare a comparative study of different screw threads measuring instruments on the basis of their least count, accuracy, cost, ease of operation
4)Prepare a short report on different types of Rotameter.
5)Prepare a set of procedure for sound measurement with suitable instrument.

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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	Inductive transducer – measurement range 0 to 100mm – sensor – inducive (nonlinear) solenoid type onboard with micrometer, micrometer screw gauge assembly for displacement, bridge balance type circuit Display 3.5-digit display	10
2	Sensor – type K (Cr-AI) thermocouple, sensor assembly and water bath with heating arrangement Display 3.5-digit display.	11
3	Rotameter -Trainer -sensor – standard glass rotameter, process tank with motor pump display – flat position on graduated scale.	12
4	Load cell – Force measurement range 5-50N – sensor 4 arm bridge with strain gauge capacity – 2Kg 3.5-digit display	13
5	Sound level meter: Measuring range 30-130 dB, portable and easy to use	14
6	Multi digital Stroboscope cum Tachometer for speed measurement – up to 5000 rpm.	15
7	Vernier Calipers (0-200 mm)	2
8	Vernier Height Gauge and Depth Gauge. (0-300 mm)	2
9	Outside Micrometer (0-25mm, 25-50mm)	2
10	Inside Micrometer 0-25mm	2
11	Surface Plate-Granite (24 x 36 inch)	2,4,7
12	Dial indicator (0-25mm) with magnetic stand.	3,4
13	Universal bevel protractor Graduation: 5 min (0 deg-90 deg -0 deg)	4
14	Sine bar, Sine Center (0-200mm)	4
15	Floating Carriage Micrometer: Least Count 0.001mm; Standard micrometer or electronic type; Non rotary 8mm micrometer spindle; Indicator with 0.001 standard dial; admit between center 200mm; Max diameter capacity 100mm; Standard accuracy ± 0.005mm.	5
16	Profile projector with gear profile / Thread profile templates. Opaque fine grained ground glass screen with 90o, 60o, 30o cross line Location; fitted with graduated ring (0 to 360 o) L.C. 1 min; Optics Std 10X, 20X, Measuring Range Std 100mm X 100mm; opt X axis up to 400mm, Y axis up to 200mm; Focusing Travel 100mm; Magnification Accuracy Contour ± 0.05% Surface ± 0.05%; Illumination Countor 24V / 150W halogen lamp with illumination control; Resolution 0.005/0.001/0.0005 mm.	5,6
17	Surface roughness Tester (Max Sampling length 0.8 mm) having profile printing facility.	7
18	Optical flats set range (0.2 μm) Diameter / Thickness 45/12mm and 60/15mm.	8
19	Angle Dekkor and Autocollimator (0 to 30')	9

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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	Overview of Metrology and Linear Measurement	CO1	12	4	4	6	14
2	II	Gauges and Comparators	CO2	10	2	6	4	12
3	III	Angular, Screw Thread, Gear and Surface Finish Measurements	CO3	18	4	6	10	20
4	IV	Displacement, Temperature and Flow Measurement	CO4	12	2	4	8	14
5	V	Miscellaneous Measurements	CO5	8	2	4	4	10
		Grand Total		**60**	**14**	**24**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

• Term work (Lab Manual), Self-Learning (Assignment) Question and Answers in class room, quiz and group discussion. Note: Each practical will be assessed considering-60% weightage to process related and 40 % weightage to product related.

Summative Assessment (Assessment of Learning)

• Practical Examination, Pen and Paper Test

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	1	1	2	1	-	2			
CO2	2	2	2	3	1	-	2			
CO3	2	2	2	3	1	-	2			
CO4	2	2	2	3	1	-	1			
CO5	1	2	1	3	1	-	1			

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

METROLOGY AND MEASUREMENT   **Course Code : 313316**

Sr.No	Author	Title	Publisher with ISBN Number
1	N.V. RAGHAVENDRA and L. KRISHNAMURTHY	ENGINEERING METROLOGY AND MEASUREMENTS	Oxford University Press, New Delhi, India ISBN-13: 978-0-19-808549-2. (2013)
2	Anand K Bewoor and Vinay A Kulkarni	METROLOGY AND MEASUREMENTS	Tata McGraw-Hill Education Private Limited, New Delhi , India ISBN (13): 978-0-07-014000-4 (2017)
3	R K Jain	Engineering Metrology	Khanna Publication, New Delhi, ISBN-10:817409153X (2022)
4	R. K. Rajput	Engineering Metrology & Instrumentation	S.K. Kataria and Sons ISBN:9788185749822 (2009)
5	R K Jain	Mechanical and Industrial Measurements	Khanna Publication, New Delhi ISBN: 8174091912 (1995)
6	Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard ·	Mechanical Measurements	Pearson Prentice Hall ISBN:9780136093763 (2013)

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://onlinecourses.nptel.ac.in/noc20_me94/preview	NPTEL MOOCS course on Engineering Metrology
2	https://onlinecourses.nptel.ac.in/noc23_me09/preview	NPTEL MOOCS course on Mechanical measurement systems.
3	https://www.youtube.com/watch?v=Hi7NUJdznc0	Video Lecture on Engineering Metrology by IIT Madras.
4	http://www.digimat.in/nptel/courses/video/112106179/L33.html	Video Lecture on Electrical and electronic comparators, Optical comparators NPTEL Video Course : Metrology
5	https://www.bing.com/videos/riverview/relatedvideo?&q=videos+on+CMM+measurement+IIT&&mid=6C0843737C0E8F2019006C0843737C0E8F201900&&FORM=VRDGAR	Video on Part inspection by using CMM
6	https://www.bing.com/videos/riverview/relatedvideo?q=videos+on+screw+thread+measurement+IIT&&view=riverview&mmscn=mtsc&mid=9850B2C61C0872810AC19850B2C61C0872810AC1&&aps=196&FORM=VMSOVR	Measurement of screw thread elements.
7	https://www.bing.com/videos/riverview/relatedvideo?&q=videos+on+displacement+measurement&&mid=53BAFCB5E8DA5553247253BAFCB5E8DA55532472&&FORM=VRDGAR	Potentiometer Working Principle

METROLOGY AND MEASUREMENT   **Course Code : 313316**

Sr.No	Link / Portal	Description
8	https://www.bing.com/videos/riverview/relatedvideo?&q=bimeta llic+temperature+measurement+devices&&mid=3ADB81DF5F95342EE5 B53ADB81DF5F95342EE5B5&&FORM=VRDGAR	How Bimetallic Temperature Gauges Works
9	https://www.bing.com/videos/riverview/relatedvideo?&q=flow+m easurement+devices+rotameter&&mid=145B5C41696FC6AFF30B145B5C 41696FC6AFF30B&&FORM=VRDGAR	Flow Measurement Devices
10	https://www.bing.com/videos/riverview/relatedvideo?&q=carbon +microphone&&mid=B08AB66B421E46892B46B08AB66B421E46892B46&&F ORM=VRDGAR	Build a carbon microphone with a soda can and a paper clip
11	https://www.bing.com/videos/riverview/relatedvideo?&q=hair+h ygrometer+working+principle&&mid=20C836F03B5418F173D620C836F 03B5418F173D6&&FORM=VRDGAR	Actual working of Hair Hygrometer

Note :

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

MSBTE Approval Dt. 02/07/2024   **Semester - 3 / 4, K Scheme**

MECHANICAL ENGINEERING MATERIALS	Course Code : 313317

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	Paper Duration	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH			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		
313317	MECHANICAL ENGINEERING MATERIALS	MEM	DSC	3	-	2	1	6	3	1.5	30	70*#	100	40	25	10	-	-	25	10		150

MECHANICAL ENGINEERING MATERIALS | **Course Code : 313317**

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

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MECHANICAL ENGINEERING MATERIALS | **Course Code : 313317**

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.
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
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

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 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

MECHANICAL ENGINEERING MATERIALS   **Course Code : 313317**

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

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

MECHANICAL ENGINEERING MATERIALS   **Course Code : 313317**

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
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)	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

MSBTE Approval Dt. 02/07/2024   **Semester - 3 / 4, K Scheme**

MECHANICAL ENGINEERING MATERIALS **Course Code : 313317**

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
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=PLyqSpQzTE6 M_ON8uXt-PP8uX6hMWJeYSJ&index=3	Crystal structure
4	https://www.youtube.com/watch?v=c1ZbiBIY6Sc&list=PLxQzQgOy_J vYd32Y6XOwFOnVc4_Dkv7v6&index=38	Ceramics
5	https://www.youtube.com/watch?v=04K0bLwCDdM	Composite materials
6	https://vedicheritage.gov.in/vedic-heritage-in-present-conte xt/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

PRODUCTION PROCESSES	Course Code : 314340

Programme Name/s : **Mechanical Engineering/ Production Engineering**

Programme Code : **ME/ PG**

Semester : **Fourth**

Course Title : **PRODUCTION PROCESSES**

Course Code : **314340**

I. RATIONALE

This course is designed to elevate students knowledge of production processes by engaging them in analyzing and evaluating various production processes. Students will progress from understanding of basic concepts to selecting appropriate production methods for specific engineering applications. The aim of this course is to increase the ability to make effective decisions in production planning and control.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Select relevant production processes in different industrial/field applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Use appropriate CNC machine as per given application.
- CO2 - Prepare the component using grinding and various finishing operation.
- CO3 - Produce gears using various gear manufacturing methods.
- CO4 - Select the press and its components for various applications.
- CO5 - Select suitable Non-Traditional machining process for given component.

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	
314340	PRODUCTION PROCESSES	PPR	DSC	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125

Total IKS Hrs for Sem. : 2 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 Classify CNC machines. TLO 1.2 List functions of different elements of CNC machine. TLO 1.3 Draw a basic schematic diagram of a CNC machine, labeling key components. TLO 1.4 Explain the different constructional details of CNC machine. TLO 1.5 Explain the various inserts used in CNC machine.	**Unit - I Fundamentals of CNC machine** 1.1 Introduction: Definition, advantages and applications of CNC 1.2 Classification of CNC: Point-to-point, continuous path, straight path, absolute and incremental co-ordinate system, open loop and closed loop control system. 1.3 Constructional elements of CNC: Machine structure- Bed, slide ways, column and tables.Spindle drives- Stepper motor, servo motor & hydraulic motor. Movement's actuators- re-circulating ball screw, linear motion bearings. Feedback elements- Positional and velocity feed backs. Automatic tool changer- Tool magazine, turret head. Pallet changer- Linear and rotary pallet changer. 1.4 Tooling: Indexable inserts, ISO code and nomenclature	Lecture Using Chalk-Board Presentations Video Demonstrations

PRODUCTION PROCESSES   **Course Code : 314340**

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.
2	TLO 2.1 Define the surface finish. TLO 2.2 Designate the grinding wheels. TLO 2.3 Explain process of grinding wheel dressing and truing. TLO 2.4 Explain construction and working of different grinding machines. TLO 2.5 Explain the different superfinishing process	**Unit - II Grinding and Superfinishing** 2.1 Introduction: Definition of surface finish. Significance of grinding in manufacturing. 2.2 Grinding wheels: Abrasives, Grit size, Grade structure and bond type. 2.3 Grinding wheel dressing and truing-Purpose and methods 2.4 Types of Grinding machines: Construction and working of Surface, cylindrical and Internal grinders. 2.5 Super finishing Processes: Lapping, Honing, Buffing, Polishing etc.	Lecture Using Chalk-Board Presentations Video Demonstrations
3	TLO 3.1 List different gear cutting methods. TLO 3.2 Explain the working principle of gear cutting methods. TLO 3.3 Differentiate amongst different gear cutting methods. TLO 3.4 Identify typical applications of gear shaping for different gear types. TLO 3.5 Explain the working principle of various gear manufacturing methods. TLO 3.6 List different gear finishing methods. TLO 3.7 State the importance of gear finishing.	**Unit - III Gear Manufacturing Methods** 3.1 Importance of gear cutting, Gear manufacturing methods. 3.2 Gear Milling: Types of milling operations for gear manufacturing, cutter selection, advantages, limitations, and applications. 3.3 Gear Shaping Process: Basics of gear shaping, tooling requirement, machining considerations, advantages, limitations, and applications. 3.4 Gear Broaching Process: Working Principle, broaches for gear teeth, applications and limitations of gear broaching. 3.5 Gear Hobbing: Working principle, equipment setup, cutting parameters, advantages, disadvantages, and applications. 3.6 Gear Finishing methods: Importance and need of gear finishing, Introduction to Gear Finishing processes like Gear grinding, Gear Honing, Gear Burnishing, Gear Lapping	Lecture Using Chalk-Board Presentations Video Demonstrations
4	TLO 4.1 Name different sheet metals used in press industry. TLO 4.2 Classify press. TLO 4.3 Name different components of press. TLO 4.4 Explain working of press with neat sketch. TLO 4.5 Compare between Jigs and Fixtures. TLO 4.6 Explain locations methods of jigs and fixtures. TLO 4.7 Explain the principle of Jig and fixtures.	**Unit - IV Press and Accessories** 4.1 Introduction: Common sheet metals used in industry. 4.2 Presses and their classification: Mechanical, Hydraulic and Pneumatic, Selection criteria for presses (Force, Speed, Production volume and type of operation) 4.3 Press tools and dies: Components of press tool. 4.4 Jigs and Fixtures: Introduction, Types, Principles of Jigs and fixtures, Methods of location.	Lecture Using Chalk-Board Presentations Video Demonstrations

PRODUCTION PROCESSES   **Course Code : 314340**

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 Non traditional machining processes. TLO 5.2 List the factors to be considered for non-traditional process selection . TLO 5.3 Explain working principle of USM/EDM/ECM/LBM process. TLO 5.4 Compare various Non traditional processes on given parameters. TLO 5.5 State the factors considered for process selection of Non traditional machining. TLO 5.6 Describe the RP cycle. TLO 5.7 Draw block diagram of CIM.	**Unit - V Non-Traditional Machining Processes** 5.1 Need for Non-Traditional Machining processes, Limitations of conventional processes, Classification of Non-Traditional Processes, Factors considered for process selection. 5.2 Electrical Discharge Machine(EDM) : Working Principle, Process parameters, applications, advantages, and disadvantages. 5.3 Ultrasonic Machining(USM): Working Principle, Process parameters, applications, advantages, and disadvantages. 5.4 Electrochemical Machining (ECM): Working Principle, Process parameters, applications, advantages, and disadvantages. 5.5 Laser Beam Machining (LBM): Working Principle, Process parameters, applications, advantages, and disadvantages. 5.6 Rapid Prototyping (RP):Introduction,Definition Cycle and applications 5.7 Computer Integrated Manufacturing (CIM): Introduction, Components of CIM, Benefits of CIM.	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 Identify different components of CNC LLO 1.2 Set the machine for given operation by using suitable parameters	1	*CNC machine.	2	CO1
LLO 2.1 Perform the surface grinding machine to finish the given job surface. LLO 2.2 Compare the pre finish and post finish condition using surface tester.	2	*Preparation of given job using Surface Grinding operation.	4	CO2
LLO 3.1 Use of grinding and lapping machine for finishing the given job surface with different surface finish operations. LLO 3.2 Compare the surface finish with justification.	3	Comparison of surface finish using i. Grinding machine ii. Lapping operation	4	CO2
LLO 4.1 Calculate the number of teeth of gears using dividing head. LLO 4.2 Measure the dimensions of gear teeth thickness.	4	*Required data for gear manufacturing.	4	CO3
LLO 5.1 Prepare given sheet metal component as per given drawing. LLO 5.2 Fabricate any sheet metal utility job as per drawing. (any one)	5	*Manufacturing of a sheet metal component	2	CO4

PRODUCTION PROCESSES | **Course Code : 314340**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Prepare a Jig as per requirement using relevant principles. LLO 6.2 Prepare a Fixture as per requirement using relevant principles.	6	Jig/Fixture Manufacturing for different machines available in workshop.	6	CO4
LLO 7.1 Prepare a colored chart showing working principle of non-traditional machining process.	7	*Non Traditional machining processes (any two).	2	CO5
LLO 8.1 Prepare a colored chart showing constructional features of non-traditional machining process.	8	Non Traditional machining processes (any two).	4	CO5
LLO 9.1 Collect information regarding tool sharpening methods in ancient India.	9	*Information collection for tool sharpening in ancient India.(IKS)	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) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	CNC Turning 250 with standard accessories and multi controller changing facility with simulated control panel and related software. Training or Productive type minimum diameter 25 mm, Length 120 mm with ATC, (Suggested)	1
2	CNC Milling 250 with standard accessories and multi-controller changing facility with simulated control panel and related software. Training or Productive type-X axis travel - 225 mm, Y axis travel - 150 mm, Z axis travel - 115 mm, with ATC. (Suggested)	1
3	Surface Grinder (200*13*31.75) Spindle speed 2800 rpm; Surface Table-225*450 mm Vertical Feed Graduation 0.01 mm 0.01 mm, Cross Feed Graduation 0.05 mm 0.05 mm	2
4	Semi automatic Lapping machine,Dimension:30 X 28 X 47, 1 KW,230 V,50 Hz,	2,3
5	Milling machine, face milling cutter, side and face milling cutter, end mill cutter. Minimum 500 mm longitudinal traverse, with required indexing head, set of work holding devices, cutting tools, accessories, and tool holders.	4,6
6	Hydraulic Press Machine 10 Ton,Non CNC,H ype, 230 V,50Hz,Semi-automatic (10-50 Ton),	5
7	Centre lathe machine. (Length between centers 1000 mm, swing 500 mm,) 3 Jaw self centred chuck,Chucking Diameter Range 25-200 mm,	6
8	Drilling Machine (drill diameter up to 40 mm),1.5 HP, Base size 500 x 500,Spindle Speed 110-1500 rpm, Drilling Capacity 40 mm,	6

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

PRODUCTION PROCESSES   **Course Code : 314340**

Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of CNC machine	CO1	10	2	4	6	12
2	II	Grinding and Superfinishing	CO2	10	2	4	6	12
3	III	Gear Manufacturing Methods	CO3	15	4	6	8	18
4	IV	Press and Accessories	CO4	15	4	6	8	18
5	V	Non-Traditional Machining Processes	CO5	10	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 Term Work -25 Marks ; For Self Learning-25 Marks

Summative Assessment (Assessment of Learning)

- End Semester Assessment of 70 Marks

XI.   SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	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	-	-	3	-	-	2			
CO2	3	2	2	3	-	-	2			
CO3	3	3	2	3	-	-	2			
CO4	3	3	2	3	-	-	2			
CO5	3	-	-	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	Rao P.N.	Manufacturing Technology Vol-2	McGraw Hill, New Delhi, ISBN: 9789353160524,July 2018, Fourth Edition

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PRODUCTION PROCESSES   **Course Code : 314340**

Sr.No	Author	Title	Publisher with ISBN Number
2	S K Hajra Choudhury, A K Hajra Choudhury, Nirjhar Roy	Elements Of Workshop Technology Vol-2	Media Propoters & Publisher PVT. LMT., ISBN: 978-8-185-09915-6,Jan 2010,Fifteenth Edition.
3	O. P. Khanna & Lal	Production Technology Volume- II	Dhanpat Rai Publications ISBN: 978-81-7409-099-7,1976,Nineteenth Edition.
4	Dr.P.C.Sharma	Production Technology	S.Chand Publications.ISBN: 978-93-550-1069-8,Dec 2006,Seventh Edition.
5	P.K.Mishra	Non-conventional Machining	Narosa Publishing House ISBN: 978-8173191381,Jan 1997,Reprint 2018.
6	S.F.Krar,A.R.Gill,P.Smid	Technology of Machine Tools	Tata-McGraw Hill ISBN: 9781260087932,April 2019, Eighth Edition.
7	Mikell P.Groover	Fundamentals of Modern Manufacturing	John Wiley & Sons, Inc.ISBN: 978-1-119-47521-7,Jan 2010,Fourth Edition.
8	Kenneth G. Cooper	Rapid Prototyping Technology	Marcel Dekker Inc.ISBN :9780824702618,Jan 2001,First Edition.

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://youtu.be/Oy875yOH1bc	CNC Machine Animation
2	https://youtu.be/jh8852sfhpw	Ultrasonic machining animation
3	https://youtu.be/06QxjEAMrKc?list=PLwFw6Nkm8oWqFJUxiUuu5c0uHK076lz2K	Non-conventional machining

Note :

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

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MSBTE Approval Dt. 21/11/2024   **Semester - 4, K Scheme**

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS	Course Code : 314014

Programme Name/s	**: Architecture Assistantship/ Automobile Engineering./ Agricultural Engineering/ Architecture/** **Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ Food Technology/ Instrumentation & Control/** **Instrumentation/ Interior Design & Decoration/ Interior Design/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Medical Electronics/ Production Engineering/** **Printing Technology/ Surface Coating Technology/ Textile Technology/ Travel and Tourism/** **Textile Manufactures**
Programme Code	**: AA/ AE/ AL/ AT/ DC/ DD/ FC/ IC/ IS/ IX/ IZ/ ME/ MK/ ML/ MU/ PG/ PN/ SC/ TC/ TR/ TX**
Semester	**: Fourth / Fifth / Sixth**
Course Title	**: ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS**
Course Code	**: 314014**

I. RATIONALE

Entrepreneurship and Startup is introduced in this curriculum to develop the entrepreneurship traits among the students before they enter into the professional life. By exposing and interacting with entrepreneurship and startup eco-system, student will develop the entrepreneurial mind set. The innovative thinking with risk taking ability along with other traits are to be inculcated in the students through micro projects and training. This exposure will be instrumental in orienting the students in transforming them to be job generators after completion of Diploma in Engineering.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

• Develop project proposals for launching small scale enterprises and starts up.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify one's entrepreneurial traits.
- CO2 - Use information collected from stakeholder for establishing/setting up/founding starts up
- CO3 - Use support systems available for Starts up
- CO4 - Prepare project plans to manage the enterprise effectively

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		
314014	ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS	EDS	AEC	1	-	2	1	4	2	-	-	-	-	-	50	20	25@	10	25	10	100	

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS | **Course Code : 314014**

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 Compare advantages and disadvantages of Entrepreneurship TLO 1.2 Identify entrepreneurial traits through self-analysis TLO 1.3 Compare risk associated with different type of enterprise	**Unit - I Introduction to Entrepreneurship Development** 1.1 Entrepreneurship as a career – charms, advantages, disadvantages , scope- local and global 1.2 Traits of successful entrepreneur: consistency, creativity, initiative, independent decision making, assertiveness, persuasion, persistence, information seeking, handling business communication, commitment to work contract, calculated risk taking, learning from failure 1.3 Types of enterprises and their features : manufacturing, service and trading	Presentations Lecture Using Chalk-Board
2	TLO 2.1 Explain Important factors essential for selection of product/service and selection of process TLO 2.2 Suggest suitable place for setting up the specified enterprise on the basis of given data/circumstances with justification. TLO 2.3 Suggest steps for the selection process of an enterprise for the specified product or service with justification. TLO 2.4 Plan a market study /survey for the specified enterprise	**Unit - II Startup Selection Process** 2.1 Product/Service selection: Process, core competence, product/service life cycle, new product/ service development process, mortality curve, creativity and innovation in product/ service modification / development 2.2 Process selection: Technology life cycle, forms and cost of transformation, factors affecting process selection, location for an industry, material handling. 2.3 Market study procedures: questionnaire design, sampling, market survey, data analysis 2.4 Getting information from concerned stakeholders such as Maharashtra Centre for Entrepreneurship Development[MCED], National Institute for Micro, Small and Medium Enterprises [NI-MSME], Prime Minister Employment Generation Program [PMEGP], Directorate of Industries[DI], Khadi Village Instries Commission[KVIC]	Presentations Lecture Using Chalk-Board

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS   **Course Code : 314014**

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 Explain categorization of MSME on the basis of turnover and investment TLO 3.2 Describe support system provided by central and state government agencies TLO 3.3 State various schemes of government agencies for promotion of entrepreneurship TLO 3.4 Describe help provided by the non-governmental agencies for the specified product/service TLO 3.5 Compute breakeven point, ROI and ROS for the specified business enterprise, stating the assumptions made	**Unit - III Support System for Startup** 3.1 Categorization of MSME, ancillary industries 3.2 Support systems- government agencies: MCED, NI-MSME, PMEGP,DI, KVIC 3.3 Support agencies for entrepreneurship guidance, training, registration, technical consultation, technology transfer and quality control, marketing and finance. 3.4 Breakeven point, return on investment (ROI) and return on sales (ROS).	Presentations Lecture Using Chalk-Board
4	TLO 4.1 Explain key elements for the given business plan with respect to their purpose/size TLO 4.2 Justify USP of the given product/ service from marketing point of view. TLO 4.3 Formulate business policy for the given product/service. TLO 4.4 Choose relevant negotiation techniques for the given product/ service with justification TLO 4.5 Identify risks that you may encounter for the given type of business/enterprise with justification. TLO 4.6 Describe role of the incubation centre and accelerators for the given product/service.	**Unit - IV Managing Enterprise** 4.1 Techno commercial Feasibility study, feasibility report preparation and evaluation criteria 4.2 Ownership, Capital, Budgeting, Matching entrepreneur with the project 4.3 Unique Selling Proposition [U.S.P.]: Identification, developing a marketing plan. 4.4 Preparing strategies of handling business: policy making, negotiation and bargaining techniques 4.5 Risk Management: Planning for calculated risk taking, initiation with low cost projects, integrated futuristic planning, definition of startup cycle, ecosystem , angel investors, venture capitalist 4.6 Incubation centers and accelerators : Role and procedure	Presentations Lecture Using Chalk-Board

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 Collect information of successful entrepreneurial traits	1	*Preparation of report on entrepreneurship as a career	2	CO1
LLO 2.1 Identify different traits as an entrepreneur from various field LLO 2.2 Suggest different traits from identified problem	2	Case study on 'Traits of Entrepreneur'	2	CO1

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ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS | **Course Code : 314014**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Explore probable risks for identified enterprise.	3	*Case study on 'Risks associated with enterprise	2	CO1
LLO 4.1 Identify new product for development LLO 4.2 Prepare a newly developed product	4	*Preparation of report on 'Development of new Product'	2	CO1 CO2
LLO 5.1 Identify Process for development of product for new startup	5	Preparation of Report on ' Process selection ' for new startup	2	CO1 CO2 CO3
LLO 6.1 Develop questioner for market survey	6	*Market survey for setting up new Start up	2	CO2 CO3
LLO 7.1 Interpret the use of Technology Life Cycle	7	A Case study on ' Technology life cycle' of any successful entrepreneur.	2	CO3
LLO 8.1 Use information related to support of startups from Government and non-government agencies' LLO 8.2 Prepare report for setting up startup	8	*Preparation of report on 'Information for setting up new startup' from MCED/MSME/KVIC etc	2	CO3 CO4
LLO 9.1 Compute ROI of successful enterprise.	9	Case study on 'Return on Investment (ROI)'of any successful startup	2	CO3
LLO 10.1 Calculate of ROS of any successful enterprise	10	Case study on 'Return on sales (ROS)'of any successful startup	2	CO3
LLO 11.1 Calculate Brake even point of any enterprise	11	Preparation of report on 'Brake even point calculation' of any enterprise.	2	CO3 CO4
LLO 12.1 Prepare feasibility report of given business	12	*Preparation of report on 'feasibility of any Techno-commercial business"	2	CO4
LLO 13.1 Plan a USP of any enterprise.	13	*A case study based on 'Unique selling Proposition (USP) of any successful enterprise	2	CO4
LLO 14.1 Prepare a project report using facilities of Atal Incubation center.	14	*Prepare project report for starting new startup using 'Atal incubation center (AIC)	2	CO1 CO2 CO3 CO4

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 a ' Women entrepreneurship business plan ' Choose relevant government scheme for the product/service
- Prepare a 'Pitch- desk' for your start up
- Prepare a business plan for a. Market research b. Advertisement agency c. Placement Agency d. Repair and Maintenance agency e. Tour and Travel agency
- Prepare a 'Social entrepreneurship business plan, plan for CSR funding.

ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS | **Course Code : 314014**

- Prepare a business plan for identified projects by using entrepreneurial eco system for the same (Schemes, incentives, incubators 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	Computers with internet and printer facility	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	Introduction to Entrepreneurship Development	CO1	5	0	0	0	0
2	II	Startup Selection Process	CO2	4	0	0	0	0
3	III	Support System for Startup	CO3	3	0	0	0	0
4	IV	Managing Enterprise	CO4	3	0	0	0	0
		Grand Total		**15**	**0**	**0**	**0**	**0**

X.   ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

Summative Assessment (Assessment of Learning)

- End of Term Examination - Viva-voce

XI.   SUGGESTED COS - POS MATRIX FORM

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ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS   **Course Code : 314014**

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	2	-	3	2			
CO3	2	2	2	2	-	3	2			
CO4	2	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	Dr. Nishith Dubey, Aditya Vyas , Annu Soman , Anupam Singh	Un- boxing Entrepreneurship your self help guide to setup a successful business	Indira Publishing House ISBN-2023,978-93-93577-70-2
2	Gujral, Raman	Reading Material of Entrepreneurship Awareness Camp	Entrepreneurship Development Institute of India (EDI), GOI, 2016 Ahmedabad
3	Chitale, A K	Product Design and Manufacturing	PHI Learning, New Delhi, 2014; ISBN: 9788120348738
4	Charantimath, Poornima	Entrepreneurship Development Small Business Entrepreneurship	Pearson Education India, New Delhi; ISBN: 9788131762264
5	Khanka, S.S.	Entrepreneurship and Small Business Management	S.Chand and Sons, New Delhi, ISBN: 978-93-5161-094-6

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.mced.nic.in/allproduct.aspx	MCED Product and Plan Details
2	http://niesbud.nic.in/Publication.html	The National Institute for Entrepreneurship and Small Business Development Publications
3	http://niesbud.nic.in/docs/1standardized.pdf	Courses : The National Institute for Entrepreneurship and Small Business Development
4	https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530	Government Schemes
5	https://www.nabard.org/Tenders.aspx?cid=501andid=24	NABARD - Information Centre
6	http://www.startupindia.gov.in/pdffile.php?title=Startup%20India%20Action%20Planandtype=Actionandq=Action%20Plan.pdfandcontent_type=Actionandsubmenupoint=action	Start Up India
7	http://www.ediindia.org/institute.html	About - Entrepreneurship Development Institute of India (EDII)

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ENTREPRENEURSHIP DEVELOPMENT AND STARTUPS | **Course Code : 314014**

Sr.No	Link / Portal	Description
8	http://www.nstedb.com/training/training.htm	NSTEDB - Training

Note :

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

MSBTE Approval Dt. 21/11/2024

Semester - 4 / 5 / 6, K Scheme

BASICS OF MECHATRONICS   **Course Code : 314017**

Programme Name/s	**: Mechanical Engineering**
Programme Code	**: ME**
Semester	**: Fourth**
Course Title	**: BASICS OF MECHATRONICS**
Course Code	**: 314017**

I. RATIONALE

Mechanical diploma engineer has to work on various multidisciplinary systems under the umbrella of Mechatronics. The goal of the course is to develop an understanding of basic elements underlying mechatronics systems viz. sensors, actuators, PLC, and control software etc.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use appropriate sensors, actuators and controller for given mechatronics system(s).

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify basic elements of mechatronics system such as sensors, actuators, controllers etc.
- CO2 - Use sensors for different mechatronics systems
- CO3 - Use actuators for different mechatronics systems
- CO4 - Develop PLC program for various mechatronics systems
- CO5 - Use microcontroller for different mechatronics systems

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme Actual Contact Hrs./Week CL	TL	LL	SLH	NLH	Credits	Paper Duration	Theory FA-TH Max	SA-TH Max	Total Max	Min	Based on LL & TL Practical FA-PR Max	Min	SA-PR Max	Min	Based on SL SLA Max	Min	Total Marks
314017	BASICS OF MECHATRONICS	BOM	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 Compare traditional system and mechatronics systems with the help of block diagram TLO 1.2 Identify sensor, actuators in the given diagram of the mechatronic system with justification	**Unit - I Fundamental of Mechatronics** 1.1 Introduction : Definition of Mechatronics, Mechatronics in Manufacturing products 1.2 Comparison between Traditional and Mechatronics approach 1.3 Block diagram representation of General Mechatronics system showing various components with suitable example	Chalk board Display charts
2	TLO 2.1 Explain the working of the given sensor TLO 2.2 Select the relevant sensor for the given application TLO 2.3 Differentiate between sensor and transducer TLO 2.4 Explain with sketches working principle of given type of thermal, optical, electric sensors	**Unit - II Sensors and Transducers** 2.1 Sensors and transducers: Definition, difference, classification 2.2 Thermal, optical, electric sensors 2.3 Transducers: Need of transducers, types of transducers: primary, secondary, active, passive, analog and Digital 2.4 Selection criteria of sensor and transducer	Demonstration of actual devices Chalk board NPTEL Video
3	TLO 3.1 Explain with sketches the working of the given Pneumatic actuator with sketch and block diagram TLO 3.2 Explain with sketches the working of the given Hydraulic actuator with sketch and block diagram TLO 3.3 Select the relevant actuator for the given application	**Unit - III Actuators** 3.1 Introduction and Classification of Actuators Need and Scope 3.2 Pneumatic Actuation system: Single and Double acting actuators 3.3 Hydraulic Actuation system: Single and Double acting actuators 3.4 Electric Actuation system: Solenoid, relay, stepper motors	Pneumatic trainer kit Hydraulic trainer kit Video Demonstrations Chalk board

BASICS OF MECHATRONICS   **Course Code : 314017**

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 with the block diagram working of PLC TLO 4.2 Select the PLC for the given application TLO 4.3 Write a simple program using ladder diagram for the given application	**Unit - IV Programmable Logic Controller (PLC)** 4.1 Introduction, definition, PLC block diagram, Manufacturers of PLC 4.2 Power supply, Input/output modules 4.3 Ladder logic symbols 4.4 Basic PLC Ladder logic programming, timers, counters	Chalk board Hands-on activity on PLC trainer kit
5	TLO 5.1 Explain the working of the given microcontroller with block diagrams TLO 5.2 Explain with the circuit diagram interfacing of stepper motor TLO 5.3 Explain with the circuit diagram interfacing of Relay	**Unit - V Microcontroller** 5.1 Comparison of Microprocessor and Microcontroller 5.2 Introduction, architecture, I/O ports 5.3 Interfacing of steeper motor, relay	Chalk board 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 Identify sensor, transducer and actuator	1	*Identification of Sensors, actuators available in the laboratory	2	CO1
LLO 2.1 Identify PLC and microcontroller	2	*Identification of PLC and microcontroller available in the laboratory	2	CO1
LLO 3.1 Develop ladder diagram for simple application using sensor and actuator LLO 3.2 Execute PLC program for simple application	3	*Development of Ladder diagram and program PLC for simple application using sensor and actuator	2	CO1 CO2 CO3 CO4
LLO 4.1 Develop ladder diagram for logic gates LLO 4.2 Execute PLC program for the logic gates	4	*Verification of Logic gate functions for the given Ladder diagram by using PLC	2	CO4
LLO 5.1 Develop ladder diagram for staircase lighting LLO 5.2 Execute PLC program for staircase lighting	5	Development of Ladder diagram and program PLC for two-way switch logic for staircase lighting	2	CO1 CO2 CO3
LLO 6.1 Develop ladder diagram for Timers and counters LLO 6.2 Execute PLC program for Timers and counters	6	*Development of Ladder diagram and program PLC for Timers and Counters	2	CO4
LLO 7.1 Develop ladder diagram for water level control LLO 7.2 Execute PLC program for water level control	7	Development of Ladder diagram and program PLC for water level control	2	CO1 CO2 CO3 CO4
LLO 8.1 Develop ladder diagram for pedestrian light on off control LLO 8.2 Execute PLC program for pedestrian light on off control	8	Development of Ladder diagram and program PLC for pedestrian light (green/red) toggle control	2	CO1 CO2 CO3 CO4

MSBTE Approval Dt. 21/11/2024   **Semester - 4, K Scheme**

BASICS OF MECHATRONICS   **Course Code : 314017**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Develop ladder diagram for temperature control LLO 9.2 Execute PLC program for temperature control	9	*Development of Ladder diagram and program PLC for on/off temperature control	2	CO1 CO2 CO3 CO4
LLO 10.1 Develop ladder diagram for lift/elevator control LLO 10.2 Execute PLC program for lift/elevator control	10	Development of Ladder diagram and program PLC for lift/ elevator control	2	CO1 CO2 CO3 CO4
LLO 11.1 Develop ladder diagram for single acting/double acting pneumatic system LLO 11.2 Execute PLC program for single acting/double acting pneumatic system	11	Development of Ladder diagram and program PLC for single acting/double acting pneumatic system	2	CO1 CO2 CO3 CO4
LLO 12.1 Develop ladder diagram for single acting/double acting Hydraulic system LLO 12.2 Execute PLC program for single acting/double acting hydraulic system	12	Development of Ladder diagram and program PLC for single acting/double acting hydraulic system	2	CO1 CO2 CO3 CO4
LLO 13.1 Develop ladder diagram for door open and close system LLO 13.2 Execute PLC program for door open and close system	13	Development of Ladder diagram and program PLC for door open and close application	2	CO1 CO2 CO3 CO4
LLO 14.1 Develop ladder diagram for material rejection system LLO 14.2 Execute PLC program for material rejection system	14	*Development of Ladder diagram and program PLC for material rejection system	2	CO1 CO2 CO3 CO4
LLO 15.1 Develop 8051 microcontroller program for stepper motor control LLO 15.2 Execute 8051 microcontroller program for stepper motor	15	Development of 8051 microcontroller program for stepper motor control	2	CO1 CO2 CO5
LLO 16.1 Develop 8051 microcontroller program for relay interfacing LLO 16.2 Execute 8051 microcontroller program for relay interfacing	16	*Development of 8051 microcontroller program for relay interfacing	2	CO1 CO2 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

MSBTE Approval Dt. 21/11/2024   **Semester - 4, K Scheme**

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Basic Electro-Pneumatic trainer kit 1) Single acting and double acting pneumatic cylinder 2) Bore size: minimum 8 mm bore 3) Stroke: minimum 15 mm 4) Operating pressure: compressed air up to 4 bar pressure 5) Solenoid: 24V DC connected with trainer kit	11
2	Basic Electro-Hydraulic trainer kit 1) Single acting and double acting hydraulic cylinder 2) Bore size: minimum 12 mm bore 3) Stroke: minimum 40 mm 4) Operating pressure: up to 20 bar pressure5) Solenoid: 24V DC connected with trainer kit	12
3	Door open and close module Electro-pneumatic operated door open and close facility of sensing arrival and departure of person/object within particular distance from door (Pneumatic actuator type: Single/double acting pneumatic cylinder, Bore: 8 mm, Stroke: 15 mm, Medium: Compressed air up to 4 bar pressure, Solenoid valve: +24V DC)	13
4	Raw Material rejection module 1) Raw material rejection module with facility to detect, sort and reject the object 2) The module with IR sensor and Electro-pneumatic actuator controlled by PLC (Pneumatic actuator type: Single/double acting pneumatic cylinder, Bore: 8 mm, Stroke: 15 mm, Medium: Compressed air up to 4 bar pressure, Solenoid valve: +24V DC)	14
5	8051 microcontroller development board (Functional description and interfacing) 1) 16 x 2 characters LCD 2) Seven segment display 3) LED 4) Keypad 5) Steeper motor 6) Relay 7) facility for I/O port expansion	15,16
6	PLC trainer kit 1) Digital input and output: 12 Nos. with toggle switches for applying 24 V DC inputs and outputs 2) Analog input and output: 02 Nos. 3) External power supply: 24V DC	3,4,5,6,7,8,9,10,11,12,13,14
7	Desktop PC/Laptop with PLC software and I/O communication facility: Minimum System Requirements Intel Core i3,4GB RAM, 500 GB Hard Disk.	3,4,5,6,7,8,9,10,11,12,13,14,15,16
8	Tank Level Controller module: Water tank with ability to sense, indicate and control high and low level (Measuring water tank 1 no., Control panel enclosure: Metal frame with accessible front panel Push buttons red and green: 1 no. (each) Indicators red and green: 1 no. (each) Buzzer: 1 no, Manual drain valve: ½", Fluid solenoid valve: 1 no. Supply: 24V DC	7

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

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term work (Lab Manual)

Summative Assessment (Assessment of Learning)

- End semester practical 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	-	3	3	1	-	3			
CO2	3	-	2	2	1	-	2			
CO3	3	-	2	2	1	-	2			
CO4	3	-	2	2	1	-	2			
CO5	3	-	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	Bolton, W	Mechatronics	Pearson Education, New Delhi, 2017, ISBN: 978-81-317-3253-3
2	Petruzella, F. D.	Programmable Logic Controllers	Tata McGraw Hill, New Delhi, 2024, ISBN: 978-0-07-337384-3
3	Ghosh, A. K.	Introduction to Instrumentation and Control	Prentice Hall of India, New Delhi, 2004, ISBN: 81-203-1626-6
4	Majumdar, S.R.	Pneumatics systems Principles and maintenance	Tata McGraw Hill, New Delhi,2013, ISBN: 978-0-07-463748-7
5	Majumdar, S.R.	Oil Hydraulic system- Principle and maintenance	Tata McGraw Hill, New Delhi,2013, ISBN: 978-0-07-463748-7
6	Rajput, R. K.	A Textbook of Mechatronics	S. Chand and Company New Delhi, 2022, ISBN: 978-81-219-2859-5

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=J_KoRp8SnoE&t=14s	Types of Sensors
2	https://www.youtube.com/watch?v=UrST-2yu8zQ	Lecture 1 : Introduction to Mechatronics (NPTEL course Mechatronics)
3	https://www.youtube.com/watch?v=YlmRa-9zDF8	Introduction to hydraulic system
4	https://www.youtube.com/watch?v=1lbdwPfFegY	Relay System
5	https://www.youtube.com/watch?v=5q7YasmwXCs&t=377s	Pneumatic Control : Festo Didactics

BASICS OF MECHATRONICS

Sr.No	Link / Portal	Description
6	https://www.youtube.com/watch?v=-MLGr1_Fw0c&t=121s	Working of Solenoid Valves - Basics actuator control valve working principle
7	https://www.youtube.com/watch?v=eyqwLiowZiU	Working of Stepper Motor work.
8	https://www.youtube.com/watch?v=qQoHQ0b-d1U	Tank Level Control with PLC ladder Logic animated PLC Programming tutorials for beginners

Note :

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

MSBTE Approval Dt. 21/11/2024

Semester - 4, K Scheme

CNC PROGRAMMING	**Course Code : 314018**

Programme Name/s	**: Mechanical Engineering**
Programme Code	**: ME**
Semester	**: Fourth**
Course Title	**: CNC PROGRAMMING**
Course Code	**: 314018**

I. RATIONALE

Today's manufacturing needs like productivity, accuracy, consistency, flexibility, quality and finally performance of the product is prime importance. The course will impart knowledge & skills necessary for working in modern manufacturing demands. This course will help the student to operate CNC machines for manufacturing various jobs as per need of industry requirements.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Develop CNC program to manufacture different industrial components using CNC machines.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Develop manual part program for CNC lathe and milling machine.
- CO2 - Simulate the part program using simulation software.
- CO3 - Produce job on CNC lathe and milling machine.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme												Total Marks
				Actual Contact Hrs./Week			SLH	NLH			Theory				Based on LL & TL				Based on SL			
				CL	TL	LL											Practical						
											FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min			
314018	CNC PROGRAMMING	CNC	SEC	-	-	4	-	4	2	-	-	-	-	-	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 Identify different axes and their nomenclature. TLO 1.2 Apply tool offsetting and presetting before program execution on CNC machines. TLO 1.3 Use of word address format for programming. TLO 1.4 Explain stepwise procedure for programming.	**Unit - I Fundamentals of CNC programming** 1.1 Definition- program, programmer and programming . 1.2 Axes identification and nomenclature for CNC lathe and CNC milling machines. 1.3 Concept of tool offsetting and presetting. 1.4 Terminology used for program in Word Address Format (WAF). 1.5 Stepwise procedure for programming- study the given part drawing, set of instructions to the machine, problem definition, sequence of machining operation and process sheet, decide- material & stock size, work zero, unit, coordinate system (Absolute & Incremental), tool, cutting parameters and coordinate points.	Demonstration Lecture Using Chalk-Board
2	TLO 2.1 Explain linear and circular path operations. TLO 2.2 Calculate of cutting parameters according to job nature. TLO 2.3 Select appropriate G & M codes. TLO 2.4 Develop program as per given job drawing. TLO 2.5 Simulate on software and test dry run-on machine.	**Unit - II Linear & circular path programming** 2.1 Concept- Linear, circular path operations in lathe and milling machine. 2.2 Calculation of Cutting parameters, address parameters I, J, K, co-ordinates. 2.3 Respective G and M codes. 2.4 CNC part program as per given job drawing. 2.5 Concept of simulation and DRY-Run test.	Demonstration Lecture Using Chalk-Board

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 Distinguish between canned cycle and Sub routine call. TLO 3.2 Develop part program for canned cycle. TLO 3.3 Develop part program for Subroutine call. TLO 3.4 Identify respective G&M code for canned cycle and subroutine call.	**Unit - III Canned & Sub-routine call programming** 3.1 Concept- canned cycle, subroutine call. 3.2 Facing, step and taper turning canned cycle, respective G & M codes, procedure to write canned cycle program, its importance. 3.3 Concept of sub-routine call, respective G & M code, procedure of sub-routine call to write program, its importance.	Demonstration Lecture Using Chalk-Board

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 Choose appropriate G & M codes for linear interpolation function on CNC lathe. LLO 1.2 Develop manual part program for linear interpolation function for given job.	1	* Facing operation on CNC lathe by Linear interpolation function.	2	CO1
LLO 2.1 Simulate prepared part program of linear interpolation function and take corrective action (if required). LLO 2.2 Use of an appropriate simulation software for part programing.	2	* Verify part program of linear interpolation function prepared in Practical No.1 by using suitable simulation software.	2	CO2
LLO 3.1 Perform DRY run-on CNC lathe machine. LLO 3.2 Verify tool path in DRY run activity.	3	Conduct DRY run of Practical No.1 on CNC lathe machine.	2	CO3
LLO 4.1 Perform linear interpolation function on CNC lathe. LLO 4.2 Check the finished job using suitable measuring instrument.	4	* Execution of part program prepared in Practical No.1 on CNC lathe machine.	4	CO3
LLO 5.1 Choose appropriate G & M codes for linear interpolation function on CNC milling. LLO 5.2 Develop manual part program for linear interpolation function.	5	* Slotting operation on CNC milling by Linear interpolation function.	2	CO1
LLO 6.1 Simulate prepared part program of linear interpolation function and take corrective action (if required). LLO 6.2 Use of an appropriate simulation software for part programing.	6	* Verify part program of linear interpolation function prepared in Practical No.5 by using suitable simulation software.	2	CO2

CNC PROGRAMMING   **Course Code : 314018**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 7.1 Perform DRY run-on CNC milling machine. LLO 7.2 Verify tool path in DRY run activity.	7	Conduct DRY run of Practical No.5 on CNC milling machine.	2	CO3
LLO 8.1 Perform linear interpolation function on CNC milling. LLO 8.2 Check the finished job using suitable measuring instrument.	8	* Execution of part program prepared in Practical No.5 on CNC milling machine.	4	CO3
LLO 9.1 Choose appropriate G & M codes for circular interpolation function on CNC lathe. LLO 9.2 Develop manual part program for circular interpolation function.	9	* Circular path operation on CNC lathe by circular interpolation function.	2	CO1
LLO 10.1 Simulate prepared part program of circular interpolation function and take corrective action(if required). LLO 10.2 Use of an appropriate simulation software for part programing.	10	* Verify part program of circular interpolation function prepared in Practical No.9 by using suitable simulation software.	2	CO2
LLO 11.1 Perform DRY run-on CNC lathe machine. LLO 11.2 Verify tool path in DRY run activity	11	Conduct DRY run of Practical No.9 on CNC lathe machine.	2	CO3
LLO 12.1 Perform circular interpolation function on CNC lathe. LLO 12.2 Check the finished job using suitable measuring instrument.	12	* Execution of part program prepared in Practical No.9 on CNC lathe machine.	4	CO3
LLO 13.1 Choose appropriate G & M codes for circular interpolation function on CNC milling. LLO 13.2 Develop manual part program for circular interpolation function.	13	* Circular path operation on CNC milling by circular interpolation function.	2	CO1
LLO 14.1 Simulate prepared part program of circular interpolation function and take corrective action (if required). LLO 14.2 Use of an appropriate simulation software for part programing.	14	* Verify part program of circular interpolation function prepared in Practical No.13 by using suitable simulation software.	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Perform DRY run-on CNC milling machine. LLO 15.2 Verify tool path in DRY run activity.	15	Conduct DRY run of Practical No.13 on CNC milling machine.	2	CO3
LLO 16.1 Perform circular interpolation function on CNC milling. LLO 16.2 Check the finished job using suitable measuring instrument.	16	* Execution of part program prepared in Practical No.13 on CNC milling machine.	4	CO3
LLO 17.1 Choose appropriate G & M codes for canned cycle on CNC lathe. LLO 17.2 Develop manual part program for canned cycle given job.	17	Facing, step and taper turning operation by canned cycle.	2	CO1
LLO 18.1 Simulate prepared part program of canned cycle and take corrective action (if required). LLO 18.2 Use of an appropriate simulation software for part programing.	18	Verify part program of canned cycle prepared in Practical No.17 by using suitable simulation software.	2	CO2
LLO 19.1 Perform DRY run-on CNC lathe machine. LLO 19.2 Verify tool path in DRY run activity.	19	Conduct DRY run of Practical No.17 on CNC lathe machine.	2	CO3
LLO 20.1 Perform Facing, step and taper turning operation by canned cycle on CNC lathe. LLO 20.2 Check the finished job using suitable measuring instrument.	20	Execution of part program prepared in Practical No.17 on CNC lathe machine.	4	CO3
LLO 21.1 Choose appropriate G & M codes for subroutine call on CNC milling. LLO 21.2 Develop manual part program for subroutine call.	21	Slotting operation on CNC milling by subroutine call.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 22.1 Simulate prepared part program of subroutine call and take corrective action (if required). LLO 22.2 Use of an appropriate simulation software for part programing.	22	Verify part program of subroutine call prepared in Practical No.21 by using suitable simulation software.	2	CO2
LLO 23.1 Perform DRY run for subroutine call on CNC milling machine. LLO 23.2 Verify tool path in DRY run activity.	23	Conduct DRY run of Practical No.21 on CNC milling machine.	2	CO3
LLO 24.1 Perform subroutine call on CNC milling. LLO 24.2 Check the finished job using suitable measuring instrument.	24	Execution of part program prepared in Practical No.21 on CNC milling machine.	4	CO3

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	CNC Turning 250 with standard accessories and multi controller changing facility with simulated control panel and related software. Training or Productive type minimum diameter 25 mm, Length 120 mm with ATC along with essential accessories.	1,3,4,9,11,12,17,19,20
2	CNC Simulation software and control pads (CAMLAB CNC Software, MasterCAM/NXCAM/, DONC CNC machine simulator, PRO, SWANSOFT, CAPSMILL and CAPSTURN IN cam software, DONCMILL AND DONCTURN software), CutViewer Turn& Mill, Sinewave Turn& Mill or equivalent simulation software.	2,6,10,14,18,22
3	Windows 10 Home Intel Core i5 HDD Capacity 500 GB RAM 8 GB DDR3 18.5 inch Display, Dedicated Graphic Memory 512 MB, USB 1x3.0 Front 6 Back.	2,6,10,14,18,22
4	CNC Milling 250 with standard accessories and multi controller changing facility with simulated control panel and related software. Training or Productive type-X axis travel - 225 mm, Y axis travel - 150 mm, Z axis travel - 115 mm, with ATC along with essential accessories.	5,7,8,13,15,16,21,23,24

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

CNC PROGRAMMING	**Course Code : 314018**

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	3	2	2	2	-	-	3			
CO2	3	2	-	2	-	-	3			
CO3	3	-	-	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	P. M. Agrawal And V. J. Patel	CNC Fundamentals and Programming	Charotar Publishing House Pvt. Limited.ISBN:9788185594989 ,Edition-2009
2	Pawan Negi, Mangey Ram, Om Prakash Yadav	Basics of CNC Programming	River Publishers.ISBN:9781000792911,Edition-2022
3	Kaushik Kumar, Chikesh Ranjan, J. Paulo Davim	CNC Programming for Machining	Springer International Publishing.ISBN:9783030412791,Edition-2020.
4	Binit Kumar Jha	CNC Programming Made Easy	Vikas Publishing House.ISBN: 9788125911807,Edition-2003
5	Ibrahim Zeid	CAD/CAM Theory and Practice	McGraw Hill Education.ISBN:0070151342,Edition-2009
6	Pabla B. S. & M. Adithan	CNC Machines	New Age International Private Limited.ISBN:978-9388818445,Edition-2023.

XIII .   LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description

CNC PROGRAMMING   **Course Code : 314018**

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=ih4Q8TJOI5I	How to create your first turning program in CNC Simulator
2	https://www.youtube.com/watch?v=m_FVE4Q59gU	CNC Milling Simulator
3	https://www.youtube.com/watch?v=_5r2XR1h1aQ	CNC programming
4	https://www.youtube.com/watch?v=PN_tGm5Gip4	CNC machines and Interpolation
5	https://www.youtube.com/watch?v=B7MM5M7DzpM	Introduction to CNC machines
6	https://www.youtube.com/watch?v=Gi42gKGiCl0	Introduction to CNC machines.
7	https://www.youtube.com/watch?v=YpQMUpWOgbE&t=2s	Programming a CNC Lathe to make a bush - part 1 G71 roughing cycle
8	https://www.youtube.com/watch?v=wYebU4JSkGQ	Step Turning With Simulation

Note :

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

MSBTE Approval Dt. 21/11/2024   **Semester - 4, K Scheme**

Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Second Year Exit

Programme Name	**: Diploma In Mechanical Engineering**
Programme Code	**: ME**
Duration of Programme	**: 6 Semester**

With Effect From Academic Year : 2023-24

Second Year Exit - NCrF Level : 4   **Scheme : K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Actual Contact Hrs./Week CL	TL	LL	Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week	Credits	Paper Duration (hrs.)	Theory FA-TH Max	SA-TH Max	Total Max	Min	Based on LL & TL Practical FA-PR Max	Min	SA-PR Max	Min	Based on Self Learning SLA Max	Min	Total Marks
General (Any - One)																							
1	EXIT INDUSTRIAL TRAINING (Full Time)	EXIT	INP	312021		-	-	-	4-6 Weeks Engagement	36 - 40	4	-	-	-	-	-	-	-	50@	20	-	-	50
	SECOND YEAR EXIT COURSE (Online)	SYEC	SEC	312022		-	-	-	90-120 Study Hours	-	4	-	-	-	-	-	-	-	50@	20	-	-	50
	Total				**0**	**0**	**0**	**0**	**0**		**4**		**0**	**0**	**0**		**0**		**50**		**0**		**50**

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

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)

Student who's exiting after second year will be awarded "Diploma of Vocation" provided following conditions are fulfilled :

- Student must have passed all the courses of 1st , 2nd, 3rd, 4th semester i.e 1st and 2nd year and shall take exit industrial training OR complete second year exit course.

- Student with lateral entry must have passed 3rd and 4th semester and shall under take exit industrial training OR complete second year exit course.

- Preference must be given to Exit industrial training so as to develop employable skills.

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 and Electronics Engineering/ 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/ Mining & Mine Surveying/ Medical Electronics/ Mining Engineering/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating 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/ EK/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MS/ MU/ MZ/ PG/ PN/ PO/ SC/ SE/ TC/ TE/ TR/ TX
Semester	: Second
Course Title	: EXIT INDUSTRIAL TRAINING (Full Time)
Course Code	: 312021

I. RATIONALE

This exit industry training is proposed for the student who seeks exit at the end of the 4th semester to get the Diploma of Vocation . This Exit industry training is aimed to impart employable skills in the respective field to get some job/employment. Students are expected to learn the work practice and environment of industry and develop a report. On the basis of this report the institute will consider for the exit.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

At the end of training, proposed for Exit with Voc. Diploma, the pass out will be able to;

- CO1 - Gain hands-on experience in applying theoretical concepts to real-world tasks, improving their understanding and problem-solving abilities and readiness for the workforce.
- CO2 - Boosts students' self-confidence and encourages them to pursue ambitious career goals. to earn a livelihood for a better status in society.
- CO3 - Interact with industry professionals during training to build valuable connections for job opportunities.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Actual Contact Hrs./Week			SLH	NLH	Credits	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	
312021	EXIT INDUSTRIAL TRAINING (Full Time)	EXIT	INP	-	-	-	-	0	4	-	-	-	-	-	-	-	50@	20	-	-	50

I .General guidelines for organizing Industrial training

The Industry/organization selected for Industrial training/ internships shall be Government / Public Limited/ Private limited / Startup /Centre of Excellence/Skill Centers/Skill Parks etc.

a) Duration of Training - 4-6 weeks students engagement time (Min. 28-30 hrs./week)
b) Period of Time slot   -   After 4th Semester
c) Industry area -   Engineering Programme Allied industries of large, medium or small-scale, Organization/Govt./ Semi Govt Sectors.

II. Role(s) of Department at the Institute:

Concerned department Head or associated faculty at the Polytechnics shall place the student for internships, coordinate with the industry/organisation and monitor the attendance and progress of the student . Acquire the undertaking from Parents/Guardians(Format 1) and Student(Format 2).

III. Role(s) and Responsibilities of students:

a) Students may interact with the faculty mentor to suggest choices for suitable industry, if any. In case of students have any contact in industry through their parents or relatives then same may be utilized for securing placement for themselves and their peers.
b) Students have to fill the forms/formats duly signed by institutional authorities along with training letter and submit it to training officer/mentor in the industry on the first day of training.
c) Students must carry with him/her Identity card issued by the institute during training period.
d) Students should follow industrial dressing protocols, if any. In absence of specific protocol student must wear college uniform compulsorily.
e) Students will have to get all necessary information from the training officer/mentor at industry regarding schedule of training, rules and regulation of the industry and safety norms to be followed. Students are expected to observe these rules, regulations and procedures.
f) Students must be fully aware that if they disobey any rule of industry or do not follow the discipline then non-disciplinary action will be taken
g) Students must Maintain weekly diary (Format 3) by noting daily activities undertaken and get get it duly signed from industry mentor or Industrial training in charge.
h) In case students faces any major problems in industry such as an accident or any disciplinary issue then they should immediately report the same to the mentor at the institute
i) Prepare final report about the training for submitting to the department at the time of presentation and viva-voce and get it signed from mentor as well as industry training in charge.
j) Student must submit the undertaking as provided in Format 2.

IV. Typographical guidelines for Industry Training report

Following is the suggestive format for preparing the training report.Actual report may differ slightly depending upon the nature of industry. The training report may contain the following

a) The training report shall be computer typed (English- British) and printed on A4 size paper.
b) Text Font -Times New Roman (TNR), Size-12 point
c) Subsection heading TNR- 12 point bold normal
d) Section heading TNR- 12 capital bold
e) Chapter Name/ Topic Name – TNR- 14 Capital
f) All text should be justified. (Settings in the Paragraph)
g) The report must be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.
h) The training report must be hardbound/ Spiralbound   with cover page in black colour. The name of the candidate, diploma (department), year of submission, name of the institute shall be printed on the cover [Refer sample sheet (outer cover)]
i) The training report, the title page should be given first then the Certificate followed by the acknowledgment and then contents with page numbers.

V. Suggestive format of industrial training report

Following format may be used for training report. Actual format may differ slightly depending upon the nature of Industry/ Organization.

- Title Page
- Certificate
- Abstract
- Acknowledgement
- Content Page

Chapter 1	Organization structure of Industry and general layout.
Chapter 2	Introduction to Industry / Organization (history, type of products and services, turn over and number of employees etc.)
Chapter 3	Types of Major Equipments/raw materials/ instruments/machines/ hardware/software used in industry with their specifications, approximate cost, specific use and routine maintenance done
Chapter 4	Processes/ Manufacturing Manufacturing techniques and methodologies and material handling procedures
Chapter 5	Testing of Hardware/Software/ Raw materials/ Major material handling product (lifts, cranes, slings, pulleys, jacks, conveyor belts etc.) and material handling procedures.
Chapter 6	Safety procedures followed and safety gears used by industry.
Chapter 7	Particulars of Practical Experiences in Industry/Organization if any in Production/Assembly/Testing/Maintenance
Chapter 8	Detailed report of the tasks undertaken (during the training).
Chapter 9	Special/challenging experiences encountered during training if any (may include students liking & disliking of work places).
Chapter 10	Conclusion
Chapter 11	References / sources of information

VI. Suggested learning strategies during training at Industry

Week No	Tentative Activities to be completed during Industry training

1	Introduction of Industry and departments.
2	Study of Layout of Industry, Specifications of Machines , raw materials, components available in the industry
3-5	Execute given project or work assigned to the students ,study of safety and maintenance procedures
4/6	Report writing

VII. Summative Assessment (SA) of training:

Academic year : 20 -20

Name of the industry:

Marks Acquired :

Sr. No	Enrolment Number	Name of student	Observations from Orals			Total 50
			Knowledge about Industry & Departments (10 Mks.)	Knowledge of Layout/M/C Specifications/ Components etc (10 Mks.)	Skill Developed (10 Mks.)	Submitted Report (20 Mks.)	

Name of mentor :

Signature of Mentor :

VII. FORMATS

Format-1

Consent Letter from parents/guardians

(Undertaking from Parents)

To,

 The Principal,

_____,

Subject: Consent for Industrial Training.

Sir/Madam,

I am fully aware that -

1. My ward studying in _____ semester at your _____ institute has to undergo _____ **weeks** of Industrial training for partial fulfillment towards completion of Diploma in _____ Engineering.
2. For this fulfillment he/she has been deputed at_____ industry, located at _____ for Industrial training /internship for the period from _____ to _____ .

With respect to above I give my full consent for my ward to travel to and from the mentioned industry. Further I undertake that –

1. My ward will undergo the training at his/her own cost and risk during training and/or stay.
2. My ward will be entirely under the discipline of the organization where he/she will be placed and will abide by the rules and regulations in face of the said organization.
3. My ward is NOT entitled to any leave during training period.
4. My ward will submit regularly a prescribed weekly diary, duly filled and countersigned by the training supervisor of the organization to the mentor faculty of the polytechnic.

I have explained the contents of the letter to my ward,who has also promised to adhere strictly to the requirements. I assure that my ward will be properly instructed to take his own care to avoid any accidents/injuries in the industry. In case of any accident neither industry nor the institute will be held responsible.

Signature of Parent/Guardian :

Name : _____

Address :_____

Phone Number:_____

Date : _____

Name and Signature of the student:

Phone Number of students:

Format-2

Undertaking by the students

TO

The Principal

Subject: Undertaking regarding Placement for Industrial training of 12/16/18 weeks duration

   I _____ Enrollment No _____ S/o/D/o. _____ studying in _____ at _____ Institute at _____ fully aware of the Industrial Training requirement and related responsibilities and   participation in the _____ Industrial training From: _____
 To_____

I assure you that I will be of good behavior and be obedient to the staff and mentor during the _____ /Industrial training. I will also abide and will not participate in all activity. I will also discipline myself within the rules and regulations of the Institution. I am also aware that I am participating in the _____ at my own risk and I will not hold the _____ Institute responsible in any way in any eventuality namely Accident /Injury/death or whatever mishap and I myself will be solely responsible for my safety.

Place :   Signature of the student

Date :

Internships Daily Diary

Name of the Student: _____ Name of the mentor (Faculty) : _____

Enrollment Number: _____ Semester:_____ Academic Year _____

Week	Day & Date	Discussion Topics/Activity	Details of Work Allotted Till Next Session /Corrections Suggested/Faculty Remarks	Signature of Industry Mentor
Week 01	**Mon, Date**			
	Tue, Date			
	Wed, Date			
	Thu, Date			
	Fri, Date			
	Sat, Date			
. . . .	**Mon, Date**			
	Tue, Date			
	Wed, Date			
	Thu, Date			
	Fri, Date			
	Sat, Date			
Week n	**Mon, Date**			
	Tue, Date			
	Wed, Date			
	Thu, Date			
	Fri, Date			
	Sat, Date			

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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 and Electronics Engineering/ 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/ Mining & Mine Surveying/ Medical Electronics/ Mining Engineering/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating 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/ EK/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MS/ MU/ MZ/ PG/ PN/ PO/ SC/ SE/ TC/ TE/ TR/ TX
Semester	: Second
Course Title	: SECOND YEAR EXIT COURSE (Online)
Course Code	: 312022

I.   RATIONALE

The National Education Policy 2020 necessitates "Academic Flexibility" , means the provision for innovative and interchangeable curricular structures to enable creative combinations of Courses or Programmes in Disciplines of study leading to Degree or Diploma or Post Graduate Diploma or Certificate of Study offering multiple entry and multiple exit facilities, while removing rigid curricular boundaries and creating new possibilities of life-long learning;

To ensure that the exiting student:exits with market relevant competency ,offering the on-line skill based course in the absence of internships opportunity is the best option .

III.   COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Demonstrate required skills and readiness relevant to their discipline (e.g., mechanical, civil, electrical, software engineering, hotel management textiles etc.) to join the workforce.
- CO2 - Practice the skills of using industry specific software, tools, machines, methodologies etc. required at the work place of an employer and earn livelihood.
- CO3 - Work collaboratively as professional in group as member and leader to complete the tasks of employers.

IV.   TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH			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		

312022	SECOND YEAR EXIT COURSE (Online)	SYEC	SEC	-	-	-	-	0	4	-	-	-	-	-	-	-	50@	20	-	-	50

V. Guidelines –

A) General Guidelines

1. This exit Course should be offered **only in absence of** opportunities for Exit Internships .
2. An exit course should focus on
   - equipping students with skills that are directly applicable to the job market trends for the level of exit from the field of study of diploma programme.
   - The course must have the scope of practical skills and knowledge may be multidisciplinary that are in high demand at job market.

   Upon completion of this course, students can earn a certificate that demonstrates their readiness to enter the workforce .

3. There are several govt./semi govt. recognized agencies and organizations which offers online courses of 90 to 120 hrs of study engagement to enhance their skills and employability of potential learners. Depending on the student's field of study and career goals, they can choose from various platforms to enhance their employability and skill set before entering the workforce.
4. Online/ platforms of AICTE, NSDC, Coursera, edX, Udacity, Skillshare, Infosys springboard, SWAYAM etc. or other relevant platform may be referred for online course as exit course. These platforms often partner with universities, industry leaders, or educational institutions to provide high-quality, industry-relevant content.
5. Multiple courses can be offered .The offered course/s must encompass 80 to 120 hrs. of study engagement. Multiple short duration courses leading to the desired minimum duration form 80 to 120 can also be offered.
6. Study engagement hours shall be taken into account. For example if the online 'X' course is of 4 hours, the students may require 10 hrs. to undertake the course and in such cases the student may undertake multiple courses oriented towards developing appropriate aligned skills. Faculty decides the course engagement duration based on the complexity of the course and accordingly assigns course/es to the exiting student.

   Ex :- If an 'Y' course on Infosys springboard is 3.5 hrs, the students may require 8 hrs of study engagements to complete the lecture due to recap, assignments, tests etc. and accordingly other courses maybe selected such that the study engagements of 90-120 hrs. is undertaken.

7. Course/es should not incur financial overheads on students.
8. Certificate of completion of Exit Industrial Training shall be provided by the institute based on the evaluation through orals.

B) Suggested RUBRIC for SA

Title : Second Year Exiting Students

Enrollment Number	Courses Undertaken	No.Of Hrs.	Overall Understanding (20 Mks.)	Knowledge/Skill Acquired (20 Mks.)	Certification (10 Mks.)	Total (50 Mks.)
	1					
	2					
	3					

C) Suggestive Courses

- Title/Modules/Area for Programme-wise possible exit courses are suggested below and students may explore more under guidance of programme head/teachers of the relevant discipline/branch.

NOTE : Below are just the groupwise list of suggestive courses . Multiple or single course depending on the number of student engagement hours can be selected from them. Respective programme head/faculty are free to decide appropriate skill based course / es as per guidelines given above.

Programme Group – CO Group					
Sr. No.	**Title of Skill Oriented Second Year Exit Course**	**Source Organization**	**Reference Link**	**Duration**	**Brief Description**	
1	Explore Machine Learning Using Python	Infosys Springboard	[TOC - Explore Machine Learning using Python | Infosys Springboard](#)	17Hr 7 min	This course introduces concepts of machine learning like supervised and unsupervised learning techniques and demonstrates their application on various data sets. It also gives an overview of artificial neural networks.	
2	Unity Game - Role Playing Game(RPG)	Infosys Springboard	[TOC - Unity Game - Role Playing Game(RPG) | Infosys Springboard](#)	10Hr 28 min	Unity is well known as a massive game developing middleware system with a user friendly editor and power house features. As 3D games has always been leading the gaming	
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| 3 | Unreal Engine Game - Pinball Game | Infosys Springboard | [TOC - Unreal Engine Game - Pinball Game \| Infosys Springboard](#) | 15 Hr 8 Min | Unreal Engine 4 is a suite of integrated tools for game developers to design and build games, simulations, and visualizations. Through this training we shall introduce you to the exciting gaming world and introducing you this powerful game engine Unreal. There are lots of code samples available but offer little or no explanation on how they should be used. This training aims to provide the necessary training to teach you how to create those awesome games. Through this tutorial we are going to create a live game the Pinball game using Unreal engine |
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| 4 | Python Machine Learning Solutions | Infosys Springboard | [TOC - Python Machine Learning Solutions \| Infosys Springboard](#) | 5 Hr 32min | Machine learning is increasingly pervasive in the modern data-driven world. It is used extensively across many fields such as search engines, robotics, self-driving cars, and more. With this course, you will learn how to perform various machine learning tasks in different environments. Throughout the course, you'll use a wide variety of machine learning algorithms to solve real-world problems and use Python to implement these algorithms. You'll discover how to deal with various types of data and explore the differences between machine learning paradigms such as supervised and unsupervised learning. We also cover a range of regression techniques, classification algorithms, predictive modelling, data visualization techniques, recommendation engines, and more with the help of real-world examples |
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5	Unity Game - Gem Collector Game	Infosys Springboard	TOC - Unity Game - Gem Collector Game | Infosys Springboard	3 Hr 4 min	Developing your script, designing the look and doing the coding is all a part of a game development. So, we brought you this course Create Gem Collector game using Unity training, to help you master the advanced tricks and techniques that usually go with the gaming industry workflow.
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6	Hands-on Scikit-learn for Machine Learning	Infosys Springboard	[TOC - Hands-on Scikit-learn for Machine Learning	Infosys Springboard](#)	10Hr 2 min	Scikit-learn is arguably the most popular Python library for Machine Learning today. Thousands of Data Scientists and Machine Learning practitioners use it for day to day tasks throughout a Machine Learning project's life cycle. Due to its popularity and coverage of a wide variety of ML models and built-in utilities, jobs for Scikit-learn are in high demand, both in industry and academia. If you're an aspiring machine learning engineer ready to take real-world projects head-on, Hands-on Scikit-Learn for Machine Learning will walk you through the most commonly used models, libraries, and utilities offered by Scikit-learn. By the end of the course, you will have a set of ML problem-solving tools in the form of code modules and utility functions based on Scikit-learn in one place, instead of spread over several books and courses, which you can easily use on real-world
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					projects and data sets.
7	UX Design for Web Developers	Infosys Springboard	. TOC - UX Design for Web Developers | Infosys Springboard	4 Hr 44 min	UX Design for Web Developers is a comprehensive course that teaches web developers the principles and techniques of user experience (UX) design. It covers topics such as empathetic design, information architecture, wireframing, responsive design, usability testing, and prototyping. Participants will learn how to create user-centered and visually appealing websites by understanding user needs, organizing content effectively, and designing intuitive interactions. The course also explores best practices for mobile and desktop design, ensuring a seamless user experience across different devices
Programme Group - AA					
1	**Architectural Graphics**	**IS 962:1989** - Code of Practice for Architectural and Building Drawings.		**8 weeks**	**IS 962:1989** - Code of Practice for Architectural and Building Drawings.
2	**Computer Aided Drawing**	**IS 16601:2016 -** Guidelines for Digital Representation of Engineering Drawings.		**8 weeks**	**IS 16601:2016 -** Guidelines for Digital Representation of Engineering Drawings.
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3	**Architectural Drawing**	**IS 962:1989** - Code of Practice for Architectural and Building Drawings.		**8 weeks**	**IS 962:1989** - Code of Practice for Architectural and Building Drawings.
4	**Python Learning**	**ISO/IEC 25010 -** System and Software Quality Requirements and Evaluation (SQuaRE).		**8 weeks**	**ISO/IEC 25010 -** System and Software Quality Requirements and Evaluation (SQuaRE).
5	**Information Security**	**IS/ISO/IEC 27001:2013 -** Information Security Management.		**8 weeks**	**IS/ISO/IEC 27001:2013 -** Information Security Management.
6	**History of Ancient Architecture**	**Swayam**	https://onlinecourses.swayam2.ac.in/ini25_ar01/preview	**8 weeks**	**IS 2645:2003 -** Architectural Preservation and Conservation Standards. Guidelines from the **ASI (Archaeological Survey of India).**
7	**Bioclimatic Architecture**	**Swayam**	https://onlinecourses.nptel.ac.in/noc25_ar06/preview	**8 weeks**	**IS 3362:1977 -** Thermal Insulation of Buildings. **IS 875 (Part 2):1987 -** Environmental Considerations in Building Design. **IS 3792:2022 -** Energy-Efficient and Sustainable Buildings.
8	**Acoustic materials and meta materials**	**Swayam**	https://onlinecourses.nptel.ac.in/noc25_me01/preview	**8 weeks**	**IS 2526:1963 -** Specification for Acoustic Material Properties. **IS 4954:1968 -** Sound Insulation Materials and Applications. **IS 13356:2000 -** Standards for Noise Control in Buildings.
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9	**Interior Design**	**Swayam**	https://onlinecourses.nptel.ac.in/noc25_de11/preview	**4 to 6 weeks**	**IS 3312:1974 -** Guidelines for Interior Finishes and Materials. **IS 6343:1982 -** Code of Practice for Interior Lighting. **IS 1643:1977 -** Guidelines for Furniture Dimensions in Interior Spaces.
10	**E Course on Griha version 2019**	**Griha**	https://www.grihaindia.org/		
Program Group : Civil Engineering					
1	Civil 3D	Infosys Springboard	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01329 18493657251845528_shared/overview	3 hrs	An Introduction to Civil 3D and Its Interface
2	The Civil 3D Workspace	Infosys Springboard	TOC - The Civil 3D Workspace | Infosys Springboard	3 hrs	This course starts off with an overview of the interface of Civil 3D, showing you how Civil 3D applies settings and styles to automate object placement. Building on this knowledge, you will learn to create and edit surfaces, alignments, and profiles.
3	GPS Surveying	NPTEL -SWAYAM	https://onlinecourses.nptel.ac.in/noc25_ce31/preview	4 WEEKS	The objective of the course is to provide optimal insights into land surveying using GPS (Global Positioning System). The course starts with an introduction to land surveying leading to GPS as the state-of-art for surveying of land.
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4	Advanced Topics in Science and Technology of Concrete	NPTEL -SWAYAM	https://onlinecourses.nptel.ac.in/noc25_ce64/preview	4 WEEKS	This edition of the Advanced Topics course focuses on the use of recycled concrete as aggregate in new concrete construction.
5	Design of Connections in Steel Structures	NPTEL -SWAYAM	https://onlinecourses.nptel.ac.in/noc25_ce65/preview	4 WEEKS	The course "Design of Connections in Steel Structures" helps students understand the fundamental mechanism of how different types of connections behave and how the analysis and design process accounts for the same.
6	Land Building And Civil Works	Infosys Springboard	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384272204612403222498_shared/overview	8 min	Project Finance modeling using Microsoft Excel offers a comprehensive introduction to project finance modeling, focusing on infrastructure projects. Participants will learn to create financial models for the EBC Underground Parking Project, gaining skills in forecasting income statements, balance sheets, and cash flows. Through hands-on Excel-based exercises, they will explore feasibility analysis, debt modeling, and scenario analysis
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| 7 | SketchUp - Beginners | Infosys Springboard | https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384208087630643211723_shared/overview | 3 hrs 10min | The SketchUp Beginners course offers a comprehensive introduction to 3D modeling using SketchUp, a powerful and intuitive software widely used by professionals in different fields. Starting with the basics, you'll learn about the software's tools and user-friendly interface. The course covers downloading and installing SketchUp and then progresses into exploring toolbars, tabs, and practical application through hands-on exercises, enabling you to create accurate and visually appealing 3D models. |
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8	Project on Google SketchUp	Infosys Springboard	TOC - Project on Google SketchUp | Infosys Springboard	1 hr 29 min	The Project on Google SketchUp offers an immersive and transformative learning experience, guiding participants through the process of 3D modeling and visualization using Google SketchUp. The course begins with an introduction to the software's interface and basic tools.The Project on Google SketchUp offers an immersive and transformative learning experience, guiding participants through the process of 3D modeling and visualization using Google SketchUp. The course begins with an introduction to the software's interface and basic tools
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9	SketchUp Case Study - 3D Landscape Garden	Infosys Springboard	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384 2083456245760118 46_shared/overview	3 hrs 15 min	The Landscape Garden Design and Visualization course is ideal for individuals interested in landscape architecture and garden design. Participants will learn essential design principles, spatial arrangement, plant selection, and focal point creation. They will gain hands-on experience using V-ray tools for realistic visualization and rendering, enabling them to create stunning presentations of their landscape garden designs.
10	SketchUp Case Study - Create a 3D AutoCAD Plan from 2D House	Infosys Springboard	TOC - SketchUp Case Study - Create a 3D AutoCAD Plan from 2D House | Infosys Springboard	2 hrs 4 min	This is a Case Study on SketchUp - Create a 3D AutoCAD Plan from 2D House
Programme Code : Chemical Engineering					
1	Effective Time Management	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	3 Hr 46 min	Certificate Course
2	Stress Management at Workplace	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	2 Hr 53 min	Certificate Course
3	Senior Professional in Human Resources : Safety and Health	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	1 Hr 8 min	Certificate Course
4	Indian oil & Gas Sector	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	1 Hr 38 min	Certificate Course
5	Fundamental of Information Security	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	3 Hr 24 min	Certificate Course
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6	Design Thinking	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	3 Hr 31 min	Certificate Course
7	Security Standards & Regulations	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	4 Hr 08 min	Certificate Course
8	Management & Leadership	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	1 Hr 45 min	Certificate Course
9	Material Management	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	3 Hr 21 min	Certificate Course
10	Risk Management Investement Management	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	5 Hr 44 min	Certificate Course
11	Financial Management	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	2 Hr 41 Min	Certificate Course
12	Quality Management	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	3Hr 51 Min	Certificate Course
13	Fundamental of Risk Management	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	4 Hr 21 Min	Certificate Course
14	Theories of Stratregic Management	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	7 Hr 18 Min	Certificate Course
15	Customer Relationship Management	Infosis Springboard	https://infyspringboard.onwingspan.com/web/en/page/home	5 Hr 18 Min	Certificate Course
Programme Code : Electrical Engineering					
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| 1 | Internet of Things 101 | Infosys Springboard | https://infyspringboard.onwingspan.com/web/en/app/toc/lex_21553622882521997000_shared/overview | 8 hours 23 minutes | **This course introduces you to the fundamental concepts of building an IoT Ecosystem, implementation of IoT use cases using DIY boards, application of various IoT elements, provides details on different IoT industry sectors, and insights on IoT implementation challenges. IoT is poised to be the World's most massive device market. The adoption of the same in the industry will save companies billions of dollars. It is a must for us to embrace IoT now!** |
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| 2 | **AutoCAD Case Study - Electrical Power Demand Calculation** | Infosys Springboard | https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384338332015001637149_shared/overview | 2 hours 3 minutes | In this course "Project on AutoCAD - Electrical Power Demand Calculation" learners will look into the realm of electrical engineering through AutoCAD. By focusing on a practical project, learners will gain hands-on experience in calculating power demands for electrical systems. Through step-by-step guidance, learners will utilize AutoCAD to create accurate and detailed electrical schematics, incorporate load calculations, and ensure compliance with industry standards. This course empowers learners to understand the nuances of power distribution and demand estimation, honing their skills in a real-world context. Whether an aspiring electrical engineer or a professional looking to refine expertise, this course equips learner with the knowledge to proficiently perform power demand |
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				calculations using AutoCAD
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| 3 | **AutoCAD Case Study - Power Distribution Layout for Commercial Kitchen** | Infosys Springboard | https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384338739362201637145_shared/overview | 2 hours 8 minutes | **AutoCAD Case Study - Power Distribution Layout for Commercial Kitchen offers an immersive and transformative learning experience, guiding participants through the process of designing power distribution layouts for commercial kitchens using AutoCAD. The course commences with an introduction to electrical load analysis and an overview of essential AutoCAD tools and features for electrical design.Participants will delve into equipment placement techniques, learning how to strategically position electrical devices and appliances for efficient power distribution.The course covers electrical circuit design, enabling participants to create organized and well-structured circuits to handle the power loads of** |
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					commercial kitchen equipmen
4	**Electronics Course**	Infosys Springboard	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01373779399397376019/overview	1 hour 26 minutes	**Today, children around the world have access to laptops, desktops, and smartphones. Knowing that the future is becoming synonymous with technology, it has become more important that our young minds become active consumers, and contribute to technology in the right manner, instead of staying mere passive users. In this course, we'll learn the most important electrical engineering concepts**
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5	**Assembling and Cabling Devices**	Infosys Springboard	https://infyspringboard.o nwingspan.com/web/en/ app/toc/lex_auth_01384 786255477964855134_s hared/overview	2 hours	The one and only energy source for our advanced civilization is electricity which is carried to every point of requirement via the cables. With the increase of electrical appliances in the domestic and commercial world, the volume of cables has increased manifold. It has become really necessary to understand and manage the volume properly to avoid accidents and assembling crisis at the time of emergency. Moreover, the type of cables varies as per the source of power and device which they are connected to. The cables are used in all types of electrical devices for proper power distribution and also for communication purpose. In fact in the case of the electronic devices like computers the cables are aptly designed as per the requirement of the parts they are connected with. The insulation and jacketing, as well as the material used for conduction, are
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					chosen with great care to serve the purpose. Other than the material, the ports which connect with the hardware should be recognized as they vary in connecting points and degree of power delivery.
6	**AutoCAD Case Study - Solar Electric Panel Design**	Infosys Springboard	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013842063701794481611614_shared/overview	1 hour 35 minutes	**The project "Solar Electric Power System Design" provides an introduction to designing a solar electric power system. It covers the design of solar electric panels using AutoCAD, including the layout and positioning of panels for optimal energy generation. The project also focuses on designing the power generation cable system to efficiently transmit the generated electricity. Additionally, learners will learn how to calculate the battery capacity needed to store the solar-generated power effectively..**
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7	**ELECTRICITY**		https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0136212072611512328893/overview	1 hour 58 minutes	
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8	AutoCAD Case Study - Fire Alarm System Layout		https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384339122647859238065_shared/overview	3 hour 8 minutes	"AutoCAD Project - Fire Alarm System Layout" is a practical course that immerses learners in designing fire alarm system layouts using AutoCAD, a powerful computer-aided design software. This course likely covers aspects such as understanding fire safety regulations, creating accurate floor plans, placing fire alarm devices, and integrating symbols and annotations. Participants will learn how to translate fire safety requirements into detailed and precise AutoCAD drawings. Through hands-on exercises and real-world scenarios, this course empowers learners to master the art of designing effective fire alarm system layouts, making it a valuable resource for architects, engineers, and professionals in the field of building safety and design
Program Group: Electronics					
1	ESim - EDA tool for circuit design, simulation, analysis and PCB design	SWAYAM , AICTE sponsored	https://onlinecourses.swayam2.ac.in/aic20_sp59/preview	4 week	self-learn eSim - EDA tool is used for circuit design, simulation, analysis and PCB design
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2	Python for Data Science-	SWAYAM , AICTE sponsored	https://onlinecourses.npt el.ac.in/noc25_cs60/prev iew	4 weeks	python programming for solving data science problems.
3	Electronic & Electrical Devices Maintenance&Troubleshooting	Udemy Online courses	https://www.udemy.com /course/electronic-electronics-maintenance-electronic-devices-maintenance/? srsltid=AfmBOop0wgN f9R5kWcZUA7pf5Vb7 TPYx9xjSL-LR1zqc9pMsX981xn7A &couponCode=ACCAG E0923	4 weeks	Understand the basic concepts of voltage, resistance and current, use of DMM and tools, Practical Troubleshooting and Maintenance of Electronic Devices
4	Python Programming - Comprehensive Training	Infosys Springboard	https://infyspringboard.o nwingspan.com/web/en/ app/toc/lex_auth_01384 17419204935682483_sh ared/overview	4 weeks	It covers essential concepts such as syntax, list, string, loops, files, GUI. Students will be able to build their own System programs, and basic malware testing programs.
5	Internet of Things 201	Infosys Springboard	https://infyspringboard.o nwingspan.com/web/en/ app/toc/lex_auth_01295 63012988354561318_sh ared/overview	4 weeks	This course provides practical insights about Raspberry Pi DIY Boards to create IoT usecases and IoT PoCs.
6	Arduino Robotics Part-I	https://easyshiksha.com/ online_courses	https://easyshiksha.com/ online_courses/arduino-robotics-part-i	4 weeks	introduction to the exciting field of robotics and to gain practical experience in building and programming robots.
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7	Microcontroller Embedded C Programming: Absolute Beginners	https://easyshiksha.com/online_courses/	https://easyshiksha.com/online_courses/microcontroller-embedded-c-programming-absolute-Beginners	4 weeks	This course provides a 'hardware-free' introduction to embedded software for students who: ? Already know how to write software for 'desktop' computer systems. ? Are familiar with a C-based language (Java, C++ or C). ? Want to learn how C is used in practical embedded systems.
8	Certificate Course in Internet of Things (IoT)	National Institute of Electronics & Information Technology,Kohima,	https://nielit.gov.in/kohima/content/short-term-courses-22	4 weeks	Introduction to IOT & embedded system, Projects using Arduino Uno and ESP-32:
Programme Group-Mechanical Engineering					
1	Robot Design and Developemnet	AICTE	https://neat.aicte-india.org/course-details/NEAT20221206_PROD_1	5 Hr	This course will help student to equip swith the fundamental skills and practical knowledge required to control robots and its part for real-world applications.
2	GD & T	AICTE	https://neat.aicte-india.org/course-details/NEAT2020616_PROD_3	5 Hr	This course will provide students with the knowledge and skills to interpret, apply, and analyze Geometric Dimensioning and Tolerancing (GD&T) standards used in engineering design and manufacturing.
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3	CAD using Autodesk Inventor	AICTE	https://neat.aicte-india.org/course-details/NEAT2020621_PROD_1	5 Hr	This course will enable students to create, modify, analyze, and optimize engineering designs using industry-standard CAD software, preparing them for roles in design and manufacturing.
4	Fundamentals of Fixture Designing Concepts for CNC Machining Application	AICTE	https://neat.aicte-india.org/b2b-course-details/NEAT2020616_PROD_9	5 Hr	Fixture design is a vital part of New Product development cycle. To design and manufacturing the fixture need a lot of skillset and in-depth understanding of CNC machining process and Locating / Clamping Principles.
5	Electrical Vehicle engineering	AICTE	https://neat.aicte-india.org/course-details/NEAT2020627_PROD_1	5 Hr	The electrical vehicle certification course is a Workshop Integrated Learning Program designed for students or professionals aspire to work or working in automotive, auto-component, design and manufacturing sector and aim to develop the required skills to build and sustain future automobiles. The program has a special emphasis on concepts such as Vehicle dynamics,
Programme - Diploma in Hotel Management and Catering Technology					
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1	Food & Beverage Management	Università Bocconi	https://www.coursera.org/learn/food-beverage-management	13 hours	The objective of this course is twofold: first, it will focus on contemporary challenges that managers and entrepreneurs in food and beverage businesses should be able to face; and second, will provide models and tools to design and implement appropriate courses of action to satisfy customers and build an advantage over the competition. This course is made up of four modules and an introduction, each exploring one dilemma that food and beverage companies face.
2	**Bar and Beverage Service** **Paid 1499**	G O BPO Services Private Limited	https://www.skillindiadigital.gov.in/courses/detail/aa9e320a-729b-44a7-9899-af61d8b75cbb	27 Hours	This course provides essential training in bar and beverage service. It includes bar opening procedures, equipment cleaning, and setting up the bar. Students will learn to prepare and serve juices, shakes, and alcoholic beverages, including handling wine and beer service. The course also covers managing intoxicated guests and maintaining a professional bar environment.
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3	Digital Marketing Strategy	Institution:EdinburghX	https://www.edx.org/learn/digital-marketing/the-university-of-edinburgh-digital-marketing-strategy	08 Weeks	Digital marketing is a major component of marketing today. This course will equip you with practical digital marketing skills to help you build your business. You will learn about the digital marketing landscape and how digital technologies can be used to help businesses identify opportunities and minimize risk. Case studies will be used to demonstrate how digital supports business objectives, and how it can set enterprise apart.
4	Counter Sales Executive - Tourism & Hospitality	Tourism & Hospitality Skill Council	https://www.skillindiadigital.gov.in/courses/detail/91f96304-4601-4568-84ec-4a994d2eb6f5	07 Hrs.	The individual at work receives guests, answers their queries, takes down their orders, handle online food and beverage orders, transfers orders to the kitchen, instructs the kitchen staff, serves guests, ensures timely delivery of the order to the customer and maintains the QSR as per organizational policy.
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5	Front Desk and Telephone Operations (Paid 1499/-)	G O BPO Services Private Limited	https://www.skillindiadigital.gov.in/courses/detail/1c311296-a77f-4c7c-8360-9a0bfd25958c	20 Hrs.	Training in reception and front office executive. Under Reception Duties we would cover areas like Pre-shift briefings. Efficiently handle reservations, check-ins, room changes, and guest records. Manage room extensions, group check-ins, and VIP servic
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