ACADEMIC CURRICULA

Professional Core Courses

MECHANICAL ENGINEERING

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18MEC101T	Course Name	THERMODYNAMICS	Course Category	C	Professional Core	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards		Steam tables and Mollier chart	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Identify the fundamental concepts of thermodynamic systems and energy transfer	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Utilize thermodynamic laws and their applications			
CLR-3 :	Utilize the concept of entropy and availability			
CLR-4 :	Utilize the evaluation of properties of pure substances and vapour power cycles			
CLR-5 :	Utilize the evaluation of properties of gas and gas mixtures			
CLR-6 :	Utilize the thermodynamic relations and its significance			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Apply the concept of thermodynamic properties to quantify energy transfer	3	90	80	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
CLO-2 :	Apply thermodynamic laws to analyze various thermodynamic systems	3	90	80	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
CLO-3 :	Apply the concept of entropy and availability to thermodynamic systems and to do exergy analysis	3	90	80	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
CLO-4 :	Evaluate the properties of pure substances and analyze vapour power cycles	3	90	80	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
CLO-5 :	Evaluate the properties of gas and gas mixtures	3	90	80	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
CLO-6 :	Apply the knowledge of thermodynamic relations to evaluate non measurable properties	3	90	80	H	M	M	M	M	L	L	L	M	M	M	M	M	M	M

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Thermodynamic system and Control volume	Limitations of first law	Clausius theorem	Pure substances, Phase change phenomenon of a pure substance	Properties of ideal gases
	SLO-2	Thermodynamic properties, State, Process and Cycle	Cyclic heat engine, Energy reservoirs,	Concept of entropy, T-s diagram	Property diagrams for phase change process	Properties of real gases
S-2	SLO-1	Thermodynamic equilibrium, Quasi-static process	Refrigerator and heat pump	Clausius inequality, Entropy principle	T-v, P-v,P-T diagram, P-v-T surface, Critical point and Triple point	Equation of state
	SLO-2	Pure substance , State postulate	Thermal efficiency and COP	Application of the concept of Clausius theorem	T-s and h-s diagram, Dryness fraction,	Vander Waal's equation of state
S-3	SLO-1	Concept of temperature, Zeroth law of thermodynamics,	Kelvin-Planck statement and Clausius statement of second law	Clausius inequality on solving problems of heat engines, heat pump and refrigerators.	Use of Steam tables,Mollier chart	Compressibility factor, compressibility chart
	SLO-2	Work and heat interaction	Equivalence of the two statements	Evaluation of change in entropy for solids and liquids	Identification of states & Determination of properties	Problem solving on evaluation of properties of ideal gas and real gas.
S-4	SLO-1	Path function and point function.	Tutorials on Second law of thermodynamics	Tutorials on change in entropy for solids and liquids	Tutorials on calculation of steam properties	Tutorials on properties of ideal gas and real gas.
	SLO-2	pdVwork for various quasi-static processes	Tutorials on Second law of thermodynamics	Tutorials on change in entropy for solids and liquids	Tutorials on calculation of steam properties	Tutorials on properties of ideal gas and real gas.
S-5	SLO-1	Tutorials on Work and Heat Transfer.	Reversible and irreversible process	Evaluation of change in entropy for ideal gases undergoing various processes	Rankine cycle	Properties of mixture of gases
	SLO-2	other types of work transfer including flow work	Causes of irreversibility	Evaluation of change in entropy for ideal gases undergoing various processes	Operation of Rankine cycle	Dalton's law of partial pressures

S-6	SLO-1	First law of thermodynamics for a closed system	Carnot cycle	Available and unavailable energy	Analysis of Rankine cycle	Amagat's law of additive volumes
	SLO-2	Concept of total energy E	Working of a Carnot engine	Dead state	Analysis of Rankine cycle	Internal energy, enthalpy
S-7	SLO-1	Various modes of energy	Thermal efficiency of a Carnot heat engine	Availability	Problems solving on Rankine cycle	specific heats and entropy of gas mixtures
	SLO-2	Tutorials on first law for a closed system	Tutorials on Carnot engines	Irreversibility	Problems solving on Rankine cycle	Problem solving on evaluation of properties of gas mixtures
S-8	SLO-1	Tutorials on first law: Constant volume, constant pressure, process in which PV=C	Reversed Carnot cycle	Tutorials on change in entropy for ideal gases	Tutorials on Rankine cycle with different turbine inlet conditions	Tutorials on properties of gas mixtures
	SLO-2	Tutorials on first law: Polytropic, adiabatic process, Combination of different process	Carnot's theorem	Tutorials on change in entropy for ideal gases	Tutorials on Rankine cycle with different turbine inlet conditions	Tutorials – Mixing of gases
S-9	SLO-1	Internal energyand Enthalpy, specific heats	Thermodynamic temperature scale.	Availability of energy entering a system	Reheat Rankine cycle	Maxwell's relations
	SLO-2	Process and cycle	Efficiency of Carnot heat engine	Availability of energy entering a system	Operation of reheat Rankine cycle	T-ds relations
S-10	SLO-1	First law applied to flow processes	COP of Carnot refrigerator	Problems solving on Availability of a closed system	Analysis of reheat Rankine cycle	Equations for dH and dU.
	SLO-2	Derivation of general energy equation for a control volume	Carnot heat pump, COP	Problems solving on Availability of a closed system	Concept of regeneration in Rankine cycle	Clausius-Clapeyron Equation
S-11	SLO-1	Application of SFEE to various steady flow devices	Tutorials on combined heat engine & refrigerator/heat pump system	Availability in a steady flow process	Problem solving on reheat Rankine cycle	Joule-Thomson experiment
	SLO-2	Problem solving on first law applied to flow processes	Tutorials on combined heat engine & refrigerator/heat pump system	Problem solving on availability	Problem solving on reheat Rankine cycle	Joule -Thomson coefficient.
S-12	SLO-1	Tutorial on first law applied to various steady flow devices	Tutorials on combined heat engine & refrigerator/heat pump system	Tutorials on availability	Tutorials on reheat Rankine cycle	Tutorials on Thermodynamic relations
	SLO-2	Tutorial on first law applied to various steady flow devices	Tutorials on combined heat engine & refrigerator/heat pump system	Tutorials on availability	Tutorials on reheat Rankine cycle	Tutorials on Thermodynamic relations

Learning Resources	1. Mahesh M. Rathore, Thermal Engineering, Tata McGraw Hill Education, 2012 2. Yunus. ACengel., Michael A Boles, Thermodynamics – An Engineering Approach, 8th ed., Tata McGraw Hill- Education, 2015 3. Nag. P.K, Engineering Thermodynamics, 5th ed., Tata McGraw Hill Education, 2013 4. R. K. Rajput, Thermal Engineering, 10th ed., Laxmi Publications (P) Ltd, New Delhi, 2017	5. Michael J Moran, and Howard N Shapiro, Fundamentals of Engineering Thermodynamics, 8th ed., John Wiley & Sons, New York, 2015 6. Claus Borgnakke, Richard E. Sonntag, Fundamentals of Thermodynamics, 7th ed., Wiley, 2009 7. Ramalingam. K. K, Steam tables, Sci.Tech Publishers, 2009

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.R.Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. Dr. R Velraj, IES,CEG, Anna University, Chennai, velrajr@annauniv.edu*	*1. Mr. V Thirunavukkarasu, SRMIST*
2. Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr. Raju Abraham, NIOT, Chennai, abraham@niot.res.in*	*2. Dr. M. Cheralathan, SRMIST*

Course Code	18MEC102T	Course Name	FLUID MECHANICS	Course Category	C	Professional Core	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Utilize the properties of fluid and pressure measurement techniques using manometer			
CLR-2 :	Utilize the basic equations of fluid mechanics to solve fluid flow problems			
CLR-3 :	Utilize the applications of dimensional and model analysis			
CLR-4 :	Identify the working principle and design of hydraulic turbines and pumps			
CLR-5 :	Utilize the concept of boundary layer, lift and drag forces			
CLR-6 :	Identify the behavior of fluids at rest as well as in motion			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify the properties of fluid	2	85	80	H	H	H	H	M	L	L	L	M	L	-	H	L	H	L
CLO-2 :	Solve the fluid flow problems	3	85	80	H	H	H	H	M	L	L	L	M	L	-	H	L	H	L
CLO-3 :	Apply the mathematical techniques for practical fluid flow problem	3	85	80	H	H	H	H	M	L	L	L	M	L	-	H	L	H	L
CLO-4 :	Identify the energy exchange process in fluid machinery	3	85	80	H	H	H	H	M	L	L	L	M	L	-	H	L	H	L
CLO-5 :	Identify the boundary layer theory and flow over submerged bodies	2	85	80	H	H	H	H	M	L	L	L	M	L	-	H	L	H	L
CLO-6 :	Analyze the dynamics of fluid flows and their governing parameters	3	85	80	H	H	H	H	M	L	L	L	M	L	-	H	L	H	L

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Types of Fluids, Properties of fluid	Types of fluid flow	Dimensional analysis	Hydraulic machines	Boundary layer
	SLO-2	Density, Specific weight, Specific volume,	Lagrangian and Eulerian approach of study	Dimensions, Dimensional Homogeneity	Turbines and Pumps	Laminar boundary layer
S-2	SLO-1	Specific gravity, Vapor pressure	Velocity of Fluid particles	Buckingham's pi theorem	Classification of turbines and pumps	Turbulent boundary layer
	SLO-2	Viscosity: Dynamic and Kinematic viscosity	Acceleration of Fluid particles	Model analysis	Pelton turbine-Working principle	Boundary layer thickness
S-3	SLO-1	Newton's law of viscosity	Continuity equation	Advantages and applications	Velocity triangle	Displacement thickness
	SLO-2	Surface tension and Capillarity	Continuity equation in three dimensions	Similitude, Dimensionless numbers	Design parameters, Performance	Problem solving on boundary layer thickness
S-4	SLO-1	Tutorials on fluid properties	Tutorials on Velocity, Acceleration and Continuity equation	Tutorials on Buckingham's pi theorem	Tutorials on Pelton turbine	Tutorials on Boundary layer thickness
	SLO-2	Tutorials on fluid properties	Tutorials on Velocity, Acceleration and Continuity equation	Tutorials on Buckingham's pi theorem	Tutorials on Pelton turbine	Tutorials on Boundary layer thickness
S-5	SLO-1	Bulk modulus of elasticity and Compressibility	Fluid Dynamics	Model laws- Reynold's, Froude	Francis turbine-Working principle	Momentumthickness
	SLO-2	Fluid statics: Pascal'slaw	Euler equation of motion	Model laws- Euler	Velocity triangle	Energy thickness
S-6	SLO-1	Hydrostatic law	Bernoulli's equation	Tutorials on Reynold's and Froude model laws	Kaplan turbine-Working principle	Drag force on a flat plate due to boundary layer
	SLO-2	Manometers: Types	Applications of bernoulli's equation	Weber and Mach model laws	Velocity triangle	von Karman momentum integral equation
S-7	SLO-1	Piezometer	Venturimeter	Laminar flow-Reynold's experiment	Cavitation in turbines	Separation of boundary layer
	SLO-2	Applications and Limitation	Orificemeter	Hagen poiseuille law	Problem solving on Turbine performances	Problem Solving on momentum integral

						equation
S-8	SLO-1	*Tutorials on laws of fluid statics*	*Tutorials on Venturimeter and Orificemeter*	*Tutorials on major and minor losses*	*Tutorials on Francis and Kaplan turbine*	*Tutorial problems on momentum integral equation*
	SLO-2	*Tutorials on laws of fluid statics*	*Tutorials on Venturimeter and Orificemeter*	*Tutorials on major and minor losses*	*Tutorials on Francis and Kaplan turbine*	*Tutorial problems on momentum integral equation*
S-9	SLO-1	*U-Tube manometer*	*Pitot tube*	*Turbulent flow-Darcy equation*	*Reciprocating pump*	*Forces exerted by a flowing fluid on a stationary body*
	SLO-2	*Problem Solving on U-tube manometer*	*Nozzle flow meter*	*Minor loss due to sudden enlargement*	*Single and double acting pumps-working principle*	*Separation of flow over bodies*
S-10	SLO-1	*Single column manometer*	*Bernoulli's equation for real fluid*	*Minor loss due to sudden contraction*	*Centrifugal pump - Working principle*	*Streamlined and bluff bodies*
	SLO-2	*Differential U-tube manometer*	*Types of flow lines, Stream line*	*entrance and exit of pipe*	*Velocity triangle, Design parameters*	*Development of lift on a circular cylinder*
S-11	SLO-1	*Inverted differential U-tube manometer*	*Streak line and Path line*	*Flow through pipes in series*	*Cavitation in pumps*	*Development of lift on an aerofoil*
	SLO-2	*Problem solving in differential manometer*	*Impulse Momentum equation*	*Flow through pipes in parallel*	*Performance curves on turbines and pumps*	*Problem Solving on lift and drag forces*
S-12	SLO-1	*Tutorials on differential manometer*	*Tutorials on finding force exerted by fluid on pipe bend*	*Tutorials on major and minor losses*	*Tutorials on centrifugal pump*	*Tutorials on lift and drag forces*
	SLO-2	*Tutorials on differential manometer*	*Tutorials on finding force exerted by fluid on pipe bend*	*Tutorials on major and minor losses*	*Tutorials on centrifugal pump*	*Tutorials on lift and drag forces*

Learning Resources	1. *Rajput. R. K, A text book of Fluid Mechanics and Hydraulic Machines, S.Chand & Company Ltd., 6th ed., 2015* 2. *Bansal. R. K, A text book of Fluid Mechanics and Hydraulics Machines, Laxmi publications (P) Ltd., 9thed., 2015* 3. *Modi P.N, Seth S.M, Hydraulics and Fluid Mechanics, Standard Book House,15thed., 2002*	4. *White. F. M, Fluid Mechanics, Tata McGraw-Hill, 7th ed., 2011* 5. *Streeter. V. L, Wylie. E. B, Fluid Mechanics , McGraw Hill,5thed., 1984* 6. *Modi P.N, Seth S.M, Hydraulics and Fluid Mechanics, Standard Book House,15thed., 2002*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

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1. Dr.R.Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. Dr. R Velraj, IES, CEG, Anna University, Chennai, velrajr@annauniv.edu*	*1. Mr. V. Rajasekar, SRMIST*
2. Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr. Raju Abraham, NIOT, Chennai, abraham@niot.res.in*	*2. Dr. K. Suresh Kumar, SRMIST*

Course Code	18MEC103T	Course Name	MANUFACTURING TECHNOLOGY	Course Category	C	Professional Core	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Utilize the Concepts of casting Technology
CLR-2 :	Identify the Mechanical working of metals
CLR-3 :	Identify the Theory of metal cutting
CLR-4 :	Utilize machine tools principles and its application in manufacturing industry
CLR-5 :	Identify the various metal joining process for the assembly operations.
CLR-6 :	Utilize principles and techniques of casting, forming, joining and finishing operations and determine their suitability

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify metal casting processes and to recognize the various casting techniques to apply for making the product	2	90	85	H	L	M	M	-	-	-	-	M	-	-	-	H	L	H
CLO-2 :	Identify metal forming processes and sheet metal techniques to apply the techniques for any fabrication work	2	90	85	H	M	M	M	-	-	-	-	M	-	-	-	H	L	H
CLO-3 :	Use the theory behind the metal cutting operation and acquire the knowledge about cutting tool and cutting fluids	2	90	85	H	M	M	M	-	-	-	-	M	-	-	-	H	L	H
CLO-4 :	Identify machine parts and operations of milling, shaping, slotting, planning and broaching machines	2	90	85	H	L	M	L	-	-	-	-	M	-	-	-	H	L	H
CLO-5 :	Identify various metal joining process and its application in various industrial sectors	2	90	85	H	L	H	H	-	-	-	-	M	-	-	-	H	L	H
CLO-6 :	Identify manufacturing processes, tools, environment and suitable manufacturing processes for fabrication work	2	90	85	H	M	M	M	-	-	-	-	M	-	-	-	H	L	H

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to Casting	Introduction to Hot Working	Orthogonal cutting	Introduction to Gear Manufacturing	Types of Welding Processes, Types of Joints, Types of Welds,
	SLO-2	Patterns and its types and Materials	Cold Working	Oblique cutting	Machining and Generating Processes	Power Density, Heat Balance in Fusion Welding
S-2	SLO-1	Pattern Allowances	Hot and Cold Rolling	Classification of cutting tools	Classification of Milling Machines and its basic construction,	General Technology of Arc Welding
	SLO-2	Moulding and its types,	Types of rolling; Two, three, four, multi and Universal rolling	Single point cutting tools	Types of cutters in Milling machines	consumable and non-consumable electrodes Oxy-fuel Gas Welding
S-3	SLO-1	Moulding sand	Open die and Closed die forging	Multipoint cutting tools	Types of milling operations; (up and down, peripheral, face milling	Fundamentals of Shielded Metal Arc Welding
	SLO-2	Design of Gating system	Wire drawing	Tool signature for single point cutting tool	Simple and differential Indexing methods and its calculations	Gas Metal Arc Welding, and Submerged Arc Welding
S-4	SLO-1	Tutorial for design of gating system	Tutorial Session	Tutorial on Numerical in cutting force calculation	Tutorial 10 Numerical in indexing methods	Tutorial Session
	SLO-2	Tutorial for design of gating system	Tutorial Session	Tutorial on Numerical in cutting force calculation	Tutorial 10 Numerical in indexing methods	Tutorial Session
S-5	SLO-1	Numerical problems on pouring time	Hot, Cold wire drawing	Mechanics of orthogonal cutting	Shaping and slotting Machine	Fundamentals of Gas tungsten arc welding
	SLO-2	Numerical problems on Caine's rule	Forward, backward and tube extrusion	Force relationship	Description and Operations	Resistance welding, and Plasma arc welding

S-6	SLO-1	*Numerical Problems on Riser design*	*Shearing, Piercing*	*Merchant Circle*	*Planing; Double house and open side*	*Parametric considerations in solid-state welding*
	SLO-2	*Numerical Problems on Riser design*	*Trimming and Stretch forming*	*Merchant Circle*	*Quick return mechanism, Work and tool holding Devices*	*Difference between fusion welding and solid-state process*
S-7	SLO-1	*Cores*	*Theory of Bending, Bending length*	*Determination of shear angle*	*Boring machine and its Specification, operations*	*Forge Welding, Roll Welding, Explosion Welding, Ultrasonic welding*
	SLO-2	*Core making*	*Bending force calculations*	*Determination of shear angle*	*Jig boring machine*	*Friction welding and Friction stir welding, Friction surfacing and processing*
S-8	SLO-1	*Tutorial on Numerical in riser design and pouring time*	*Tutorial on Numerical in bending force calculation*	*Tutorial on Numerical in Merchant circle*	*Tutorial on Discussion about mechanism of special purpose machine*	*Tutorial Session*
	SLO-2	*Tutorial on Numerical in riser design and pouring time*	*Tutorial on Numerical in bending force calculation*	*Tutorial on Numerical in Merchant circle*	*Tutorial on Discussion about mechanism of special purpose machine*	*Tutorial Session*
S-9	SLO-1	*Shell casting*	*Drawing*	*Chip formation*	*Specification of Broaching machine, its types and operations; internal, surface*	*Basic Solidification Concepts, Grain structure*
	SLO-2	*Investment Casting*	*Blank size and and drawing force calculations*	*Cutting tool materials*	*Tool nomenclature of broaching tool*	*Post-Solidification Phase Transformations, CCT diagram*
S-10	SLO-1	*Die casting*	*Tube forming, Embossing and coining*	*Tool wear calculation*	*Grinding process, Types of Grinding machines*	*Residual Stresses and Distortion, weld defects, Inspection and Testing Methods,*
	SLO-2	*Centrifugal Casting*	*Progressive dies*	*Taylor tool life calculation*	*Surface, Cylindrical and Centerless Grinding*	*factors of weldability, Types of weldability test techniques,*
S-11	SLO-1	*Casting defects*	*Compound and Combination dies*	*Machinability*	*Grinding Wheel and its types, Grinding specifications and type of abrasive bonds*	*Introduction on brazing and soldering methods*
	SLO-2	*Remedies for defects*	*Defects in forming*	*Cutting Fluids*	*Lapping, Buffing, Honing, and Super finishing*	*filler materials*
S-12	SLO-1	*Tutorial Session*	*Tutorial Session*	*Tutorial Session*	*Tutorial Session*	*Tutorial Session*
	SLO-2	*Tutorial Session*	*Tutorial Session*	*Tutorial Session*	*Tutorial Session*	*Tutorial Session*

Learning Resources	1. *SeropeKalpakjian, Steven R Schmid Manufacturing Engineering and Technology, 7th ed., Pearson, 2018* 2. *Mikell P. Groover, Fundamentals of Modern Manufacturing Materials, Processes, and Systems, 4th ed., John Wiley & Sons, 2010* 3. *Roy A. Lindberg, Processes and materials of manufacture, Boston: Allyn and Bacon, Pearson education, 2006* 4. *A.C. Davies, The science and practice of welding, Vol. 1 and 2, 10th ed., Cambridge University Press, 2002*	5. *John A. Schey, Introduction to manufacturing processes, 3rd ed., McGraw-Hill, 2000* 6. *Sindo Kou, Welding Metallurgy, 2nd ed., John Wiley & Sons, 2003.* 7. *John C. Lippold, Welding Metallurgy and Weldability, John Wiley & Sons, 2015* 8. *Welding Handbook – Volume 1 to 5, 9th ed., American Welding Society.2013*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. R. Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in, rkpearls@yahoo.com	*1. Dr. P. Hariharan, Anna University, hari@annauniv.edu, hariharan2311@gmail.com*	*1. Dr. M. Prakash, SRMIST*
2. Dr. A. Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr. N. Arunachalam, IIT Madras, chalam@iitm.ac.in*	*2. Dr. Manidipto Mukherjee, SRMIST*

Course Code	18MEC104L	Course Name	FLUID DYNAMICS LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	18MEC102T	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Practice working of flow measuring devices			
CLR-2 :	Practice Kinematics and dynamics of fluid flow in pipes			
CLR-3 :	Identify the various energy losses in pipes			
CLR-4 :	Identify the performance of pumps			
CLR-5 :	Analyze the performance of turbines			
CLR-6 :	Analyze fluid flow concepts, working principles of flow meters, energy heads and losses, performance of pumps, turbines			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Practice the concept of flow measurement devices	3	95	85	H	H	H	H	M	L	L	L	M	M	M	M	L	L	L
CLO-2 :	Analyze the different type of energy heads	3	95	85	H	H	H	H	M	L	L	L	M	M	M	M	L	L	L
CLO-3 :	Evaluate the various energy losses in pipe	3	95	85	H	H	H	H	M	L	L	L	M	M	M	M	L	L	L
CLO-4 :	Analyze the performance of pumps	3	95	85	H	H	H	H	M	L	L	L	M	M	M	M	L	L	L
CLO-5 :	Analyze the performance of turbines	3	95	85	H	H	H	H	M	L	L	L	M	M	M	M	L	L	L
CLO-6 :	Analyze fluid flow concepts, working principles of flow meters, energy heads and losses, performance of pumps, turbines	3	95	85	H	H	H	H	M	L	L	L	M	M	M	M	L	L	L

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Flow measurement using Orificemeter	Flow visualization using Reynolds apparatus	Study of major Energy loss in a pipe	Study of Kaplan turbine Test Rig	Study of Submersible Pump Test Rig
	SLO-2					
S-2	SLO-1	Determine the co-efficient of discharge of Orifice meter	Free and forced vortex flow visualization	Determine friction factor at a given pipe	Performance test on Kaplan turbine	Performance test on Submersible pump
	SLO-2					
S-3	SLO-1	Flow measurement using Venturimeter	Obtain surface profile of forced vortex and find the depth of the forced vortex curve	Study of Pelton turbine	Study of Francis turbine Test Rig	Study of Reciprocating Pump Test Rig
	SLO-2					
S-4	SLO-1	Determine the co-efficient of discharge of Venturimeter	Verify Bernoulli's theorem	Performance test on Pelton turbine	Performance test on Francis turbine	Performance test on Reciprocating pump
	SLO-2					
S-5	SLO-1	Flow measurement using Pitot tube/ Visualization of cavitation in pipe flow	Determine total heads of fluids at given points in the pipe	Study on impact of jet of water on vanes	Study of Centrifugal Pump Test Rig	Study of Jet pump/ Performance test on Gear Pump Test Rig
	SLO-2					
S-6	SLO-1	Determine velocity at a point by using Prandtl type Pitot tube	Study of Minor losses &Determine minor losses due to pipe fittings	Determine co-efficient of impact of jet of water on different vanes	Performance test on Centrifugal pump	Performance test on Jet pump Performance test on Gear pump
	SLO-2					

Learning Resources	
	1. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, Introduction to Fluid Mechanics, 8th ed., Wiley, 2013
	2. P.N. Modi, S.M. Seth, Hydraulics& Fluid Mechanics Including Hydraulics Machines, 20th ed., Standard Book House,2018
	3. Frank M.White, Fluid Mechanics,7th ed., McGraw-Hill, 2018
	4. K L Kumar, Engineering Fluid Mechanics, 10th ed., S Chand & Co., 2015
	5. Laboratory Manual

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	18MEC105L	Course Name	MANUFACTURING PROCESS LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	18MEC103T	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Practice Various types of lathe operations			
CLR-2 :	Practice the Production of flat surface and contour shapes on the given component			
CLR-3 :	Practice basic Gear making processes			
CLR-4 :	Practice Surface finishing process			
CLR-5 :	Practice and Preparation of Sand Mould			
CLR-6 :	Utilize machines like lathe, CNC Lathe, Shaper, Slotter, Milling, CNC MIlling, Gear hobbing, grinding and sand moulding			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:				Program Learning Outcomes (PLO)													
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Machine using lathe to create new components according to specified dimensions	3	85	80	H	H	H	L	H	L	H	L	L	H	L	H	L	L	L
CLO-2 :	Produce the flat surface and contour shapes on the given component	3	90	85	H	M	L	L	H	L	L	L	L	H	L	H	L	L	L
CLO-3 :	Practice basic Gear Making Processes	3	95	90	M	L	H	H	L	L	L	L	H	H	L	H	L	L	L
CLO-4 :	Practice Surface Finish Process	3	85	80	H	L	H	L	L	L	H	H	L	L	L	H	L	L	L
CLO-5 :	Practice casting and molding	3	95	90	M	H	H	L	L	L	H	L	L	L	L	L	L	L	L
CLO-6 :	Practice machines like lathe, CNC Lathe, Shaper, Slotter, Milling, CNC MIlling, Gear hobbing, grinding and sand moulding	3	90	85	H	M	H	M	M	L	M	M	M	M	L	H	L	L	L

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Perform plain turning in lathe	Perform eccentric turning in lathe	Perform V block shaping in shaper machine	Helical Gear cutting in Hobbing machine	Grinding of single point cutting tool in Tool and Cutter grinding machine
	SLO-2					
S-2	SLO-1	Perform step turning in lathe	Perform Taper boring in lathe	Perform V block shaping in shaper machine.	Helical Gear cutting in Hobbing machine	Grinding of single point cutting tool in Tool and Cutter grinding machine
	SLO-2					
S-3	SLO-1	Perform chamfering in lathe	Perform Knurling in lathe	Perform Polygon milling in milling machine	Perform surface grinding in Grinding machine	Preparation of Sand mold using solid/split pattern with loose-piece pattern
	SLO-2					
S-4	SLO-1	Perform taper turning by compound rest/offset method in lathe	Perform plain turning in CNC Lathe	Perform Polygon milling in milling machine	Perform surface grinding in Grinding machine	Preparation of Sand mold using solid/split pattern with loose-piece pattern
	SLO-2					
S-5	SLO-1	Perform drilling in lathe	Perform step turning in CNC Lathe	Spur Gear cutting in milling machine	Perform cylindrical grinding in Grinding machine	Preparation of Sand mold using solid/split pattern with loose-piece pattern
	SLO-2					
S-6	SLO-1	Perform external and internal thread cutting in lathe	Performing chamfering in CNC Lathe	Spur Gear cutting in milling machine	Perform cylindrical grinding in Grinding machine	Preparation of Sand mold using solid/split pattern with loose-piece pattern
	SLO-2					

Learning Resources	1. Chapman.W.A.J, Workshop Technology, Vol. I and II, Arnold Publisher, 2001 2. Hajra Choudhary.S.K., Hajra Choudhary.A.K, Elements of Manufacturing Technology Vol II, Media Publishers, 2007	3. James Madison, CNC Machining Hand Book, Industrial Press Inc., New York, 1996 4. Laboratory Manual

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
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1. Dr. R. Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in, rkpearls@yahoo.com	*1. Dr. P. Hariharan, Anna University,* hari@annauniv.edu, *hariharan2311@gmail.com*	*1. Mr. S. Sakthivel, SRMIST*
2. Dr. A. Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr. N. Arunachalam, IIT Madras, chalam@iitm.ac.in*	*2. Mr. Sundar Singh Sivam S.P, SRMIST*

Course Code	18MEC106T	Course Name	MECHANICS OF SOLIDS	Course Category	C	Professional Core	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MES201T	Co-requisite Courses	Nil	Progressive Courses	18MEC208T, 18MEE305T
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Utilize concepts of stress and strain
CLR-2 :	Analyze bending and shear stresses in beams
CLR-3 :	Utilize concepts to design shafts
CLR-4 :	Analyze of slope and deflection in beams
CLR-5 :	Utilize concepts to design column and cylinders
CLR-6 :	Utilize concepts of stress, strain, slope and deflection in beams and design of shaft, column and cylinders

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning 1 Level of Thinking (Bloom)	Learning 2 Expected Proficiency (%)	Learning 3 Expected Attainment (%)	PLO 1 Engineering Knowledge	PLO 2 Problem Analysis	PLO 3 Design & Development	PLO 4 Analysis, Design, Research	PLO 5 Modern Tool Usage	PLO 6 Society & Culture	PLO 7 Environment & Sustainability	PLO 8 Ethics	PLO 9 Individual & Team Work	PLO 10 Communication	PLO 11 Project Mgt. & Finance	PLO 12 Life Long Learning	PLO 13 PSO - 1	PLO 14 PSO - 2	PLO 15 PSO - 3
CLO-1 :	Identify concepts of stress and strain	3	85	80	H	H	L	L	L	L	L	L	L	L	L	L	L	M	L
CLO-2 :	Analyze bending and shear stresses developed in beams	3	85	80	H	H	L	L	L	L	L	L	L	L	L	L	L	M	L
CLO-3 :	Apply the concepts necessary to design of shafts	3	85	80	H	H	H	L	L	L	L	L	L	L	L	L	L	M	L
CLO-4 :	Analyze the slope and deflection in beams	3	85	80	H	H	L	L	L	L	L	L	L	L	L	L	L	M	L
CLO-5 :	Apply the concepts necessary to design of column and cylinders	3	85	80	H	H	H	L	L	L	L	L	L	L	L	L	L	M	L
CLO-6 :	Analyze the stresses, slope and deflection in beams and apply the concepts to design of shaft, column and cylinders	3	85	80	H	H	H	L	L	L	L	L	L	L	L	L	L	M	L

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Concept of stress and strain, Hooke's law	Introduction to types of beams and loads	Theory of pure torsion	Introduction, Beam deflection	Columns and struts
	SLO-2	Tensile, compressive and shear stresses, Poisson's ratio	Shear force, bending moment diagram for cantilever beam: (a) due to pure point load	shear stress in terms of torque in a circular shaft	Relation between deflection, slope, radius of curvature, shear force, bending moment	Members subjected to combined bending and axial loads
S-2	SLO-1	Stress-strain diagram Elastic constants and their relationship	(b) due to pure Uniformly Distributed Load (c) pure Uniformly Varying Load	Strength, Stiffness of shaft, Torsional rigidity & power transmitted	Problems on Relations	Expression for crippling load with different end conditions based on Euler's theory
	SLO-2	Volumetric strain	Problems on Shear force and bending moment diagrams for cantilever beam	Problems on solid shaft, finding dimensions	Problems on Relations	Problems on crippling load with different end conditions based on Euler's theory
S-3	SLO-1	Bars of uniform and varying sections subjected to single loads	Shear force, bending moment diagram for simply supported beam: (a) due to pure point load	Torque expression for (a) solid circular shaft subjected to torsion	Slope and deflection of cantilever beam with (a) a point load	Expression for crippling load by Rankine's theory
	SLO-2	Bars of uniform and varying sections subjected to multiple loads	(b) due to pure Uniformly Distributed Load (c) pure Uniformly Varying Load	(b) hollow circular shaft subjected to torsion.	(b) Uniformly Distributed Load	Problems on crippling load by Rankine's theory
S-4	SLO-1	Tutorial on stress, strain, Hooke's law, elastic constants and volumetric strain	Tutorial on Shear force, bending moment diagrams for simply supported beam	Tutorial on hollow shaft (a) finding dimensions,	Tutorial on Slope, deflection of cantilever beam with (a) a point load	Tutorial on crippling load by Rankine's theory
	SLO-2	Tutorial on bars of uniform and varying sections subjected to single, multiple loads	Tutorial on Shear force, bending moment diagrams for simply supported beam	(b) percentage of material savings	(b) Uniformly Distributed Load	Tutorial on crippling load by Rankine's theory
S-5	SLO-1	Analysis of bars of composite sections	Shear force, bending moment diagram for overhanging beam due to(a)pure point load	Circular shafts in series	Slope and deflection of simply supported beam with (a) a point load	Thin cylindrical shells subjected to internal pressure

	SLO-2	*Analysis of bars of composite sections*	*(b)pure Uniformly Distributed Load (c) pure Uniformly Varying Load*	*Circular shafts in parallel*	*(b) a Uniformly Distributed Load (Double integration method)*	*Change in dimensions of thin cylindrical shells due to internal pressure*
S-6	SLO-1	*Problems on Analysis of bars of composite sections*	*Problems on Shear force and bending moment diagrams for overhanging beam*	*Problems on Circular shafts in series and parallel*	*Problems on Slope and deflection of simply supported beam with (a) a point load*	*Problems on thin cylindrical shells subjected to internal pressure*
	SLO-2	*Problems on Analysis of bars of composite sections*	*Problems on Shear force and bending moment diagrams for overhanging beam*	*Problems on Circular shafts in series and parallel*	*(b) Uniformly Distributed Load (Double integration method)*	*change in dimensions of thin cylindrical shells due to internal pressure*
S-7	SLO-1	*Concept of Thermal stresses in simple bars*	*Theory of ure bending derivation,*	*Concepts on Strain energy due to torsion*	*Slope and deflection of simply supported beam with (a) a point load*	*Thin spherical shells subjected to internal pressure*
	SLO-2	*Concept of Thermal stresses in composite bars*	*Bending stress in beams of regular sections*	*Concepts on Strain energy due to torsion*	*(b) Uniformly Distributed Load (Macaulay's method)*	*Change in dimensions of thin spherical shells*
S-8	SLO-1	*Tutorial. on Thermal stresses in simple and composite bars*	*Tutorial on Bending stress in beams of regular sections*	*Tutorial on Strain energy due to torsion*	*Tutorial on Slope, deflection of simply supported beam with point load, Uniformly Distributed Load*	*Tutorial on thin spherical shells subjected to internal pressure, change in dimensions of thin spherical shells due to internal pressure*
	SLO-2					
S-9	SLO-1	*Principal plane, principal stress, Direct stress in two mutually perpendicular directions*	*Bending stress in beams having I- section*	*Solid circular shaft subjected to combined bending and torsion*	*Slope and deflection of cantilever beam with (a) a point load*	*Lame's theory on stresses in thick cylinders*
	SLO-2	*Direct stress in two mutually perpendicular directions accompanied by a simple shear stress*	*Bending stress in beams having T- section*	*Hollow circular shaft subjected to combined bending and torsion*	*(b) Uniformly Distributed Load (Moment area method)*	*Lame's theory on stresses in thick cylinders*
S-10	SLO-1	*Problems on Direct stress in two mutually perpendicular directions*	*Problems on bending stress in beams having I and T sections*	*Problems on circular shaft subjected to combined bending and torsion*	*Slope and deflection of simply supported beam with (a) point load*	*Problems on Lame's theory on stresses in thick cylinders*
	SLO-2	*Problems on Direct stress in two mutually perpendicular directions*	*Problems on bending stress in beams having I and T sections*	*Problems on circular shaft subjected to combined bending and torsion*	*(b) Uniformly Distributed Load (Moment area method)*	*Problems on Lame's theory on stresses in thick cylinders*
S-11	SLO-1	*Mohr's circle: direct stress in tow mutually perpendicular directions without shear stress*	*Derivation of shear stress distribution in beams of different sections*	*Composite solid circular shaft*	*Castigliano's theorem*	*Stresses in compound thick cylinder and Shrink fit*
	SLO-2	*Mohr's circle: direct stress in two mutually perpendicular directions with shear stress*	*Derivation of shear stress distribution in beams having I and T sections*	*Composite hollow circular shaft*	*Maxwel's reciprocal theorem*	*Problems on stresses in compound thick cylinder*
S-12	SLO-1	*Tutorial on direct stress in two mutually perpendicular directions*	*Tutorial on shear stress distribution in beams of different sections such as I and T*	*Tutorial on composite circular shafts*	*Tutorial on Castigliano's and Maxwel's reciprocal theorem*	*Tutorial on stresses in compound thick cylinder and Shrink fit*
	SLO-2					

Learning Resources	1. *Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf, David F. Mazurek, Mechanics of Materials, 7th ed., McGraw Hill, 2014* 2. *William A. Nash, Theory and Problems of Strength of Materials, Schaum's Outline Series, 3rd ed., McGraw Hill, 2007*	3. *Egor P. Popov, Engineering Mechanics of Solid, 2nd ed., Prentice Hall of India Pvt. Ltd., 2009* 4. *James M. Gere, Mechanics of Materials, 8th ed., Brooks/Cole, USA, 2013* 5. *Shigley. J. E., Applied Mechanics of Materials, International Student edition, McGraw Hill, 2000*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

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Course Code	18MEC107T	Course Name	APPLIED THERMAL ENGINEERING	Course Category	C	Professional Core	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MEC101T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards		Refrigeration Tables &Psychrometric chart	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Analyze the sequence of operation of energy cycles
CLR-2 :	Identify the fundamentals of Fuels and calculation of enthalpies
CLR-3 :	Analyze the performance testing of IC Engines
CLR-4 :	Apply the construction, principle of working and analysis of compressors
CLR-5 :	Analyze the working principle of refrigeration systems
CLR-6 :	Utilize the fundamentals and psychrometric processes

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify the basic operations required for energy release and method to calculate the efficiency	2	85	80	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
CLO-2 :	Comprehend the Fuel properties and its applications	2	85	80	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
CLO-3 :	Analyze the performance of IC Engines	3	85	80	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
CLO-4 :	Identify the construction, operation of compressors, their performance evaluation	3	85	80	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
CLO-5 :	Comprehend the types of refrigeration systems and evaluate its performance	2	85	80	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
CLO-6 :	Analyze the fundamental processes of air conditioning systems and do fundamental calculations	2	85	80	H	M	M	M	M	L	L	L	M	M	M	M	M	M	M

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to air standard cycles	Introduction to fuels, Solid fuels	Classification of IC engines	Classification of Air Compressors	Vapor compression refrigeration system and its working principle
	SLO-2	Air standard efficiency, Assumptions	Liquid fuels	Basic operations	Construction and working of reciprocating compressor	Refrigerants and properties
S-2	SLO-1	Otto cycle: Air standard efficiency	Gaseous fuels, Fuel properties	Actual p-v diagram of four stroke SI engines	Compression with clearance volume	Eco-friendly refrigerants
	SLO-2	Mean effective pressure	Stoichiometric air fuel ratio	Actual p-v diagram of four strokeCI engines	Compression without clearance	Analysis of vapor compression refrigeration cycle
S-3	SLO-1	Power developed	Theoretical air and excess air.	Comparison of four stroke and two IC engines	Equation for work-Single acting reciprocating compressor	P-h Chart
	SLO-2	Tutorials on Otto cycle	Air fuel ratio from analysis of products	Comparison of CI and SI Engines	Volumetric efficiency of compressor	Sub-cooling and superheating phenomena in VCR cycle
S-4	SLO-1	Tutorials on Otto cycle	Conversion between volumetric analysis to weight analysis	Engine Performance parameters	Tutorial problems on single stage compressor with clearance	Tutorial: Numerical problems on VC refrigeration system
	SLO-2	Diesel cycle: Air standard efficiency	Analysis of exhaust and flue gas	Measurements of fuel consumption	Tutorial problems on single stage compressor without clearance	Tutorial: Numerical problems on VC refrigeration system
S-5	SLO-1	Mean effective pressure	Internal energy and enthalpy of formation	Measurements of air consumption	Free air delivered	Simple vapor absorption refrigeration system
	SLO-2	Power developed	Determination of calorific values of the fuel-	Measurement of brake power	Free air delivered	Simple vapor absorption refrigeration

			Solid fuel and liquid fuel.			*system*
S-6	SLO-1	*Dual cycle: Air standard efficiency*	*Determination of calorific values of the fuel-Gaseous fuel*	*Measurement of in-cylinder pressure*	*Multistage compression*	*Properties of atmospheric air and Psychrometric chart*
	SLO-2	*Mean Effective pressure*	*Tutorials on determination of calorific value*	*Tutorials on IC Engine performance*	*Multistage compression*	*Properties of atmospheric air and Psychrometric chart*
S-7	SLO-1	*Power developed*	*Tutorials on determination of calorific value*	*Tutorials on IC Engine Performance*	*Problems on multistage compression*	*Psychrometric processes. sensible heating and cooling*
	SLO-2	*Tutorials on Diesel cycle*	*Tutorials on determination of calorific value*	*Tutorials on IC Engine Performance*	*Problems on volumetric efficiency*	*Psychrometric processes. sensible heating and cooling*
S-8	SLO-1	*Tutorials on Diesel cycle*	*Tutorial: Numerical problems on First law analysis*	*Tutorial: Numerical problems on engine performance parameters*	*Tutorials on multi stage compression, FAD*	*Cooling and dehumidification*
	SLO-2	*Tutorials on Dual cycle*	*Tutorial: Numerical problems on First law analysis*	*Tutorial: Numerical problems on engine performance parameters*	*Tutorials on multi stage compression, FAD*	*Heating and humidification*
S-9	SLO-1	*Problems on Mean effective pressure*	*Heat calculations using enthalpy tables*	*Heat balance sheet*	*Rotary compressors*	*Tutorial: Numerical problems on psychrometric processes*
	SLO-2	*Comparison of Otto, Diesel and Dual cycles*	*Problem Solving in Heat calculations*	*Heat balance sheet*	*Vane compressor*	*Summer air conditioning system*
S-10	SLO-1	*Brayton cycle*	*Adiabatic flame temperature*	*Problems on Heat balance sheet*	*Roots blower*	*Winter air conditioning system*
	SLO-2	*Brayton cycle efficiency*	*Adiabatic flame temperature*	*Problems on Heat balance sheet*	*Different compressors and features*	*Year-round air conditioning systems*
S-11	SLO-1	*Concept of Reheat in Brayton cycle*	*Chemical Equilibrium*	*Problems on Heat balance sheet*	*Reciprocating compressors and rotary compressors - comparison*	*Heat load and simple calculations*
	SLO-2	*Concept of Regeneration in Brayton cycle*	*Chemical equilibrium calculations*	*Problems on Heat balance sheet*	*Reciprocating compressors and rotary compressors - comparison*	*Heat load and simple calculations*
S-12	SLO-1	*Tutorials on power developed*	*Tutorial Problems on Adiabatic flame temperature for various fuels*	*Engine performance curves: Constant speed engines*	*Tutorial: Numerical problems on multi stage compression*	*Tutorial: Numerical problems on psychrometric processes*
	SLO-2	*Tutorials on power developed*	*Tutorial Problems on Adiabatic flame temperature for various fuels*	*Engine performance curves: Variable speed engines*	*Tutorial: Numerical problems on multi stage compression*	*Tutorial: Numerical problems on psychrometric processes*

Learning Resources	1. *Mahesh Rathore , Thermal Engineering, Tata McGraw Hill, 2012* 2. *Eastop T. D., Mcconkey. A, Applied Thermodynamics for Engineering Technologists, 5th ed., Pearson Edition, 2009* 3. *Kenneth A Kroos, Merle C. Potter, Thermodynamics for Engineers, Cengage learning, 2016*	4. *Rajput.R. K, Thermal Engineering, 10th ed., Laxmi Publications, 2015* 5. *Yunus A Cengel, Michael A Boles, Thermodynamics: An Engineering Approach,8th ed., Tata McGraw Hill, 2015*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.R.Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. Dr. R Velraj, IES, CEG, Anna University, Chennai, velrajr@annauniv.edu*	*1. Mr. G. Manikandaraja, SRMIST*
2. Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr. Raju Abraham, NIOT, Chennai, abraham@niot.res.in*	*2. Dr. G. Kasiraman,SRMIST*

Course Code	18MEC108T	Course Name	MATERIALS TECHNOLOGY	Course Category	C	Professional Core	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	18MEC111L	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Acquire knowledge about solidification of metals, phase diagrams and salient features of iron-carbon system	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Apply mechanism of plastic deformation, strengthening mechanisms, heat treatment and surface hardening processes			
CLR-3 :	Utilize the mechanical behavior of materials and learn about failure analysis			
CLR-4 :	Identify about structure, properties and applications of ferrous and non-ferrous materials			
CLR-5 :	Acquire knowledge about properties and applications of advanced engineering materials			
CLR-6 :	Utilize knowledge about mechanical behavior, phase diagrams, structure, properties of materials and their applications			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Interpret phase diagrams and correlate structure property relationships	2	90	85	H	-	-	-	M	-	-	-	-	-	-	-	-	-	
CLO-2 :	Identify strengthening mechanism, effect of heat treatment and surface hardening on the properties of materials	3	90	85	H	-	-	-	M	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Analyze failure of engineering materials	2	90	85	H	H	-	M	M	-	-	-	-	-	-	-	-	M	-
CLO-4 :	Select ferrous and non-ferrous alloys for various engineering applications	3	90	85	H	-	-	-	-	-	L	-	-	-	-	L	-	-	-
CLO-5 :	Apply advanced materials for specific applications based on their properties	2	90	85	H	-	-	-	-	-	M	M	-	-	-	-	-	-	L
CLO-6 :	Interpret phase diagrams, analyze mechanical behavior of materials, select materials for various engineering applications	3	90	85	H	H	-	M	M		M	M	-	-	-	L	-	M	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Crystal structures	Deformation by slip	Introduction to fracture	Properties of plain carbon steel	Introduction to Smart materials
	SLO-2	Imperfection in solids: Point, line	Slip systems, critically resolved shear stress	Types of fracture in metals	Properties of tool steel and stainless steel	Types of Smart materials
S-2	SLO-1	interfacial and volume defects Solidification	Shear strength of perfect and real crystals,	Stress-strain behavior of metals	Dual phase steels: properties	Shape memory alloys
	SLO-2	Nucleation and Growth	Concept of work hardening, Stages of work hardening	ceramics and polymers; True stress – true strain	Dual phase steels: processing, composition and applications	Properties of Nickel based and other superalloys
S-3	SLO-1	Dendritic growth	Solid solution strengthening	Hardness: Rockwell, Brinell, Vickers hardness	Brief introduction on High Strength Low Alloy (HSLA) steel	Classes of polymers
	SLO-2	Segregation and Homogenization	Grain boundary strengthening, Hall-Petch relation	Impact test: Charpy and Izod	effects of microalloying elements	Properties and applications of PE, PP, PS, PVC, Teflon
S-4	SLO-1	Introduction to Solid solutions	Dispersion strengthening: Precipitation	Griffith's theory of brittle fracture	Transformation induced plasticity (TRIP) steel, its properties and applications	Classes of ceramics
	SLO-2	Types and factors governing substitutional solubility based on Hume Rothery's rules	Particulates and Fibers	Griffith equation	Twinning induced plasticity (TWIP) steel, its properties and applications	Properties and applications of Al2O3, ZrO2, SiC, Si3N4, AlN
S-5	SLO-1	Introduction to Phase diagrams	Non-equilibrium phases	Stress intensity factor	Properties of cast irons: grey, white,	Types and classification of composite materials
	SLO-2	Phase rules and its application	Martensite, Bainite	Fracture toughness, Ductile to brittle transition	Properties of cast irons: malleable and spheroidal cast irons	Reinforcement and matrix material, Rule of Mixture

S-6	SLO-1	*Interpretation of phase diagrams*	*Introduction to TTT*	*Introduction to Fatigue, S-N curve*	*Copper and copper alloys with their applications*	*Properties of MMC, CMC and PMC*
	SLO-2	*Interpretation of phase diagrams*	*CCT diagrams, and their importance*	*Low and high cycle fatigue test*	*Copper, Brass, Bronze, Cupronickel, Muntz metal, Gun metal*	*Applications of MMC, CMC and PMC*
S-7	SLO-1	*Classification of phase diagram*	*Heat treatment processes: Annealing, Normalizing,*	*Stages of fatigue*	*Classification and properties of Aluminium alloys*	*Nanocrystalline materials, Classification based on dimension with examples,*
	SLO-2	*Classification of phase diagram*	*Tempering, Quenching*	*High temperature fracture, Creep curve*	*Age hardening, Different alloy series*	*CNT, graphene and their applications*
S-8	SLO-1	*Iron Iron-carbide phase diagram*	*Case hardening: carburizing,*	*Failure analysis: sources of failure*	*Magnesium alloys – advantages and problems*	*Biomaterials - applications, Types - metals, ceramics*
	SLO-2	*Iron Iron-carbide phase diagram*	*nitriding, cyaniding, carbo-nitriding*	*Procedure of failure analysis*	*Magnesium alloys – Types and designations*	*polymers and composites, Biocompatibility*
S-9	SLO-1	*Microstructural aspects and invariant reactions in Fe-C diagram*	*Flame and induction hardening*	*Introduction to Non-Destructive Testing (NDT)*	*Titanium alloys - α, β and $\alpha+\beta$ alloys*	*Introduction to structure and characterization of materials*
	SLO-2	*Microstructural aspects and invariant reactions in Fe-C diagram*	*Effect of hardening processes on hardness and microstructure*	*Liquid penetrant testing, Magnetic particle testing*	*Types of alloying additions, Properties and applications*	*XRD, SEM and TEM*

Learning Resources	1. *Flake.C Campbell, Elements of Metallurgy and Engineering Alloys, ASM International, 2008* 2. *Dieter.G.E, Mechanical Metallurgy, McGraw Hill, Singapore, 2001* 3. *Thomas H. Courtney, Mechanical Behaviour of Engineering materials, McGraw Hill, Singapore, 2000* 4. *Flinn.R.A , Trojan.P.K, Engineering Materials and their applications, Jaico, Bombay, 1995* 5. *Budinski.K.G, Budinski.M.K, Engineering Materials Properties and selection, Prentice Hall of India, 2004* 6. *ASM Metals Hand book, Failure analysis and prevention, Vol: 10, 14th ed., New York, 2002* 7. *Reza Abbaschian, Lara Abbaschian& Robert E. Reed-Hill, Principles of Physical Metallurgy, Cengage Learning, 2010* 8. *Michelle Addington and Daniel Schodek, "Smart Materials and New Technologies", Elsevier print, 2005*	9. *George S. Brady, Henry R. Clauser, JhonA.Vaccari, Materials Science Hand Book, McGraw-Hill, 2002* 10. *Sidney H Avnar, Introduction to physical metallurgy, 2nd ed., Tata McGraw-Hill, 1997* 11. *William D. Callister, David G. Rethwisch, Materials Science and Engineering: An Introduction,8th ed., Wiley publication, 2009* 12. *Donald R. Askeland, Wendelin J. Wright, Science and Engineering of Materials, 7th ed., Cengage Learning, 2011* 13. *Donald R. Askeland, Wendelin J. Wright, Essentials of Materials Science & Engineering, 3rd ed., Cengage, 2013* 14. *Raghavan V. Physical Metallurgy: Principles and Practice, Prentice Hall of India, 2012* 15. *Polmear I. Light Alloys: From Traditional Alloys to Nanocrystals, Butterworth-Heinemann, UK, 2005*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. R. Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in, rkpearls@yahoo.com	*1. Dr. P. Hariharan, Anna University,* hari@annauniv.edu, *hariharan2311@gmail.com*	*Dr. ShubhabrataDatta, SRMIST*
2. Dr. A. Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr. N. Arunachalam, IIT Madras, chalam@iitm.ac.in*	*Mr. D. Selwyn Jebadurai, SRMIST*

Course Code	18MEC109L	Course Name	STRENGTH OF MATERIALS LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	18MEC206T	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Identify the procedures for conducting various destructive tests			
CLR-2 :	Identify the concept of hardness and influence of heat treatment			
CLR-3 :	Utilize mechanical properties of various materials under different loading			
CLR-4 :	Utilize behavior of materials under cyclic loading			
CLR-5 :	Identify the aspects of testing the strength of various materials under different loading conditions			
CLR-6 :	Utilize destructive tests to determine strength of materials under externally applied loads			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify the procedures for conducting various destructive testing methods like impact, compression test	3	80	85	H	H	M	M	H	-	-	-	H	-	-	-	-	-	-
CLO-2 :	Identify to measure hardness of materials and to interpret the same after heat treatment	3	80	85	H	H	M	M	M	-	-	-	H	-	-	-	-	-	-
CLO-3 :	Determine the Young's modulus using deflection test on beams and tensile test on rods & springs	3	80	85	H	H	M	M	H	-	-	-	H	-	-	-	-	-	-
CLO-4 :	Compare the fatigue behavior of a notched and un-notched specimen	3	80	85	H	H	M	M	M	-	-	-	H	-	-	-	-	-	-
CLO-5 :	Identify the aspects of testing the strength of various materials under different loading conditions	3	80	85	H	H	M	M	M	-	-	-	H	-	-	-	-	-	-
CLO-6 :	Conduct destructive tests to determine strength of materials under externally applied loads	3	80	85	H	H	M	M	M	-	-	-	H	-	-	-	-	-	-

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Tensile test on Mild steel rod	Test on open coil springs	Torsion test on Graded steels	Double shear test on metallic materials	Bend test of metallic rods
	SLO-2					
S-2	SLO-1	Tensile test on Mild steel rod	Test on closed coil Helical springs	Torsion test on Graded steels	Double shear test on metallic materials	Bend test of metallic rods
	SLO-2					
S-3	SLO-1	Compression test of Concrete cubes	Izod impact test	Deflection test on beams of different materials	Rockwell & Brinell hardness test of metallic materials	Fatigue testing of materials under notched conditions
	SLO-2					
S-4	SLO-1	Compression test of Cylinders	charpy impact test	Deflection test on beams of different materials	Rockwell & Brinell hardness test of metallic materials	Fatigue testing of materials under un-notched conditions
	SLO-2					
S-5	SLO-1	Comparison of mechanical properties of Unhardened specimen	Strain measurement on rods using rosette strain gauge	Measurement of pressure on thin walled cylinders using strain gauge.	Buckling analysis of struts	Study on photo elasticity
	SLO-2					
S-6	SLO-1	Comparison of mechanical properties of Quenched and tempered specimen	Strain measurement on beams using rosette strain gauge	Measurement of pressure on thin walled cylinders using strain gauge.	Buckling analysis of struts	Study on photo elasticity
	SLO-2					

Learning Resources	1. Ferdinand Beer, E. Russell Johnston, Jr., John DeWolf, David Mazurek, Mechanics of Materials, 7th ed., McGraw - Hill, 2013	2. Kazimi S. M. A, Solid Mechanics, 2nd ed.,Tata McGraw Hill, 2001 3. Laboratory Manual

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*30 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. R. Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in, rkpearls@yahoo.com	*1.Dr. Shankar Krishnapillai, IIT Madras, skris@iitm.ac.in*	*1. Dr. P. Nandakumar, SRMIST*
2. Dr. A. Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2.Dr. K. Jayabal, IIITDM, Kancheepuram, jayabal@iiitdm.ac.in*	*2. Mr. A. Vinoth, SRMIST*

Course Code	18MEC110L	Course Name	HEAT POWER LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	18MEC107T	Progressive Courses	
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Analyze components and functions of IC Engines			
CLR-2 :	Utilize the properties of lubricants and fuels			
CLR-3 :	Analyze performance and heat balance test on IC engines			
CLR-4 :	Utilize Morse, retardation and emissions test			
CLR-5 :	Analyze performance test on steam power plant and air compressor			
CLR-6 :	Utilize operations and performance of Internal combustion engines, air compressors and steam power plant			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify the components and functions of IC Engines	2	95	85	H	M	-	M	-	-	-	-	H	-	-	-	H	-	-
CLO-2 :	Analyze the properties of lubricants and fuels	2	95	85	H	H	-	L	-	-	-	-	H	-	-	-	-	L	-
CLO-3 :	Conduct performance and heat balance test on IC engines	2	95	85	H	H	M	L	M	-	-	-	H	-	-	-	-	M	-
CLO-4 :	Conduct Morse, retardation and emissions test	3	95	85	H	H	-	-	-	-	-	-	H	-	-	-	-	-	M
CLO-5 :	Analyze performance test on steam power plant and air compressor	3	95	85	H	H	-	-	-	-	-	-	H	-	-	-	-	H	H
CLO-6 :	Analyze operations and performance of Internal combustion engines, air compressors and steam power plant	3	95	85	H	H	M	L	-	-	-	-	H	-	-	-	H	-	-

Duration (hour)		6	6	6	6	6
S 1-2	SLO-1	Components of Internal combustion engine	Determine viscosity using Redwood viscometer	Performance test on petrol engine with electrical dynamometer	Heat balance test on four stroke diesel engine with calorimeter	Heat balance test on boiler
	SLO-2					
S 3-4	SLO-1	Valve timing diagram of IC Engines	Determine viscosity using Saybolt viscometer	Performance test on single cylinder high speed diesel engine with Rope brakedynamometer/Morse Test	Heat balance test on four stroke diesel engine without calorimeter	Performance test on steam turbine
	SLO-2					
S 5-6	SLO-1	Port timing diagram of IC Engines	Determine flash and fire point/cloud and pour point	Performance test on single cylinder high speed diesel engine withEddy current/hydraulic dynamometer	Retardation test on slow speed diesel engine/engine emission measurements	Performance test on two stage reciprocating air compressor
	SLO-2					

Learning Resources	1. Ganesan. V, Internal Combustion Engines, Tata McGraw-Hill, New Delhi, 2015	2. Mathur.M. L, Sharma. R. P, A course in Internal Combustion Engines, DhanpatRai & Sons, 2010 3. Laboratory Manual

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. R. Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. Dr. R Velraj, IES,CEG, Anna University, Chennai, velrajr@annauniv.edu*	*1.Dr. G. Balaji, SRMIST*
2. Dr. A. Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr. Raju Abraham, NIOT, Chennai, abraham@niot.res.in*	*2.Dr. D. Sivakrishna Reddy, SRMIST*

Course Code	18MEC111L	Course Name	MATERIALS TECHNOLOGY LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	18MEC108T	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Utilize the concepts and need of specimen preparation and procedures to be followed for microscopic observation			
CLR-2 :	Identify and utilize the microstructure of various metals, alloys and its metallurgical properties			
CLR-3 :	Utilize heat treatment process for various applications			
CLR-4 :	Evaluate heat treatment impact on hardness and micro structural changes			
CLR-5 :	Analyze the wear behavior and understand stress acting on a tensile specimen			
CLR-6 :	Utilize the knowledge for identifying metals, alloys based on microstructure and analyze the effect of heat treatment			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify concepts of specimen preparation for microscopic observation	1	95	90	H	-	-	-	H	-	-	-	H	-	-	-	L	-	-
CLO-2 :	Identify microstructure of various metals, alloys and micro structural changes for various heat treatment processes	1	95	90	H	-	-	M	H	-	-	-	M	-	-	-	L	-	-
CLO-3 :	Evaluate hardness and analyze the effect of heat treatment processes	2	95	90	H	-	-	H	H	-	-	-	M	-	-	-	H	-	H
CLO-4 :	Analyze the effects of heat treatments and properties of GC Iron and SG Iron	3	95	90	H	-	-	H	M	-	-	-	H	-	-	-	H	-	H
CLO-5 :	Analyze wear behavior and understand stress acting on a tensile specimen	2	95	85	H	H	-	H	H	-	-	-	H	-	-	-	H	-	H
CLO-6 :	Identify metals, alloys based on microstructure, analyze effect of heat treatment on hardness and microstructural changes	3	95	90	H	-	-	H	H	-	-	-	M	-	-	-	H	-	H

Duration (hour)		6	6	6	6	6
S 1-2	SLO-1	Study the Mounting Process Preparing the sample for identification under microscope	Identify Alloy - Steel based alloys	Identify various heat treatment for MCS	Jomny End quenched Steel	Coating thickness Evaluation
	SLO-2					
S 3-4	SLO-1	Identify Metal - Plain Carbon steel	Identify Alloy - Copper based alloys	Various heat treated steels like Quenched, Normalised, annealed, Tempered	Micro Vickers Tester	Analyze various stress using tensometer
	SLO-2					
S 5-6	SLO-1	Identify Metal - Cast iron	Identify Alloy -Light Metal alloys	Case hardened steel- Induction Hardened and Laser Hardened	properties of GC Iron and SG Iron	Wear analysis using Pin-on-disc
	SLO-2					

Learning Resources	
1.	Sidney H Avnar, Introduction to physical metallurgy, 2nd ed., Tata McGraw-Hill, 1997
2.	Donald R. Askeland, Wendelin J. Wright, Science and Engineering of Materials, 7th ed., Cengage Learning, 2011
3.	ASTM standards
4.	Laboratory Manual

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. R. Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in, rkpearls@yahoo.com	*1. Dr. P. Hariharan, Anna University,* hari@annauniv.edu, *hariharan2311@gmail.com*	*1. Mrs. R. Ambigai, SRMIST*
2. Dr. A. Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr. N. Arunachalam, IIT Madras, chalam@iitm.ac.in*	*2. Dr. U. Mohammed Iqbal, SRMIST*

ACADEMIC CURRICULA

Professional Core Courses

MECHANICAL ENGINEERING

Regulations - 2018

SRM INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18MEC201T	Course Name	MACHINES AND MECHANISMS	Course Category	C	Professional Core	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mechanical Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*understand motion of linked mechanisms in terms of displacement, velocity and acceleration at any point in a rigid link*			
CLR-2 :	*be able to synthesis cam profile and to understand the kinematics of gear trains*			
CLR-3 :	*understand the Balancing of rotating masses and friction*			
CLR-4 :	*Know the concepts of free vibration of single degree of freedom systems.*			
CLR-5 :	*Know the concepts of forced vibration of single degree of freedom systems.*			
CLR-6 :	*understand the concepts of kinematics and machine dynamics*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*explain the basics of mechanism and perform kinematic analysis.*	*1&2*	*90*	*85*
CLO-2 :	*construct various cam profiles based on follower motion and performkinematic analysis and Epicyclic Gear train*	*1,2&3*	*85*	*85*
CLO-3 :	*perform balancing of rotating masses and describe friction in machine elements*	*1&2*	*90*	*85*
CLO-4 :	*analyze free vibration single degree of freedom systems.*	*1&2*	*90*	*85*
CLO-5 :	*define the concepts of forced vibration and critical speed or whirling of shaft*	*1&2*	*90*	*90*
CLO-6 :	*apply the concepts of kinematics and machine dynamics in real time applications*	*1&2*	*80*	*80*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Introduction to mechanism and its elements, Degrees of Freedom, its application in different mechanism*	*circular Cam terminology, types of cams and followers*	*Friction- Introduction, Types of friction, Laws of solid and dry friction, Limiting angle of friction*	*Introduction to vibration terminologies and types of vibration*	*Equation of motion for harmonically excited single Degree of Freedom system*
S-2	SLO-1	*Four Bar Chain, Grashof's law, Kutzback's and Grubler's criterion*	*Types of follower motion and its derivatives, under cutting*	*Friction Clutches- single plate and multiplate Clutches*	*Equation of motion for free un-damped single Degree of Freedom system by Newton's and energy method- Longitudinal vibration*	*Forced vibration –Beating Phenomenon*
S-3	SLO-1	*Kinematic Inversions of kinematic chain: Four bar chain, Single and double slider crank chain*	*Displacement, velocity and acceleration for different follower motion*	*Cone and Centrifugal Clutches*	*Equation of motion for free un-damped single Degree of Freedom system by Newton's and energy method- torsional vibration*	*Forced vibration due to unbalanced rotating and reciprocating masses*
S-4	SLO-1	*Tutorial-simple problems*	*Tutorial-simple problems*	*Tutorial on Clutches*	*Tutorials on single Degree of Freedom un-damped free vibration systems*	*Tutorials on harmonically excited single Degree of Freedom system*
S-5	SLO-1	*Velocity analysis of Four bar and single slider crank mechanism by relative velocity (RV) method*	*construction of circular cam profile for radial follower with different motion*	*Friction in Brakes-Block or shoe brake*	*Equation of motion for free damped single Degree of Freedom systems*	*Forced vibration due to Base excitation by Relative amplitude Method*
S-6	SLO-1	*Acceleration analysis of Four bar mechanism and single slider crank linkages by relative*	*construction of circular cam profile for offset follower with different motion*	*Friction in Brakes-Band brake principle*	*Free vibration with viscous damping*	*Forced vibration due to Base excitation by Absolute Method*

Duration (hour)		12	12	12	12	12
S-7	SLO-1	*Velocity and Acceleration of double slider crank mechanism.*	*basic principles of tangent cam profile*	*Friction in Brakes-Band brake principle*	*Logarithmic decrement*	*Force Transmissibility and vibration isolation*
S-8	SLO-1	*Tutorial on Velocity and Acceleration by relative method*	*Tutorial on cam profile construction*	*Tutorial for Friction Brakes*	*Tutorials on free damped single Degree of Freedom systems*	*Tutorials on Forced vibration due to Base excitation by Absolute and Relative amplitude Method*
S-9	SLO-1	*Velocity and Acceleration of six bar mechanism by relative method*	*Gear terminology, types, law of gearing Tutorial on path of contact, arc of contact, sliding velocity*	*Balancing of rotating masses- Need for balancing, Static and dynamic balancing of rotating masses*	*Torsional system with viscous damping*	*Critical speed or whirling of shaft*
S-10	SLO-1	*Instantaneous center (IC) method, Kennedy's theorem*	*Gear train, types and applications*	*Balancing of several masses rotating in same plane by analytical and graphical methods*	*Torsional Vibration of Two Rotor and three rotor Systems*	*Critical speed or whirling of shaft-with air damping*
S-11	SLO-1	*Velocity analysis of Four bar and single slider crank mechanism by Instantaneous center method*	*velocity ratio, torque calculations in epicyclic gear train*	*balancing of several masses rotating in different planes using couple and force polygon*	*Torsional Vibration of Geared Systems with Two and Three rotor System*	*Critical speed or whirling of shaft-without air damping*
S-12	SLO-1	*Tutorial on Instantaneous center method*	*Tutorials on epicyclic gear train*	*Tutorial on balancing of several masses rotating in same plane and different planes using couple and force polygon*	*Tutorials on Torsional Vibration of Two Rotor and three rotor Systems*	*Tutorials on Critical speed or whirling of shaft-with air damping*

Learning Resources	
1. *Rattan, S. S, "Theory of Machines",McGrawHill Education, 4th edition, 2015* 2. *Thomas Bevan, "The Theory of Machines", Pearson India Education Services Pvt. Ltd., 3rd Edition, 2010.*	3. *L Norton, "Design of machinery - An introduction to the synthesis and analysis of mechanisms and machines", McGrawHill Education, 5th edition, 2011.* 4. *William Cleghorn, Nikolai Dechev, "Mechanics of Machines", Oxford University Press, 2nd Edition, 2014.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.R.Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. Dr. Sudheesh Kumar, sudheeshkumar3@gmail.com, GCE, Kannur*	*1. Dr.P.Nandakumar, SRMIST*
2. Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr.R.Prabhusekar, rprabhusekar@mnnit.ac.in, MNNIT Allahabad*	*2. Dr.P V Jeyakarthikeyan, SRMIST*

Course Code	18MEC202T	Course Name	HEAT AND MASS TRANSFER	Course Category	C	Professional core	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*18MEC101T & 18MEC102T*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mechanical Engineering*	Data Book / Codes/Standards		*Heat and Mass transfer data book and steam tables*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the concept of conduction heat transfer*
CLR-2 :	*Understand the concepts of fins and unsteady state heat transfer*
CLR-3 :	*Understand the concept of convection heat transfer*
CLR-4 :	*Understand the concept of radiation heat transfer*
CLR-5 :	*Understand the phase change heat transfer and mass transfer*
CLR-6 :	*Understand the concepts of heat and mass transfer*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Analyse and evaluate steady state heat conduction in simple and composite systems*	*3*	*90*	*80*	*H*	*H*	*L*	*H*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*
CLO-2 :	*Analyse and evaluate steady state heat conduction in finned systems and unsteady state heat conduction in simple geometries*	*3*	*90*	*80*	*H*	*H*	*L*	*H*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*
CLO-3 :	*Evaluate the heat transfer coefficient under free and forced convection in various geometries and simple design of heat exchangers*	*3*	*90*	*80*	*H*	*H*	*L*	*H*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*
CLO-4 :	*Evaluate surface and gas radiation for black and grey bodies*	*3*	*90*	*80*	*H*	*H*	*L*	*H*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*
CLO-5 :	*Analyse and evaluate heat and mass transfer coefficient for phase change process and mass transfer*	*3*	*90*	*80*	*H*	*H*	*L*	*H*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*
CLO-6 :	*Apply the concepts of heat transfer in real time applications*	*3*	*90*	*80*	*H*	*H*	*L*	*H*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Modes and mechanism of heat transfer in solids, liquids and gases*	*Fins – types,Differential equation,Types of fin boundary conditions*	*Hydrodynamic and thermal boundary layer,Principles and governing equations*	*Basic concepts of radiation ,Laws of radiation*	*Nusselt theory of condensation,Film condensation on a vertical plate and its flow regimes*
S-2	SLO-1	*General conduction equation, boundary and initial conditions*	*Circumferential and longitudinal fins*	*Dimensional analysis for free convection*	*Atmospheric and solar radiation*	*Heat transfer correlations for film condensation,Film condensation inside horizontal tubes*
S-3	SLO-1	*One dimensional steady state heat conduction in plane wall, cylinder and sphere, electrical analogy*	*Fin efficiency,Fin effectiveness*	*Dimensional analysis for forced convection*	*Black body radiation Grey body radiation*	*Dropwise condensation*
S-4	SLO-1	*Tutorial on plane wall, cylinders and spheres*	*Tutorial on fins*	*Tutorial on hydrodynamic and thermal boundary layer*	*Tutorial on laws of radiation*	*Tutorial on Filmwise condensation*
S-5	SLO-1	*One dimensional steady state heat conduction in composite plane wall*	*Unsteady state heat conduction in Lumped heat model*	*Forced convection: Flow over flat plate, cylinders and spheres*	*Shape factor algebra*	*Modes of Boiling*
S-6	SLO-1	*One dimensional steady state heat conduction in composite cylinders*	*Unsteady state heat conduction in semi-infinite solid*	*Forced convection : Internal flow*	*Electrical analogy*	*Pool boiling regimes, Correlations for pool boiling heat transfer*
S-7	SLO-1	*One dimensional steady state heat conduction in composite spheres*	*Unsteady state heat conduction in infinite solid*	*Free convection : Flow over plates, cylinders and spheres*	*Radiation shield*	*Flow boiling regimes*

Duration (hour)		12	12	12	12	12
S-8	SLO-1	*Tutorial on composite systems*	*Tutorial on unsteady state heat conduction*	*Tutorial on free and forced convection*	*Tutorial on shape factor, radiation shield and electrical analogy*	*Tutorial on pool boiling*
S-9	SLO-1	*Critical thickness of insulation for cylinders*	*Numerical solution for one dimensional steady state heat conduction*	*Heat Exchangers – Types, overall heat transfer coefficient, fouling factor*	*Introduction to Solar radiation*	*Diffusion mass transfer – Fick's law of diffusion,Steady state diffusion through plane membrane*
S-10	SLO-1	*Critical thickness of insulation for spheres*	*Numerical solution for one dimensional steady state heat conduction*	*LMTD and Effectiveness – NTU method method of analysis*	*Radiation properties of gases*	*Equimolar counter diffusion,Isothermal evaporation of water vapour into air*
S-11	SLO-1	*One dimensional steady state heat conduction with internal heat generation*	*Numerical solution for two dimensional steady state heat conduction*	*Heat transfer enhancement methods, Selection of heat exchangers*	*Gaseous emission and absorption - water vapour and carbon dioxide*	*Convective mass transfer,Convective mass transfer correlations, Simultaneous heat and mass transfer*
S-12	SLO-1	*Tutorial on critical thickness of insulation and internal heat generation*	*Tutorial on one and two dimensional steady state heat conduction*	*Tutorial on heat exchangers*	*Tutorial on gas radiation*	*Tutorial on diffusion and convective mass transfer*

Learning Resources	1. *Sachdeva, R.C., Fundamentals of Heat and Mass Transfer, 2nd Edition, New Age International (P) Ltd., New Delhi,2017.* 2. *Nag, P.K., Heat Transfer and Mass Transfer, Tata McGraw Hill, 3rd Edition, New Delhi, 2011.* 3. *Ozisik. M. N, "Heat Transfer", McGraw-Hill Book Co., 2003.* 4. *Holman. J. P "Heat and Mass Transfer" Tata McGraw-Hill, 2008.* 5. *Yunus A. Çengel, Afshin J. Ghajar "Heat and Mass Transfer", Tata McGraw Hill Education, 2017.* 6. *Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, 2016.* *DATA BOOKS* 7. *Kothandaraman. C. P, Subramanyan, S, "Heat and Mass Transfer Data Book", New Age International, 7th edition, 2012.* 8. *K.K.Ramalingam "Steam Tables", SciTech Publications, 2015.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

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1. Dr.R.Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. Dr. M. R. Kamesh, Dayanada Sagar College of Engineering*	*1. Mr. D. Premnath, SRMIST*
2. Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr.N. Saravanan, Smart Implements and Machinery and Sustainability*	*2. Dr.P. Chandrasekaran, SRMIST*

Course Code	18MEC203L	Course Name	MACHINE DYNAMICS LABORATORY	Course Category	C	Professional core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*18MEC201T*	Progressive Courses	*Nil*
Course Offering Department	*Mechanical Engineering*		Data Book / Codes/Standards	*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*understand the static and kinematics behavior of machines*
CLR-2 :	*understand the dynamic behavior of machines*
CLR-3 :	*understand the balancing of masses in machines*
CLR-4 :	*understand the effect of centrifugal forces in machine*
CLR-5 :	*understand the free and forced vibration analysis*
CLR-6 :	*acquire the ability to analyze the dynamics behavior of machines*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Draw cam profiles based on follower motion*	*3*	*80*	*85*	*H*	*H*	*M*	*M*	*H*	-	-	-	*H*	-	-	-	-	-	-
CLO-2 :	*Analyze Epicyclic Gear train and Gyroscopic effect*	*3*	*80*	*85*	*H*	*H*	*M*	*M*	*M*	-	-	-	*H*	-	-	-	-	-	-
CLO-3 :	*Do balancing of rotating masses in machines*	*3*	*80*	*85*	*H*	*H*	*M*	*M*	*H*	-	-	-	*H*	-	-	-	-	-	-
CLO-4 :	*Determine the frequency of single degree of freedom systems.*	*3*	*80*	*85*	*H*	*H*	*M*	*M*	*M*	-	-	-	*H*	-	-	-	-	-	-
CLO-5 :	*Find the Critical speed or whirling of shaft*	*3*	*80*	*85*	*H*	*H*	*M*	*M*	*M*	-	-	-	*H*	-	-	-	-	-	-
CLO-6 :	*Do dynamic analysis of machines*	*3*	*80*	*85*	*H*	*H*	*M*	*M*	*M*	-	-	-	*H*	-	-	-	-	-	-

Duration (hour)		6	6	6	6	6
S-1		*Cam and Follower Analysis*	*Dynamic analysis of Proelland porter Governor*	*Measurement of cutting forces using Drill tool Dynamometers*	*Free damped and un-damped torsional vibration of single rotor systems*	*Transmissibility Ratio in Vibrating Systems*
S-2						
S-3		*Dynamic analysis of Gyroscope*	*Dynamic Balancing of massesin machine*	*Measurement of cutting forces using Milling Dynamometers*	*Free & forced vibration of equivalent spring mass system*	*Free and forced transverse vibration analysis for beams*
S-4						
S-5		*Dynamic analysis of Epi cyclic gear trains*	*Measurement of cutting forces using, Lathe tool Dynamometer*	*Free Vibration of helical springs*	*Whirling of shaft*	*Vibration measurement using strain gauge*
S-6						

Learning Resources	
	1. *Laboratory Manual*
	2. *Thomas Bevan, "The Theory of Machines", Pearson India Education Services Pvt. Ltd., 3rd Edition, 2010.*
	3. *Robert L Norton, "Design of machinery - An introduction to the synthesis and analysis of mechanisms and machines", McGrawHill Education, 5th edition, 2011.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.R.Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. Dr. Sudheesh Kumar, sudheeshkumar3@gmail.com, GCE, Kannur*	*1. Dr.P.Nandakumar, SRMIST*
2. Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr.R.Prabhusekar, rprabhusekar@mnnit.ac.in, MNNIT Allahabad*	*2. Dr.P V Jeyakarthikeyan, SRMIST*

Course Code	18MEC204L	Course Name	SIMULATION LABORATORY	Course Category	C	Professional core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*18MEE305T Finite Element Method*	Progressive Courses	*Nil*
Course Offering Department	*Mechanical Engineering*		Data Book / Codes/Standards	*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Upon learning the students shall understand the need of software tools to analyze the Engineering problems.*
CLR-2 :	*Understand and practice structural analysis of components.*
CLR-3 :	*Understand and practice modaland vibrational analysis of components.*
CLR-4 :	*Understand and practice Thermal analysis of components.*
CLR-5 :	*Understand and practice Dynamic analysis of components.*
CLR-6 :	*Simulate any engineering problem numerically.*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Learn data exchange standard and integration of FEA with software tools.*	*3*	*85*	*80*	*H*	*H*		*H*	*H*		*H*					*H*			
CLO-2 :	*learnand practice structural analysisof components using software tools.*	*3*	*75*	*80*	*H*	*H*		*H*	*H*							*H*			
CLO-3 :	*Earn and practice modal and vibrational analysis of components using software tools.*	*3*	*75*	*80*	*H*	*H*		*H*	*H*							*H*			
CLO-4 :	*Learn and practice Thermal analysis of components using software tools.*	*3*	*75*	*80*	*H*	*H*		*H*	*H*							*H*			
CLO-5 :	*Learn and practice Dynamic analysis of components of components using software tools.*	*3*	*75*	*80*	*H*	*H*		*H*	*H*							*H*			
CLO-6 :	*Practice numerical simulation of any engineering problem using softeare.*	*3*	*75*	*80*	*H*	*H*		*H*	*H*							*H*			

Duration (hour)		6	6	6	6	6
S-1	SLO-1	*Displacement bar structures with different support conditions.*	*Stress and deflection analysis in beams with different support condition.*	*Modal analysis of beam – Finding natural frequency –Cantilever beam, Simply supported beam etc with UDL*	*Dynamic analysis of thin circular cylindrical shell.*	*Thermal analysis – Steady state and Transient - 3D problem.*
S-2						
S-3	SLO-1	*Force and stress analysis using link elements in Trusses.*	*Plane stress and Plane strain problems – Simple examples – flat plate with hole, circular disc with hole Tapper plate etc.*	*Modal analysis of beam – Finding natural frequency –Cantilever beam, Simply supported beam etc with UVL*	*Thermal analysis – Steady state and Transient - 1D problem.*	*Kinematic analysis of Four bar mechanism.*
S-4						
S-5	SLO-1	*Stress and deflection analysis in beams with different loading condition.*	*Stress analysis of axi -symmetric component.*	*Vibrational analysis - plate with dynamic condition.*	*Thermal analysis – Steady state and Transient - 2D problem.*	*Dynamic analysis of slider crank mechanism.*
S-6						

Learning Resources	1. *Laboratory Manual* 2. *Reddy .J.N., An Introduction to finite Element Method, 3 rd .,Tata McGraw Hill.2005.*	3. *Chandrupatla, T.R., Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall,1990. 1990ndia, 1997.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Laboratory Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Mr. Vignesh Shanmugam.s,Hyundai Motors Limited, Chennai, 273357@hmil.net*	*2. Dr.P V Jeyakarthikeyan, SRMIST*

Course Code	18MEC205L	Course Name	HEAT AND MASS TRANSFER LABORATORY	Course Category	C	Professional core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*18MEC202T Heat and Mass Transfer*	Progressive Courses	Nil
Course Offering Department	*Mechanical Engineering*	Data Book / Codes/Standards		*Heat and Mass Transfer Data Book and Refrigerant Tables and Charts*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Conduction, Convection and Radiation modes of Heat Transfer.*
CLR-2 :	*The Performance of Heat Exchangers, condensation and boiling apparatus.*
CLR-3 :	*The Performance of Refrigeration and Air Conditioning systems.*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Analyze Conduction, Convection and Radiation modes of heat transfer and evaluate the thermal conductivity, heat transfer coefficients and radiation constants.*	*3*	*95*	*90*	*H*	*H*	*L*	*L*	*L*		*M*		*H*						
CLO-2 :	*Evaluate the effectiveness of heat exchangers, heat transfer rate in condensation and boiling.*	*3*	*95*	*90*	*H*	*H*	*H*	*L*	*L*		*M*		*H*						
CLO-3 :	*Evaluate the Coefficient of performance of refrigeration and air conditioning systems.*	*3*	*95*	*90*	*H*	*H*	*L*	*L*	*L*		*M*		*H*						

Duration (hour)		Conduction Heat Transfer	Convection Heat Transfer	Radiation Heat Transfer	Heat Exchangers, Boiling and Condensation	Refrigeration and Air Conditioning Systems
		6	8	4	8	4
S-1	SLO-1	*Heat Transfer through Composite wall.*	*Heat transfer by Natural Convection.*	*Study of the Emissivity apparatus.*	*Study of parallel flow and counter flow Heat Exchanger.*	*Study of Refrigeration Test Rig.*
	SLO-2	*Determination of heat transfer rate.*	*Determination of convective heat transfer coefficient*	*Determination of the emissivity of grey surface.*	*Determination of overall heat transfer coefficient, heat transfer rate and effectiveness of heat exchanger.*	*Determination of CoP of the Refrigeration Test Rig.*
S-2	SLO-1	*Heat Transfer through Composite lagged pipe.*	*Heat transfer by Forced Convection.*	*Study of Stefan – Boltzmann's Apparatus.*	*Study of Shell and tube Heat Exchanger.*	*Study of Air Conditioning Test Rig.*
	SLO-2	*Determination of Thermal Conductivity of the materials.*	*Determination of convective heat transfer coefficient*	*Determination of Stefan Boltzmann Constant.*	*Determination of overall heat transfer coefficient, heat transfer rate and effectiveness of heat exchanger.*	*Determination of CoP of the Air Conditioning Test Rig.*
S-3	SLO-1	*Thermal conductivity of an insulating Material.*	*Heat transfer through Pin Fin by Natural Convection.*	-	*Study of Film wise and drop wise condensation apparatus.*	
	SLO-2	*Determination of Thermal Conductivity of insulating material.*	*Determination of Efficiency and Effectiveness of the pin fin*		*Determination of Condensate rate.*	
S-4	SLO-1	-	*Heat transfer through Pin Fin by Forced Convection.*		*Study on Critical heat Flux Apparatus.*	
	SLO-2	-	*Determination of Efficiency and Effectiveness of the pin fin*		*Determination of Critical heat Flux.*	

Learning Resources	1. *Laboratory Manual* 2. *Kothandaraman.C.P, Subramanyan.S, "Heat and Mass Transfer Data Book", New age International, 8th edition, 2014.* 3. *Mehta.F.S, Mathur.M.L, "Refrigeration &Psychrometric Properties Tables & Charts",3rd Edition, Jain Publishers, 2014.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.R.Kalimuthu,ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. Dr. M.R.Kamesh, Dayananda Sagar College of Engineering, Bangalore*	*1. Mr.M.D.Kathir Kaman , SRM IST*
2. Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr.N.Saravanan, Smart Implements & Machinery and Sustainability, Mahindra Research Valley, Chennai*	*2. Dr.C.Selvam, SRM IST*

Course Code	18MEC206T	Course Name	METROLOGY AND QUALITY CONTROL	Course Category	C	Professional core	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mechanical Engineering*	Data Book / Codes /Standards	*Approved Metrology & Quality Control Tables and Charts*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Be familiar with standards of measurements and types of measurement errors*
CLR-2 :	*Know the basics of measurement for thread, gear and surface finish*
CLR-3 :	*Be familiar with optical and other non-contact measurements*
CLR-4 :	*Be familiar with working of coordinate measuring machines and alignments of machine tool*
CLR-5 :	*Select the appropriate control chart and sampling plan*
CLR-6 :	*Be familiar with dimensional and form measurements using conventional and coordinate metrology, together with quality control techniques*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Understand the types of measurement errors, design of limit gauges and various comparative measurement methods*	*3*	*90*	*85*	*H*	*H*	*M*	*L*	*L*								*M*	*L*	*L*
CLO-2 :	*Acquire the fundamentals of the gear, thread and surface finish measurements*	*3*	*90*	*85*	*H*	*H*	*M*		*L*								*L*	*L*	*L*
CLO-3 :	*Perceive the knowledge about the optical metrology and non-contact measurement*	*3*	*90*	*85*	*H*	*M*			*H*								*L*	*L*	*L*
CLO-4 :	*Learn the fundamentals of CMMs*	*3*	*90*	*85*	*H*	*M*			*H*								*H*	*L*	*L*
CLO-5 :	*Choose the appropriate control charts*	*3*	*90*	*85*	*H*	*H*	*L*		*M*					*H*		*L*	*H*	*L*	*L*
CLO-6 :	*Choose the types of sampling and methods in acceptance sampling for SQC*	*3*	*90*	*85*	*H*	*H*	*M*		*M*							*L*	*H*	*L*	*L*

Duration (hour)		Introduction To Metrology	Measurements Of Screw Thread - Gear Elements – Surface Finish	Optical And Other Non-Contact Measurement Techniques	Coordinate Metrology And Form Measurement; Machine Tool Metrology	Theory Of Control Charts & Acceptance Sampling
		9	9	9	9	9
S-1	SLO-1	*Introduction to metrology; Need for inspection; Physical measurements*	*Measurements of various elements of external and internal threads: Measurement of major and minor diameters, pitch and flank angle*	*Principle of light wave interference, light sources, measurements using optical flats*	*Introduction to coordinate metrology; Coordinate metrology versus conventional metrology*	*Definition of quality; Assignable causes and Chance causes; SQC: Benefits and limitations*
S-2	SLO-1	*Methods of measurement; Classification and characteristics of measuring instruments*	*Measurement of effective diameter: two and three wire methods; best size wire; error corrections*	*Types of interferometers: Michelson, Twyman Green Specialization of Michelson*	*Types and construction of CMM; Components: Bearings; Drive systems*	*Theory of Control Charts; Control Charts for Variables: X bar and R charts*
S-3	SLO-1	*Role of NPL; Sources and types of errors*	*Measurements of various elements of spur gears: gear tooth vernier*	*NPL flatness interferometer, The Pitter NPL gauge interferometer*	*Components: Transducers; Probes*	*Control Charts for attributes: P chart, np chart*
S-4	SLO-1	*Statistical treatment of errors; tutorial*	*Constant chord method: derivation and tutorial*	*Laser interferometer, Laser micrometer*	*Measuring accuracy, causes of errors and calibration of CMM: Tutorial*	*Control charts for Non Conformities - C and U chart*
S-5	SLO-1	*Standards of measurements; Classification of standards; Calibration*	*Base tangent method: derivation and tutorial*	*Surface roughness measurement using Lasers*	*Performance of CMM and its applications*	*Basic Concepts of acceptance sampling and OC curve, AQL, LTPD ,AOQL*
S-6	SLO-1	*Limits, fits, and tolerances: tutorial*	*Circular pitch and composite error measurement*	*Measurement of straightness using Autocollimator, Tutorial*	*Overview of alignment tests in machine tools using dial gauge, sprit level, straight edges*	*Tutorial*
S-7	SLO-1	*Interchangeability and Selective Assembly*	*Surface finish: Surface topography definitions*	*Measurement of flatness using Autocollimator*	*Measurement of squareness and parallelism*	*Sampling Plans: Simple*

Duration (hour)		Introduction To Metrology	Measurements Of Screw Thread - Gear Elements – Surface Finish	Optical And Other Non-Contact Measurement Techniques	Coordinate Metrology And Form Measurement; Machine Tool Metrology	Theory Of Control Charts & Acceptance Sampling
		9	9	9	9	9
S-8	SLO-1	*Inspection Gauges, Types of Gauges*	*Measurement of surface finish: measuring instruments*	*Machine vision, Image processing techniques*	*Circularity: tutorial*	*Sampling Plans: Double and Multiple - tutorial*
S-9	SLO-1	*Introduction to Comparators; Mechanical (Sigma), Electrical, and Pneumatic comparators*	*Methods of evaluation of surface finish*	*Edge detection, feature extraction - applications*	*Measurement of cylindrical and conical features, and runout*	*Sequential sampling plans*

Learning Resources	1. *Jain, R. K., "Engineering Metrology", Khanna Publishers, New Delhi, 2012.* 2. *Gupta, R. C, "Statistical Quality Control", Khanna Publishers, New Delhi, 1994.* 3. *Kevin Harding, "Handbook of Optical Dimensional Metrology", CRC Press, A Taylor & Francis group, 2013.* 4. *Robert J. Hocken, Paulo H. Pereira, "Coordinate Measuring Machines and Systems", CRC Press, Taylor & Francis Group, 2011.* 5. *Connie Dotson, Roger Harlow and Richard L. Thompson, "Fundamentals of Dimensional Metrology", Thomson Delmar Learning", 4th edition, 2005.* 6. *Galyer, J. F. W., and Shotbolt, C. R., Metrology for Engineering, Cassell London, 5th Edition* 7. *Toru Yoshizawa, "Handbook of Optical Metrology: Principles and Applications", CRC Press, 2009.*	8. *Grant E. L., "Statistical Quality Control", McGraw Hill, New York, 1972* 9. *M. Mahajan, Statistical Quality Control, Dhanpat Rai & co. Gagankapur, 2010.* 10. *Heinrich Schwenke, Ulrich Neuschaefer-Rube, Tilo Pfeifer, Horst Kunzmann ,"Optical Methods for Dimensional Metrology in Production Engineering", CIRP Annals - Manufacturing Technology, 51(2) (2002) 685–699* 11. *Weckenmann, T. Estler, G. Peggs, D. McMurtry ,"Probing Systems in Dimensional Metrology", CIRP Annals - Manufacturing Technology, 53 (2) (2004) 657–684* 12. *A.M.A. Al-Ahmari, Javed Aalam, "Optimizing parameters of freeform surface reconstruction using CMM", Measurement, 64 (2015) 17–28* 13. *K. Duraivelu and S. Karthikeyan. "Engineering Metrology and Measurment", Universities Press (India) Private Limited, 2018.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Sridhar.narasimhan@hexagon.com	*2. Dr.N.Arunachalam, IIT Madras, chalam@iitm.ac.in*	*2. Dr. A. Vijaya, SRMIST*

Course Code	18MEC207T	Course Name	CAD/CAM	Course Category	C	Professional core	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mechanical Engineering*	Data Book / Codes/Standards		-	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Be familiar with the concepts of modeling in 2D and 3D*
CLR-2 :	*Be familiar with he Mathematical Representation of curves and surfaces*
CLR-3 :	*Be familiar with the concepts of Computer Graphics*
CLR-4 :	*Be familiar with the basics of CNC machines and manufacturing systems*
CLR-5 :	*Be familiar with the concepts of Computer aided production planning and control*
CLR-6 :	*Be familiar with the concepts of CAD and CAM*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Recognize and analyze the concepts of modeling in 2D and 3D*	*3*	*90*	*85*	*H*	*M*	*H*	*L*	*L*	-	-	-	-	*L*	*M*	*L*	*H*	*M*	*M*
CLO-2 :	*Apply the concepts learned in Mathematical Representation of curves and surfaces*	*3*	*90*	*85*	*H*	*M*	*H*	*L*	*L*	-	-	-	-	*L*	*M*	*L*	*H*	*M*	*M*
CLO-3 :	*Understand and apply the concepts of Computer Graphics like shading, coloring, clipping, animation and simulation*	*3*	*90*	*85*	*H*	*L*	*M*	*H*	*M*	-	-	-	-	*L*	*M*	*M*	*H*	*M*	*M*
CLO-4 :	*Understand and analyze the basics of CNC machines and manufacturing systems*	*3*	*90*	*85*	*H*	*M*	*L*	*L*	*L*	-	*M*	-	-	*L*	*M*	*H*	*H*	*M*	*H*
CLO-5 :	*Apply and evaluate the concepts of Computer aided production planning and control*	*3*	*90*	*85*	*H*	*M*	*L*	*L*	*L*	-	*M*	-	-	*L*	*H*	*H*	*H*	*M*	*H*
CLO-6 :	*Understand, apply and evaluate the concepts of CAD and CAM*	*3*	*90*	*85*	*H*	*M*	*M*	*L*	*L*	-	*L*	-	-	*L*	*M*	*M*	*H*	*M*	*M*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Fundamentals of Computer aided design*	*Mathematical representation of lines, circle*	*Cohen Sutherland Clipping Algorithm*	*Fundamentals of CNC machines, Classification, Developments*	*Computer Aided Process Planning (CAPP)*
S-2	SLO-1	*Product Life Cycle*	*Mathematical representation of Hermite curves*	*Shading and its types*	*CNC principles of operation and features*	*Materials Requirement planning with Case study*
S-3	SLO-1	*sequential and concurrent engineering*	*Mathematical representation of Bezier curves, B-spline curves*	*Colouring and its types*	*Machining Centers and its types*	*Management Resource planning with case study*
S-4	SLO-1	*Coordinate Systems, 2D transformations*	*Parametric representation of plane surface and Ruled surface*	*Introduction to Data exchange standards*	*Introduction to Group technology and its types*	*Capacity Planning and Data collection systems*
S-5	SLO-1	*3D transformations*	*parametric representation of Surface of revolution and Tabulated cylinder*	*Data exchange standards: IGES,STEP*	*Part families, coding and classification*	*Shop floor control and monitoring systems*
S-6	SLO-1	*Wire frame modeling and Surface modeling*	*Hidden line removal - Visibility Techniques*	*Data exchange standards: DXF and CALS and GKS*	*Production flow analysis with case study*	*Inventory control and Case study*
S-7	SLO-1	*Solid modeling - Constructive Solid Geometry*	*Priority and Area -oriented Algorithm*	*Animation Types*	*Machine cell design with numerical case study*	*JIT approach and Case study*
S-8	SLO-1	*Solid modeling - Boundary Representation*	*Hidden surface removal algorithms*	*Animation Techniques*	*Introduction to FMS, types, applications and benefits*	*Lean Manufacturing*
S-9	SLO-1	*Feature Entities and Representation*	*Hidden Solid removal algorithms*	*Simulation Technique*	*FMS :components, Layout Configurations and implementation*	*Agile manufacturing*

Learning Resources	1. *Ibrahim Zeid, "Mastering CAD /CAM (Sie)", Tata McGraw-Hill, New Delhi, 2010* 2. *P.N. Rao, "CAD/CAM Principles and Application",3rd Edition, Tata McGraw-Hill, New Delhi, 2012* 3. *Mikell P. Groover, "Automation, Production systems and computer integrated manufacturing", Prentice Hallof India Private Ltd., New Delhi, 2008.* 4. *Mikell P. Groover, Emory W. Zimmers Jr., "CAD/CAM: Computer Aided Design and Manufacturing", Prentice Hall of India Private Ltd., New Delhi, 2008.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr.R.Kalimuthu,ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in*	1. *Dr. S. Sridhar, PSNA college of Engg. & Tech., Dindigul*	1. *Mr.J.Daniel Glad Stephen, SRMIST*
2. *Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in*	2. *Mr.V.Selvakumar, vselvakumar86@gmail.com, Ford India, Chennai*	2. *Dr. P. Nandakumar, SRMIST*

Course Code	18MEC208T	Course Name	MECHANICAL ENGINEERING DESIGN	Course Category	C	Professional core	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*18MEC206T*	Co-requisite Courses	*Nil*	Progressive Courses	*18MEE401T*
Course Offering Department	*Mechanical Engineering*	Data Book / Codes/Standards		*PSG Design Data Book*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Know fundamental concepts to design the mechanical components.*
CLR-2 :	*Be familiar with the concepts to design the shafts, keys and couplings*
CLR-3 :	*Know the concepts to design the temporary joints.*
CLR-4 :	*Be familiar with the concepts to design the permanent joints.*
CLR-5 :	*Know the concepts to design the levers and springs.*
CLR-6 :	*Know the fundamental concepts in design of machine elements*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Design of mechanical components.*	*3*	*85*	*75*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*
CLO-2 :	*Design of shafts, keys and couplings.*	*3*	*85*	*75*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*
CLO-3 :	*Design of temporary joints.*	*3*	*85*	*75*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*
CLO-4 :	*Design of permanent joints.*	*3*	*85*	*75*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*
CLO-5 :	*Design of levers and springs.*	*3*	*85*	*75*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*
CLO-6 :	*Design of machine elements*	*3*	*85*	*75*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*L*

Duration (hour)		FUNDAMENTALS OF MECHANICAL DESIGN	VARIABLE STRESSES ,DESIGN OF SHAFTS,KEYS AND COUPLINGS	DESIGN OF TEMPORARY JOINTS	DESIGN OF PERMANENT JOINTS	DESIGN OF LEVERS AND SPRINGS
		12	12	12	12	12
S-1	SLO-1	*Introduction to design, types of design. Criteria for Design based on strength, fatigue, stiffness.*	*Analysis of variable stresses: Endurance limit. Classification of variable stresses, factors influencing the endurance limit and fatigue stress determination.*	*Design of Pin joints- cotter joints , basic concepts and types Design of Socket and spigot cotter joint*	*Riveted joints: Types, materials, arrangement of rivets, terminology of riveted joints Riveted joints: Types of failures.*	*Levers: Types, applications and analysis*
	SLO-2					
S-2	SLO-1	*Criteria for Design based on, wear resistance, vibration resistance, heat resistance and reliability.*	*Stress concentration, Methods of reducing stress concentration, Notch sensitivity.theoritical stress concentration factor and fatigue stress concentration factor.*	*Design of Sleeve and cotter joint*	*Strength and efficiency of a riveted joint, Design of riveted joints for non eccentric loads.*	*Design of hand lever, foot lever.*
	SLO-2					
S-3	SLO-1	*Overview of Engineering materials and their properties. Impact stress, Resilience. Principal Stresses and Principal Planes, Application of Principal Stresses in design of machine members.*	*Variable stresses using Soderberg method, Goodman method. Variable stresses using Gerber method.*	*Design of Gib and cotter joint for square rods.*	*Design of riveted joints for pressure vessels.*	*Design of cranked lever, bell crank lever*
	SLO-2					
S-4	SLO-1	*Tutorial -Problems on Principal Stresses and Principal Planes.*	*Tutorial -Problems on variable stresses using Soderberg method, Goodman method and Gerber method.*	*Tutorial - problems on cotter joint.*	*Tutorial –Problems on riveted joints for structural applications and pressure vessels.*	*Tutorial – Problems on cranked lever and bell crank lever*
	SLO-2					

Duration (hour)		FUNDAMENTALS OF MECHANICAL DESIGN	VARIABLE STRESSES ,DESIGN OF SHAFTS,KEYS AND COUPLINGS	DESIGN OF TEMPORARY JOINTS	DESIGN OF PERMANENT JOINTS	DESIGN OF LEVERS AND SPRINGS
		12	12	12	12	12
S-5	SLO-1	*Theories of failure, Rankine theory, Guests theory, St.Venants theory, Maximum strain energy theory and Distortion energy theory.*	*Types of Shafts, Shafting Materials and working stresses in shafts. Design of uniform cross sectional Shafts.*	*Design of Knuckle joint*	*Design of Diamond riveted joint.*	*Design of lever safety valve ,Rocker-Arm*
	SLO-2					
S-6	SLO-1	*Theories of failure, Rankine theory, Guests theory, St.Venants theory, Maximum strain energy theory and Distortion energy theory.*	*Design of shaft subjected to combined twisting moment and bending moment.*	*Bolted joints: Design procedure and problems on bolted joints with non eccentric loads,*	*Design of Eccentrically loaded riveted joint.*	*Springs: classification, application, spring materials and their properties.* Terminology and end conditions of helical compression spring
	SLO-2					
S-7	SLO-1	*Design of members subjected to combined stresses with eccentric load.*	*Design of shaft subjected to combined twisting moment, bending moment and axial loads.*	*Design of bolted joints for cylinder cover*	*Welded joints: Types and strength calculations*	*Design of circular and non circular wire helical springs for static loadings, Eccentric loading of helical springs,buckling of compression springs*
	SLO-2					
S-8	SLO-1	*Tutorial –Design of members subjected to combined stresses with eccentric load*	*Tutorial –Problems on Design of shaft.*	*Tutorial –Problems on bolted joints*	*Tutorial - Problems on axially loaded welded joints*	*Tutorial - Problems on helical springs*
	SLO-2					
S-9	SLO-1	*Eccentric loading in curved beams, crane hooks*	*Design of keys: Types of keys, forces acting on a key Couplings: Types of couplings, design of sleeve coupling and clamp coupling.*	*Design of bolted joints with eccentric load parallel to axis of bolt and perpendicular to axis of bolt*	*Welded joints subjected to axial loads for unsymmetrical sections*	*Design of concentric helical springs Design of helical springs for fatigue loading*
	SLO-2					
S-10	SLO-1	*Eccentric loading in frames, clamps*	*Design of Flange coupling*	*Design of bolted joints with eccentric load in the plane containing bolts.*	*Eccentrically loaded linear fillet welded joints.*	*Design of helical torsion springs Design of Belleville springs*
	SLO-2					
S-11	SLO-1	*Standardization, interchangeability, fits and tolerances-Terminology of fits and tolerances Tolerances and their grades, fundamental deviation, Fits and its classifications*	*Design of bushed pin Flexible coupling*	*Design of Power screws; types, working principal and analysis of power screws.*	*Eccentrically loaded circular fillet welded joints. Welded joint subjected to fatigue loading*	*Design of leaf springs, analysis and nipping of leaf springs*
	SLO-2					
S-12	SLO-1	*Tutorial –Problems on computation of IT tolerances, fundamental deviations*	*Tutorial – Problems on coupling*	*Tutorial – Problems on bolted joints with eccentric load and Power screws.*	*Tutorial –Problems on eccentrically loaded welded joint.*	*Tutorial –Problems on leaf springs*
	SLO-2					

Learning Resources	1. *Robert C.Juvinalland Kurt M. Marshek "Fundamentals of Machine Component Design", John wiley& sons, 2017.* 2. *Spotts.M.F, ShoupT.E, "Design of Machine Elements", Prentice Hall of India Eighth Edition, 2006.* 3. *Joseph Edward Shigley and Charles ,R.Mischke, "Mechanical Engineering Design",McGraw-Hill International Editions,10th edition., 2015* 4. *William Orthwein, "Machine Component Design", Vol. I and II, JaicoPublishing house, New Edition, 2006.* 5. *Khurmi, R.S. and Gupta J.K, "Machine design ", S.Chand publishing , 14th Edition, 2014.* 6. *V.B. Bandari, " Design of Machine Elements", McGraw-Hill International Editions, 4th edition., 2016* 7. *P.S.G Tech..,"Design Data Book", KalaikathirAchchagam, 2012*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr.R.Kalimuthu,ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in*	1. *Dr. T.Jeyapoovan jeyapoovan@hindustanuniv.ac.in, Hindustan University, Chennai.*	1. *Dr.R.Santhana Krishnan., SRM IST,*
2. *Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in*	2. *Mr. V.Sundara Raghavan,sundararaghavanv@bharatpetroleum.in Bharat Petroleum Corporation Limited, Chennai*	2. *Dr. P. Nandakumar, SRMIST*

Course Code	18MEC209L	Course Name	CAD/CAM LABORATORY	Course Category	C	Professional core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*18MEC207T*	Progressive Courses	*Nil*
Course Offering Department	*Mechanical Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Learn to Modeling of 3D Mechanical Components*
CLR-2 :	*Prepare assembly drawings of joints, couplings and machine elements*
CLR-3 :	*Design and prepare modelling for Jigs and fixtures of given components*
CLR-4 :	*Familiarize CNC Part programming techniques for Lathe operations and milling operations*
CLR-5 :	*Machining of components using CNC Lathe and CNC milling machine*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Acquire knowledge on Modeling of 3D Mechanical Components*	*3*	*90*	*85*
CLO-2 :	*Understand the concepts of assembly drawings of joints, couplings and machine elements*	*3*	*85*	*80*
CLO-3 :	*Acquire knowledge to design and prepare drawing for Jigs and fixtures of given components*	*3*	*85*	*80*
CLO-4 :	*Understand and generate the NC part programming for Lathe and milling operations.*	*3*	*90*	*85*
CLO-5 :	*Acquire Practical knowledge on machining of components using CNC Lathe, Milling.*	*3*	*90*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	*H*	*M*	*H*	-	-	-	*M*	*H*	-	-	*L*	-	*L*
H	-	*H*	*M*	*H*	-	-	-	*M*	*H*	-	-	*M*	-	*L*
H	-	*H*	*M*	*H*	-	-	-	*M*	*H*	-	-	*M*	-	*M*
H	-	*H*	*L*	*H*	-	-	-	-	-	-	-	*L*	-	*M*
H	-	*H*	*M*	*H*	-	-	-	-	-	-	-	*L*	-	*M*

Duration (hour)	Modeling of mechanical components	Machine Tool components	Jigs& Fixtures	CNC LATHE	CNC MILLING
	6	6	6	6	6
S 1-2	*Modeling of Simple Mechanical Components and temporary fasteners, Modeling of components with sweep ,variable sweep ,loft and blend feature*	*Assembly modeling for Machine Vice*	*Assembly modelling for lathe, milling and broaching fixtures types*	*CNC Part Program for Facing, Step turning, Taper and Finish Turning using ordinary cycle*	*CNC Part Program for Linear and Circular Interpolation using Milling operation*
S 3-4	*Assembly Modeling of joints and Couplings*	*Assembly modelling for Lathe tail stock*	*Assembly modelling for plate, latch, channel, box, post, pot drill jigs and automatic drill jigs*	*CNC Part Program for Grooving,Threading and Axial Drilling Using canned cycle*	*CNC Part Program for Drilling, Mirroring and Threading Operation.*
S 5-6	*Assembly modeling of Screw jack*	*Assembly modeling of connecting rod*	*Assembly modelling for Grinding, planning, shaping and welding fixtures*	*Machining of components on Turning operation using CNC Lathe*	*Machining of components on Milling operation using Vertical machining Center*

Note: Course committee will follow any 11 experiment

Learning Resources	
	1. *Narayana.K.L, Kanniah.P and VenkataReddy.K, Machine Drawing, New Age International, New Delhi, 2006.*
	2. *Gopalakrishnan.K.R, Machine Drawing, Subash Publishers, Bangalore, 2000.*
	3. *Narang, JS, "CNC Machines and automation", Dhanpat Rai & Co. Ltd, 2016.*
	4. *James Madison, "CNC Machining Hand Book", Industrial Press Inc., New York, 1996.*
	5. *P.S.G Tech..,"Design Data Book", KalaikathirAchchagam, 2012*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.R.Kalimuthu,ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. Dr. S. Sridhar, PSNA college of Engg. & Tech., Dindigul*	*1. S.Balamurugan, SRMIST*
2. Dr.A.Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Mr.V.Selvakumar, vselvakumar86@gmail.com, Ford India, Chennai*	*2. J.Santhakumar, SRMIST*

Course Code	18MEC210L	Course Name	AUTOMATION LABORATORY	Course Category	C	Professional core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mechanical Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-1 :	*Design pneumatic circuits for low cost automation*																		
CLR-2 :	*Design hydraulic circuits for industrial automation*																		
CLR-3 :	*Design of Electro pneumatics, servo and stepper motor control circuits*																		
CLR-4 :	*Design logic circuits and execute using PLC*																		
CLR-5 :	*Implement photo electric and ultrasonic, positional and velocity sensors, Virtual instrumentation and pick and placerobot.*																		
CLR-6 :	*Design circuits and simulate hydraulics/ pneumatics/ stepper, servo motors for industrial applications.*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Acquire knowledge on designing pneumatic circuits.*	*3*	*90*	*85*	*H*		*H*										*H*	*M*	*M*
CLO-2 :	*Acquire knowledge on designing hydraulic circuits.*	*3*	*85*	*80*	*M*		*M*										*M*	*M*	*L*
CLO-3 :	*Acquire knowledge on designing electro pneumatic circuits, control of stepper and servo motors for various applications.*	*3*	*85*	*80*	*M*		*L*										*L*	*M*	*L*
CLO-4 :	*Do PLC ladder logic programming and execute.*	*3*	*90*	*85*	*H*		*M*		*H*								*H*	*L*	*L*
CLO-5 :	*Use photo electric, ultrasonic, positional, velocity sensors for various applications and virtual instrumentation and pick and place robot.*	*3*	*90*	*85*	*M*		*L*		*H*								*M*	*M*	*L*
CLO-6 :	*Design low cost automation and provide solution for industrial and societal needs*	*3*	*85*	*80*	*H*		*M*		*H*								*M*	*M*	*H*

Duration (hour)	Devising and simulation of pneumatic circuits	Designing and simulation of hydraulic circuits	Electro pneumatics, servo and stepper motor control circuits	PLC based ladder logic circuits	Virtual instrumentation and pick & place robot
	10	4	6	4	6
S 1-2	*Continuous reciprocation of double acting cylinder with speed control circuit.*	*Synchronization circuit for two cylinders*	*Electro Pneumatic circuits: Continuous reciprocation of cylinder (with timer and Counter) and Sequencing of two cylinders*	*PLC Controlled Pneumatic / Hydraulic linear actuator Circuits*	*Process control: Temperature/ force/ pressure/ control using virtual instrumentation*
S 3-4	*Sequencing of two cylinders Circuit*	*Force, velocity calculations in hydraulic linear actuation*	*Speed control of AC Servo Motor using open and closed loop control.*	*PLC application circuits: Basic Trainer kit/ Water Level Controller/ Material Handling system*	*Characteristics of inductive, capacitive and photoelectric proximity sensors*
S 5-6	*Cascading circuit for trapped signal- 2 Cylinder*		*Positional control of a stepper motor*	*Study of SCADA and PAC systems*	*Pick and place operation using industrial robot in Teach pendent method / Manual mode*
S 7-8	*Cascading circuit for trapped signal – 3 Cylinder*				*Study of Image Processing Technique*
S 9-10	*Implementation of logic circuits: AND, OR*				

Note: Course committee will follow any 11 experiment

Learning Resources	*1. Laboratory Manual* *2. Anthony Esposito, "Fluid Power with applications", Pearson Education Inc, 2015.*	*3. FESTO manual, "Fundamentals of Pneumatics", Vol I, II and III.* *4. Joji Parambath "Industrial Hydraulic Systems: Theory and Practice", Universal Publishers, USA, 2016.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
Level 2	Apply Analyze	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
Level 3	Evaluate Create	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. R. Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. Dr. P. Hariharan, Anna University, hari@annauniv.edu, hariharan2311@gmail.com*	*1. Mr. B.Ramprasath, SRMIST*
2. Dr. A. Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Dr.N.Arunachalam, IIT Madras, chalam@iitm.ac.in*	*2. Mr.R. Murugesan, SRMIST*

Course Code	18MEC211L	Course Name	METROLOGY AND QUALITY CONTROL LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*18MEC206TMetrology and Quality Control*	Progressive Courses	*Nil*
Course Offering Department	*Department of Mechanical Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understandvarious standards of measurement (line, end and wavelength standard)*
CLR-2 :	*Perceivethe measurement of Gear, Thread and Form errors*
CLR-3 :	*Acquaintthe calibration of measuring instruments.*
CLR-4 :	*Acquire and explore the use of computer aided measuring techniques*
CLR-5 :	*Interpret and drafting sampling and control charts*
CLR-6 :	*Recognize the various measuring techniques in dimensional, optical and computer aided inspection and its role in SQC*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*demonstrate and practice different standards of measuring instrument (line, end& wavelength)*	*3*	*95*	*90*
CLO-2 :	*Apply and accomplish the measurement of Gear, Thread and Form errors*	*3*	*95*	*90*
CLO-3 :	*Exhibit and Perform the caliberation of measuring instruments.*	*3*	*95*	*90*
CLO-4 :	*Exemplify and carry measurements using computer aided measuring techniques.*	*3*	*95*	*90*
CLO-5 :	*Exposition and drafting sampling and control charts*	*3*	*95*	*90*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*H*	*H*		*L*	*H*			*L*	*M*	*L*			*H*	*M*	*M*
CLO-2 :	*H*	*H*		*L*	*L*			*M*	*L*	*M*			*L*	*L*	*M*
CLO-3 :	*H*	*H*		*M*					*L*			*L*	*M*	*M*	*M*
CLO-4 :	*H*	*H*		*M*	*H*	*M*		*H*	*M*	*M*		*H*	*H*	*M*	*M*
CLO-5 :			*H*		*M*	*L*		*M*	*H*			*L*	*M*	*L*	*H*

Duration (hour)	*Basic Measuring instruments (end line and light standard)*	*Gear, Thread and Form errors*	*Calibration of Instruments and comparative method of measurement*	*Measurement using computer aided measuring techniques*	*Optical methods & Drafting sampling and control charts*
	6	6	6	6	6
S 1-2	*Linear measurements using Verniercalliper,micrometer, height gauge and slip gauge.*	*Gear tooth measurement using Gear tooth vernier and Parkinson Gear Tester*	*Calibration of Measuring Instruments (Micrometer, Vernier Caliper, Vernier Height gauge and Dial)*	*Various parameter measurement using Computerized profileprojector*	*Attribute Control Charts using Go, No-Go gauges*
S 3-4	*Angle measurements using Sine bar and Sine center*	*Thread parameter measurement using floating carriage*	*Measurement using different comparators (mechanical, electronic and pneumatic)*	*Fundamental measurements including circularity using CMM*	*Demo on Interferometers and measurements using laser*
S 5-6	*Indirect linear and angular measurements using standard balls and rollers*	*Straightness, flatness measurement using autocollimator*	*Surface roughness measurement*	*Measurement using Machine Vision system*	*Tool Angle measurement in tool makers microscope*

Learning Resources	*1. Laboratory Observation Manual* *2. Machine Manuals supplied by supplier/Company*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. R. Kalimuthu, ISRO, Mahendragiri, r_kalimuthu@vssc.gov.in	*1. S Samsudeen, National Skill Training institute, CTI Campus, ssamsadt@gmail.com*	*1. Dr. A Vijaya, , SRMIST*
2. Dr. A. Velayutham, DRDO, Avadi, velayudham.a@cvrde.drdo.in	*2. Mr. Ramesh Ramanathan ,rramanathan@outlook.com*	*2. Mr. S. Muralidharan, SRMIST*

Course Code	18MEC350T	Course Name	COMPREHENSION	Course Category	C	Professional Core	L	T	P	C
							0	1	0	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mechanical Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the concepts in design engineering courses*			
CLR-2 :	*Understand the concepts in thermal engineering courses*			
CLR-3 :	*Understand the concepts in manufacturing engineering courses*			
CLR-4 :	*Understand the concepts in engineering that they have learnt so far in the Mechanical Engineering programme*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected	Expected
CLO-1 :	*Gain the confidence and competence to solve the design engineering problems*	*1,2&3*	*85*	*80*
CLO-2 :	*Gain the confidence and competence to solve the thermal engineering problems*	*1,2&3*	*85*	*80*
CLO-3 :	*Gain the confidence and competence to solve the manufacturing engineering problems*	*1,2&3*	*85*	*80*
CLO-4 :	*Gain the confidence and competence to solve real life engineering problems*	*1,2&3*	*85*	*80*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering	Problem Analysis	Design &	Analysis, Design,	Modern Tool	Society & Culture	Environment &	Ethics	Individual & Team	Communication	Project Mgt. &	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
H	*H*	*H*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*M*	*L*	*M*
H	*H*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*M*	*M*	*M*
H	*H*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*M*	*L*	*M*
H	*H*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*M*	*M*	*M*

Duration (hour)		5	5	5
S-1	SLO-1	*Tutorial on Engineering graphics and design*	*Tutorial on Thermodynamics*	*Tutorial on Material technology*
	SLO-2			
S-2	SLO-1	*Tutorial on Engineering Mechanics*	*Tutorial on Fluid mechanics*	*Tutorial on Manufacturing technology*
	SLO-2			
S-3	SLO-1	*Tutorial on Mechanics of solids*	*Tutorial on Applied thermal engineering*	*Tutorial on Metrology and quality control*
	SLO-2			
S-4	SLO-1	*Tutorial on Machines and mechanisms*	*Tutorial on Heat and mass transfer*	*Tutorial on CAD/CAM*
	SLO-2			
S-5	SLO-1	*CLA-1*	*CLA-2*	*CLA-3*
	SLO-2			

Learning Resources	1. *R.S.Khurmi, J.K.Gupta, Mechanical Engineering: Conventional and Objective Types, S.Chand & Co., 2018*	2. *R.K.Jain, Conventional & Objective Type Question & Answers on Mechanical Engineering for Competitions, Khanna Publishers, 2014*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40%	-	30%	-	30%	-	-	-	-	-
	Understand										
Level 2	Apply	60%	-	70%	-	70%	-	-	-	-	-
	Analyze										
Level 3	Evaluate	-	-	-	-	-	-	-	-	-	-
	Create										
	Total	100 %		100 %		100 %		0		-	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr.M.Kamaraj, SRMIST