

## 1. COURSE DETAILS

Programme: CE/ME/EE/IE/PL/CH/DE	Semester: III
Course: Applied Mathematics	Group: C*
Course Code: AMT190013	Duration: 16 Weeks

## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
3	-	-	1	4	3	70	20	10	70	25	-	-	125

## 3. COURSE OBJECTIVE:

This Course is being introduced to provide mathematical background needed for any Diploma engineer. It intends to enable the students to apply basic facts, concepts and principles of Differential Equation, Application of derivatives, Probability Distribution and Definite integral with application as a tool to analyze engineering problems.

## 4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified

Competency through various teaching learning experiences:

- Solve application-based Engineering problems using the Advanced Knowledge of mathematics

## 5. COURSE OUTCOMES (COs) at the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
1	Understand the concepts of differential calculus and definite integral and apply to solve engineering related problems.	U,A
2	Study the Concept of differential equation and apply it to solve engineering problems	R, U, A
3	Solve the Problem based on Numerical Method.	U,A
4	Define Laplace transform, study properties of it and apply it to solve numerical	R,U, A

## 6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	<b>Application of Derivatives</b> 1.1 Tangent and normal line 1.2 Velocity and Acceleration 1.3 Maxima and minima 1.4 Radius of curvature	04	07	CO1



2	<b>Differential Equation</b> 2.1 Introduction and definition 2.2 Concept of order, degree of Differential equation 2.3 Formation of Differential Equation 2.4 Differential Equation of first order and first degree <ul style="list-style-type: none"> <li>• Method of variable separable</li> <li>• Equation reducible to method of variable separable</li> <li>• Homogeneous Differential equation</li> <li>• Exact Differential equation</li> <li>• Linear Differential equation</li> </ul> 2.5 Application of Differential Equation <ul style="list-style-type: none"> <li>• Geometrical</li> <li>• Growth and Decay</li> <li>• Newton's law of cooling</li> <li>• Electrical circuit</li> </ul>			14	19	CO2
3	<b>Numerical Method</b> 3.1 Solution of equation of one variable using <ul style="list-style-type: none"> <li>• Bisection method</li> <li>• Regular falsi method</li> <li>• Newton Raphson method</li> </ul> 3.2 Solving simultaneous equation with 2 and 3 variables using <ul style="list-style-type: none"> <li>• Gauss elimination method,</li> <li>• Iterative methods –Gauss Seidal and Jacobi's methods</li> </ul>			06	09	CO3
4	<b>Integration</b> Method of integration 4.1 By Substitution – Various Types of Integration 4.2 By Parts 4.3 Mixed Problems			07	10	CO1
5	<b>Definite Integral &amp; its Applications</b> 5.1 Definition of Definite Integral 5.2 Properties of Definite Integral 5.3 Reduction Formula 5.4 Area under the curve & Area between curve 5.5 Volume of Solid 5.6 Mean Value, RMS Value 5.7 Centre of Gravity			05	08	CO1
6	<b>Laplace Transform</b> 6.1 Introduction 6.2 Definition and Basic Formula 6.3 Properties of Laplace transform' <ul style="list-style-type: none"> <li>• Linearity property</li> <li>• First shifting</li> <li>• Change of Scale</li> <li>• Multiplication by <math>t^n</math></li> <li>• Division by <math>t</math></li> </ul> 6.4 Inverse of Laplace Transform 6.5 Properties of Inverse of Laplace Transform 6.6 Methods of Inverse of Laplace Transform <ul style="list-style-type: none"> <li>• By Partial Fraction</li> </ul>			12	17	CO4
				<b>TOTAL</b>	<b>48</b>	<b>70</b>



## 7. LIST OF ASSIGNMENTS/TUTORIALS

Term Work consists of Journal containing minimum no of 08 tutorials.

Sr. No.	Title of Tutorial	Approx.Hrs required	Cos
1	Assignment on Application of derivatives	2	1
2	Assignment on Differential equation.	3	2
3	Assignment on application of Differential equation	1	2
4	Assignment on Numerical Method.	2	3
5	Assignment on Integration	2	1
6	Assignment on definite integration & its Applications	2	1
7	Assignment on Laplace Transform	2	4
8	Assignment on Inverse Laplace Transform	2	4
Total		16	

## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan/Tutorials
2. Assignments
3. Home Work Assignment

## 9. LEARNING RESOURCES

Sr. No.	Title Of Book	Author	Publication
1.	Calculus for Polytechnics	Shri. S.P.Deshpande	Pune Vidyarthi Graha Prakashan Pune-30
2.	Applied Mathematics	Shri. B.M. Patel, Shri J.M. Rawal	Nirali Prakashan Mumbai
3.	Higher Engineering Mathematics	Dr. B.S. Grewal	Khanna Publishers 2/B, Delhi-6
4	Applied Mathematics	G.V.Kumbhojkar	P.Jamnadas LLP

## 10. WEB REFERENCES.

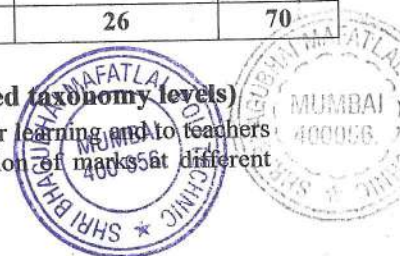
1. www.mic-mathematics.com
2. www.math.com
3. www.lernerstv.com
4. www.onlinetutorials.com
5. www.archieves.math.utk.edu

## 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN


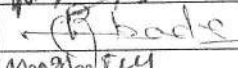
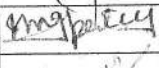
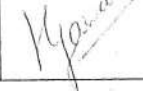
TOPIC	Distribution of Theory Marks			
	R Level	U Level	A Level	Total Marks
1 Application of Derivatives			7	07
2 Differential Equation	4	10	5	19
3 Numerical Method	2	5	2	09
4 Integration	6	2	2	10
5 Definite Integral & its Applications	2		6	08
6 Laplace Transform	3	10	4	17
<b>TOTAL</b>	<b>17</b>	<b>27</b>	<b>26</b>	<b>70</b>

**R Remembering, U Understanding, A Applying and Above (Bloom's revised taxonomy levels)**

**NOTE:** This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.



## 12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	MS.Kavita.K.Dange	
2	Internal	Mr.R.R.Ambade	
3	Internal	Mr.U.J.Patel	
4	External	Ms.Meena Gawas Organisation: Mithibai College Of Arts and Science	



### 1. COURSE DETAILS:

<b>Program: Mechanical Engineering</b> <b>Course: Fluid Mechanics &amp; Hydraulic Machines.</b> <b>Course Code:FMH190205</b>	<b>Semester:III</b> <b>Group:C*</b>  <b>Duration:16 Weeks</b>
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### 2. TEACHING AND EXAMINATION SCHEME:

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper		SSL	TA	TH	TW	PR	OR	TOTAL
					Duration and marks(ESE)	Hour Marks							
03	02	---	-----	5	03	70	20	10	70	50	50	--	200

### 3. COURSE OBJECTIVE

This course offers basic knowledge of fluid statics and hydraulic machines. The objective of this course is to enable the students to understand laws of fluid mechanics and evaluate pressure, velocity and acceleration fields for various fluid flows and performance parameters for hydraulic machinery.

### 4. SKILL COMPETENCY :

The aim of this course is to help the student to attain the following identified competency through various teaching learning experiences:

**Maintain hydraulic machinery using knowledge of fluid mechanics. Knowledge of various gauges used in Industries.**

### 5. COURSE OUTCOMES(COs): At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Use Manometers and Bourdon's Tube gauge to measure pressure.	Understand
CO2	Use flow meters to measure the rate of flow.	Understand
CO3	Maintain flow through pipes.	Apply
CO4	Maintain hydraulic Turbines.	Apply
CO5	Maintain hydraulic pumps.	Apply



## 6. COURSE CONTENTS:

Sr. No.	TOPIC/Sub-topic	Hours	Marks	Cos
1	<b>Properties of Fluid and Fluid Pressure</b> <b>1.1 Properties of Fluid</b> Density, Specific gravity, Specific volume, Specific Weight, Dynamic viscosity, Kinematic viscosity, Surface tension, Capillarity, Vapor Pressure, Compressibility. <b>1.2 Fluid Pressure &amp; Pressure Measurement.</b> Fluid pressure, Pressure head, Pressure intensity Concept of absolute vacuum, gauge pressure, atmospheric pressure, absolute pressure. Simple and differential manometers, Bourdon's pressure gauge.	4	04	CO1
2	<b>2.1. Fluid Flow</b> <ul style="list-style-type: none"> <li>Types of fluid flows- Laminar, turbulent, steady, unsteady, uniform, non-uniform, rotational, irrotational.</li> <li>Continuity equation, Bernoulli's theorem. Venturimeter – construction, principle of working, coefficient of discharge, Derivation for discharge through Venturimeter.</li> <li>Orifice meter – Construction, Principle of working, hydraulic coefficients. Derivation for discharge through Orifice meter.</li> </ul>	6	12	CO2 CO2 CO2
3	<b>3.1 Flow Through Pipes</b> <ul style="list-style-type: none"> <li>Laws of fluid friction (Laminar and turbulent)</li> <li>Darcy's equation and Chezy's equation for frictional losses.</li> <li>Minor losses in fittings and valves.</li> <li>Hydraulic gradient line and total energy line.</li> </ul>	6	10	CO3
4	<b>4.1 Hydraulic Turbines</b> <ul style="list-style-type: none"> <li>Layout and features of hydroelectric power plant, surge tanks and its need.</li> <li>Classification of hydraulic turbines and their applications.</li> <li>Construction and working principle of Pelton wheel, Francis and Kaplan turbine.</li> <li>Draft tubes – types and construction, Concept of cavitation in turbines.</li> <li>Calculation of Work done, Power, efficiency of turbine.</li> </ul>	10	14	CO4
5	<b>5.1 Centrifugal Pumps:</b> <ul style="list-style-type: none"> <li>Construction, principle of working, priming methods and Cavitation</li> <li>Types of casings and impellers.</li> <li>Manometric head, Work done, Manometric efficiency, Overall efficiency, NPSH.</li> <li>Performance Characteristics of Centrifugal pumps.</li> <li>Trouble Shooting, Construction, working and applications multistage pumps, Submersible pumps and jet pump</li> </ul>	10	14	CO5



Sr. No.	TOPIC/Sub-topic	Hours	Marks	Cos
6	<b>6.1 Reciprocating Pumps:</b> <ul style="list-style-type: none"> <li>• Construction, working principle and applications of single and double acting reciprocating pumps.</li> <li>• Slip, Negative slip, Cavitation and separation.</li> <li>• Use of Air Vessels.</li> <li>• Indicator diagram with effect of acceleration head &amp; frictional head.</li> </ul> <b>(No numerical on reciprocating pumps)</b>	6	08	CO5
	<b>TOTAL</b>	<b>48</b>	<b>70</b>	

#### 7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS:

Term work consists of Journal containing 09 experiments..

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx. Hrs required	COs
1	Verification of Bernoulli's theorem	02*	CO2
2	Determination of co-efficient of discharge for Venturimeter and orifice plate.	04*	CO2
3	To perform Reynolds's experiment for determinations of different regimes of flow.	02	CO2
4	Determination of loss of head due to friction in pipes.	04	CO3
5	Determination of loss of head due to bends, sudden enlargement, sudden contraction.	08	CO3
6	Study of Centrifugal Pump	02	CO5
7	Study of Reciprocating pump.	02	CO5
8	Study and demonstration of Pelton wheel.	04	CO4
9	Study and demonstration of Francis turbine.	04	CO4
	<b>TOTAL</b>	<b>32</b>	

#### 8. IMPLEMENTATION STRATEGY (PLANNING) :

In depth study and understanding of the Course will be implemented by adopting the following strategy.(Teaching plan)

- Lessonplan.
- Use of charts, models and transparencies.
- Use of actual devices.

#### 9. LEARNING RESOURCES :

Sr.No.	Author	Title of Book	Publication
1	Modi P.N. and Seth S. M.	Hydraulics and Fluid Mechanics including Hydraulics machines	Sixteenth 2007 Standard book house, New Delhi
2	R.S. Khurmi	Fluid Mechanics & Hydraulics machinery	First 2001 S. Chand & Co Ltd., New Delhi.
3	Dr.R.K.Bansal	Fluid Mechanics & Hydraulics machines	Ninth 2010 Laxmi publications (P)Ltd



4	K. L. Kumar	Engineering Fluid Mechanics	Eighth 2009 Eurasia Publishing House(P), New Delhi
5	Streeter Victor, Bedford K.W., Wylie E.B	Fluid Mechanics	Ninth 2003 McGraw Hill Int.
6	Jagdish Lal	Fluid Mechanics & Hydraulics machinery	Second 1986 Metropolitan Book Co.

#### 10. WEB REFERENCES:

- www.nptel.ac.in
- www.learnerstv.com
- www.ni.com/multisim
- www.youtube.com/watch?v=e6a2q9k2JCA
- www.youtube.com/watch?v=5TTnFccqJEE
- www.youtube.com/watch?v=3Gq3tR3fkM0
- www.youtube.com/watch?v=UNBW16MV\_IY
- www.youtube.com/watch?v=IjMVt7T4HQM


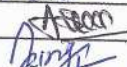


#### 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr.No	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Properties of fluid and pressure	04	04	04	12
2	Fluid flow	04	04	04	12
3	Flow through pipes	--	04	06	10
4	Hydraulic Turbine	--	06	08	14
5	Centrifugal pump	--	06	08	14
6	Reciprocating pump	04	04	--	08
<b>TOTAL</b>		<b>12</b>	<b>28</b>	<b>30</b>	<b>70</b>

R Remembering, U Understanding, A Applying and Above (Bloom's revised taxonomy levels)

**NOTE:** This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

#### 12. COURSE EXPERT COMMITTEE MEMBERS:

Sr. No.	Examiners	NAME	SIGNATURE
1	Internal	Shri Amol D. Bele	
2	Internal	Shri A.S. Shukla	
3	Internal	Shri Virag Timbadiya	
4	External	Shri Mahendra Bhor	





## 1. COURSE DETAILS

<b>Programme: Mechanical Engineering</b> <b>Course: Mechanical Engineering Drawing</b> <b>Course Code: MED190206</b>	<b>Semester: III</b> <b>Group: C*</b> <b>Duration: 16 Weeks</b>
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## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
01	---	05	-----	06	04	70	20	10	70	50	--	50	200

## 3. COURSE OBJECTIVE

Mechanical Engineering Drawing course is useful for understanding of drawing, designing of parts, manufacturing of parts, in assembly etc. This course develops the ability to visualize and draw assembly and detail drawing by using CAD software. It also reinforcing and enhancing the knowledge acquired in Engineering Drawing and Engineering Graphics.

## 4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences

**Interpret and prepare mechanical working drawing /production drawing of a given component using CADD software.**

## 5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Use freehand sketching for designing of simple machine components.	Remember, Understand Apply
CO2	Interpret and draw details, assembly and working drawing of different mechanical systems using drawing board, drawing sheet and CAD software	Remember, Understand Apply
CO3	Use development of lateral surfaces of solids to manufacture mechanical parts.	Remember, Understand Apply
CO4	Interpret auxiliary views of object.	Remember, Understand Apply
CO5	Interpret curves of the intersection of surfaces for two solids.	Remember, Understand Apply



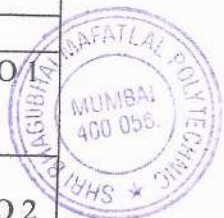
## 6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	<b>Free hand sketches:</b> 1.1 Free hand sketches of joints, keys, bearings, Fast and loose pulley.	02	08	CO1
2	<b>Details and Assembly of Machine Parts</b> 2.1 Couplings, Screw jack, bench vice, tool post, simple Tail stock, piston and connecting rod assembly. 2.2 Non- return valve, gate valve, steam stop valve (maximum 8 parts), gland and stuffing box assembly 2.3 Jigs and fixtures (with about 8 parts excluding standard parts like nuts, studs, bolts, pins, Washers, etc.) 2.4 Machine Elements: Preparation of 2-D drawings of standard machine elements (nuts, bolts, keys, cotter, screws, spring etc)	04	22	CO2
3	<b>Working Drawing</b> 1.1 Weld symbols 1.2 Machining and surface finish symbols 1.3 Limits, fits and tolerances 1.4 Geometrical tolerances 1.5 Representation of the above symbols and tolerances on part drawings.	02	08	CO2
4	<b>Development of lateral surfaces of solids</b> 4.1 Developments of Lateral surfaces of prism, cylinder, pyramid and, cone. 4.2 Antidevelopment. 4.3 Applications of development	02	09	CO3
5	<b>Auxiliary Projection</b> 5.1 Auxiliary projections of machine parts 5.2 Use of auxiliary projections for solid geometry	02	09	CO4
6	<b>Interpenetration of Surfaces of Solids</b> 6.1 Intersections/ interpenetration of surfaces of the solids with axis perpendicular or parallel to reference planes 6.2 Intersection/interpenetration of two prisms 6.3 Intersection/interpenetration of two cylinders 6.4 Intersection/interpenetration of prism and cylinder 6.5 Intersection/interpenetration of pyramid and prism 6.6 Intersection/interpenetration of cone and cylinder	04	14	CO5
<b>TOTAL</b>		<b>16</b>	<b>70</b>	

## 7. LIST OF PRACTICALS

Term work consists of sheets and printout.

Sr. No.	Title of Experiment	Approx.Hr s required	COs
<b>Drawing Practical</b>			
1	<b>Free hand sketches:</b> a. One sheet with four problems b. Home Assignments: Four problems in sketchbook.	06	CO1
2	<b>Details and Assembly</b> a. i) Assembly to detail of Machine Parts	06	CO2



Sr. No.	Title of Experiment	Approx.Hrs required	COs
<b>Drawing Practical</b>			
	ii) Detail to assembly of Machine parts b. Home Assignments: Remaining problems in sketchbook.	09	
3	<b>Working Drawing</b> A drawing sheet on two problems of working drawing of detail/assembly	06	CO 2
4	<b>Development Of surfaces of solids</b> a. One sheet with four problems. b. Home Assignments: Four problems in sketchbook.	06	CO 3
5	<b>Auxiliary Projection</b> a. One sheet with four problems. b. Home Assignments: Four problems in sketchbook.	06	CO 4
6	<b>Interpenetration of Surfaces of Solids</b> a. One sheet with four problems. b. Home Assignments: Four problems in sketchbook.	09	CO 5
	<b>TOTAL</b>	<b>48</b>	
<b>Practical Using CADD Software</b>			
7	Machine Elements:Preparation of 2-D drawings of standard machine elements (nuts, bolts, keys, cotter, screws, spring etc) any 04	06	CO2
8	Use the CADD software to draw an assembly drawing from the given detailed drawing showing conventional representation, bill of material.	10	CO2
9	Use the CADD software to draw detailed drawing from the given assembly drawing showing conventional representation, bill of material.	10	CO2
10	Use the CADD software to draw an assembly drawing from the given detailed drawing showing conventional representation, dimensional and geometrical tolerances and surface finish symbols.	04	CO2
11	Plot the above assembly drawings on A2/A3 size paper with title block.	02	CO2
	<b>TOTAL</b>	<b>32</b>	
	<b>GRAND TOTAL</b>	<b>80</b>	

### 8 IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. PPT
3. All Practical's are compulsory. For CAD a judicial mix of 2 or more practical is required to be performed.
4. Home Assignments

### 9. LEARNING RESOURCES

Sr. No.	Title Of Book	Author	Publication
1.	Geometrical and Machine drawing	N.D.Bhatt and Panchal	Charotar publishing house pvt.ltd.Edition 49th2010
2.	Engineering Drawing	R.K. Dhawan	S.Chand & Co. Ltd,Ram Nagar,New Delhi-110 0552nd2001



3.	Machine drawing	R.K. Dhawan	S.Chand & Co. Ltd, Ram Nagar, New Delhi-110055 2nd 2001 New Delhi-
4	Machine Drawing	P.S.Gill	S.Kataria & sons 4760-61/23, Ansari Road, Daryaganj, New Delhi-110002
5	Machine Drawing	N Sidheswar, P Kannaiah, V.V.S	Tata McGraw Hill Publications, New Delhi
6	Engineering Graphics with AutoCAD	Kulkarni D. M Rastogi A. P. Sarkar A. K	Pill Learning. New Delhi (2010), ISBN: 978-8120337831
7	Essentials of Engineering Drawing	Jeyapooan T	Vikas Publishing House Pvt. Ltd. Noida. 2011. ISBN: 978-8125953005
8	AutoCAD User Guide	Autodesk	Autodesk Press. USA, 2015

### 10 WEB REFERENCES

- <http://www.mycadsite.com/tutorials>
- <http://tutorial45.com/learn-autocad-basics-in-21-days/>
- <https://www.lynda.com/AutoCAD-training-tutorials/160-0.html>
- <http://www.investintech.com/resources/blog/archives/5947-free-online-autocad-tutorials-courses.html>
- <http://vwww.cad-training-course.com/>
- <http://au.autodesk.com/au-online/overview>

### 11 SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Free hand sketches	02	06	--	08
2	Details and Assembly	--	06	16	22
3	Working Drawing	02	06	--	08
4	Development Of surfaces of solids	--	--	09	09
5	Auxiliary Projection	02	03	04	09
6	Interpenetration of Surfaces of Solids	--	--	14	14
<b>TOTAL</b>		<b>06</b>	<b>21</b>	<b>43</b>	<b>70</b>

**R Remembering, U Understanding, A Applying and Above (Bloom's revised taxonomy levels)**

**NOTE:** This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

### 12. QUESTION PAPER PATTERN FOR END SEMESTER EXAMINATION

Que. No.	Bits	Marks
1	Any 1 out of 2 a. On Chapter 2 Detail drawing b. On Chapter 2 Assembly Drawing	22
2	Attempt the following On Chapter 1	08



3	Attempt the following On Chapter 3		08
4	Attempt the following a. On Chapter 4 b. On Chapter 5		09 09
5	Any 1 out of 2 a. On Chapter 6 b. On Chapter 6		14
	<b>TOTAL</b>		<b>70</b>

### 13. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	N.M.Pathak	<i>N.M.Pathak</i>
2	Internal	P.R.Parate	<i>P.R.Parate</i>
3	Internal	G.B.Deshpande	<i>G.B.Deshpande</i>
4	External	Shri Mahendra Bhor	<i>Shri Mahendra Bhor</i>



## 1. COURSE DETAILS

<b>Programme: Mechanical Engineering</b> <b>Course: Thermal Engineering</b> <b>Course Code: THE190207</b>	<b>Semester: III</b>  <b>Group: C*</b> <b>Duration:16 Weeks</b>
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## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	-----	-----	05	03	70	20	10	70	25	-----	25	150

## 3. COURSE OBJECTIVE

This course offers basic knowledge of thermodynamics and various component of thermal power plant. The objective of this course is to enable the students to understand laws of thermodynamics, different modes of heat transfer and calculation of thermal power plant components efficiency.

## 4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

**Use principles of thermal engineering to maintain thermal related equipment's and**  
**Use principles of thermodynamics and heat transfer to calculate efficiencies of boiler, turbine, condensers etc.**

## 5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Interpret general concepts of thermodynamics and various thermodynamic processes	Remember Understand
CO2	Classify various boilers, its construction, working, mountings and accessories.	Remember Understand
CO3	Identify the concepts of steam, steam engine, steam cycles, steam nozzles, condensers and turbines.	Remember Understand
CO4	Calculate properties of two phase system by using steam tables and Mollier diagram.	Apply
CO5	Interrelate various modes of heat transfer	Remember Understand

## 6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs



Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	<p><b>Basic Thermodynamics</b></p> <p>1.1 <b>Basic Concepts</b> - Concept of pure substance, types of systems, properties of systems, Extensive and Intensive properties, flow and nonflow processes, specific volume, temperature, density, pressure. Processes and cycles.</p> <p>1.2 <b>Energy</b> - Work, Heat Transfer and Energy Thermodynamic definition of work and heat, difference between heat and work. energy —Potential Energy, kinetic Energy, internal Energy, Flow Work, concepts of enthalpy and physical concept of entropy.</p> <p>1.3 <b>Laws of Thermodynamics</b>- Zeroth law, first law of thermodynamics, second law of thermodynamics, Kelvin Planks, Clausius statements and their equivalence. Reversible and irreversible processes, factors making process irreversible, reversible carnot cycle for heat engine and refrigerator.</p> <p>1.4 <b>Application of Laws of Thermodynamics</b> - Steady flow energy equation and its application to boilers, engine, nozzle, turbine, compressor and condenser simple numericals on steady flow energy equation. Application of second law of thermodynamics to heat engine, heat pump and refrigerator and simple numerical.</p>	08	08	CO1
2	<p><b>Thermodynamic Processes</b></p> <p>2.1 Avogadro's law, calculate molar volume. Derivation of characteristic gas equation using Boyle's and Charle's law, characteristic gas constant and universal gas constant.</p> <p>2.2 Ideal gas processes —Isobaric, Isochoric, Isothermal, Isentropic, Polytropic. Throttling and their representation on P-V and T-S diagrams. Determination of work, heat, internal energy, enthalpy change and entropy change.</p> <p>2.3 Flow work and Heat transfer for open systems - calculation</p>	08	08	CO1
3	<p><b>Steam Boilers</b></p> <p>3.1 Steam fundamentals - Applications of steam, generation of steam at constant pressure with representation on various charts such as PV, T-S, I-I-S. Properties of steam and use of steam table, dryness fraction, degree of superheat, sensible and latent heat, boiler efficiency, Mollier chart.</p> <p>3.2 Vapour processes - Constant pressure, constant volume, constant temperature, constant enthalpy, constant entropy process (numerical on all above process using steam table to) Rankine cycle.</p> <p>3.3 Modified Rankine cycle</p> <p>3.4 Steam Boilers - Classification, Construction and working of Cochran, Babcock and Wilcox, La-mont and Loeffler boiler, packaged boilers. Boiler draught. Indian Boiler Regulation (IBR)</p> <p>3.5 Boiler mountings and accessories.</p> <p>3.6 Boiler instrumentation.</p> <p>3.7 Methods of energy conservation in boilers.</p>	08	14	CO2 CO4
4	<p><b>Steam Nozzle &amp; Steam Turbines</b></p> <p>4.1 Steam nozzle - Continuity equation, types of nozzles,</p>	08	10	CO3 CO4



Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
	concept of Mach number, critical pressure and choked flow condition, application of steam nozzles. Simple numericals. 4.2 Steam turbine - Classification of turbines, Construction and working of impulse and reaction turbine. 4.3 Compounding of turbines and its types. Regenerative feed heating, bleeding or steam, governing and its types, losses in steam turbines. Simple numericals			
5	<b>Steam Condenser</b> 5.1 Steam condensers - Dalton's law of partial pressure, function and classification of condensers. 5.2 Construction and working of surface condensers and jet condensers. 5.3 Condenser performance - Sources of air leakage and its effect, concept of condenser efficiency, vacuum efficiency (Simple numerical). 5.4 Cooling Towers-Construction and working of forced, natural and induced draught cooling tower.	05	10	CO3 CO4
6	<b>Heat Transfer</b> 6.1 Modes of heat transfer - Conduction, convection and radiation. 6.2 Conduction - Fourier's law, thermal conductivity, conduction through cylinder, thermal resistance, composite walls, list of conducting and insulating materials. Simple numericals on flat, cylindrical & spherical surfaces. 6.3 Convection - Newton's law of cooling, natural and forced convection. 6.4 Radiation- Thermal Radiation, absorptivity, transmissivity, reflectivity, emissivity, black and gray bodies, Stefan-Boltzman law. 6.5 Heat Exchangers - Classification, construction and working of shell and tube, shell and coil, pipe in pipe type and plate type heat exchanger, automotive heat exchanger and its applications. Derivation of LMTD & Simple numericals	11	20	CO5
	<b>TOTAL</b>	<b>48</b>	<b>70</b>	

## 7. LIST OF PRACTICALS

Term work consists of journal containing minimum 10 number of experiments.

Sr. No.	Title of Experiment	Approx.Hrs required	COs
1	Study of Steam Boilers	02*	CO2
2	Study of Boiler and mounting accessories	04*	CO2
3	Study of high pressure boilers	02*	CO2
4	Study of Steam Engines.	02*	CO3
5	Study of steam condensers.	04*	CO3
6	Study of Steam Turbines.	02*	CO3
7	Study of compounding and governing of Steam Turbines.	04*	CO3
8	Calculate the thermal conductivity of Metallic Rod.	02*	CO5
9	Classify heat exchangers, Write construction and working of any 03 heat exchangers.	02	CO5
10	Calculate mass flow rate of one fluid using energy balance equation	04	CO5





Sr. No.	Title of Experiment	Approx.Hrs required	COs
	inheat exchanger.		
11	Calculate convective heat transfer coefficient for the given fluid.	04	CO5
	<b>TOTAL</b>	<b>32</b>	

### 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. \* Practical's are compulsory
3. Guest/Expert lectures.
4. PPT

### 9. LEARNING RESOURCES

Sr.No.	Title Of Book	Author	Publication
1.	Basic Thermodynamics	Nag, P. K.	McGraw-Hill Education
2.	Thermal Engineering	Raiput, R. K.	Firewall Media, New Delhi 2005. ISBN: 978-8170088349 ISBN: 978-
3.	A Textbook of Thermal Engineering	Gupta, J. K.: Khurmi	S. Chand Limited, New Delhi 1997, ISBN: 9788121925730
4	Heat and Mass transfer	Raiput, R. K.	S. Chand Limited, New Delhi 2011, ISBN 81-219-2617-3

### 10. WEB REFERENCES

- <http://www.sfu.ca/~mbahrami/ENSC%20388/Notes!Intro%20and%20Basic%20Concepts.pdf>
- <http://web.mit.edu/16.unified/www/FALL/thermodynamics/notes/node12.html>
- <https://www.youtube.com/watch?v=9GMBpZZtjXM>
- <https://www.youtube.com/watch?v=3d yxjBwq F-8>
- <https://www.youtube.com/watch?v=02p5AKP6WOQ>
- <http://www.learnengineering.org/2013/02/working-of-steam-turbine.html>
- <https://www.youtube.com/watch?v=MuiWTBx3szc>
- <http://nptel.ac.in/courses/103106101/Module%20-%208/Lecture%20-%202.pdf>
- <https://www.youtube.com/watch?v=Jv5p7o-7Pms>
- [http://www.cdeep.iitb.ac.in/webpage\\_data/nptel!Mechanical/Heat%20and%20Mass%20Transfer!Course%20home%201.html](http://www.cdeep.iitb.ac.in/webpage_data/nptel!Mechanical/Heat%20and%20Mass%20Transfer!Course%20home%201.html)
- [http://www.rinfra.com/energy\\_generation.html](http://www.rinfra.com/energy_generation.html)

### 11 SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

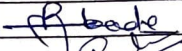
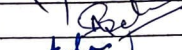
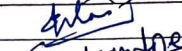
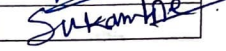
Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Basic Thermodynamics	02	02	04	08
2	Thermodynamic Processes	02	02	04	08
3	Steam Boilers	02	04	08	14
4	Steam Nozzle & Steam Turbines	02	04	04	10
5	Steam Condenser	02	04	04	10
6	Heat Transfer	06	06	08	20
	<b>TOTAL</b>	<b>16</b>	<b>22</b>	<b>32</b>	<b>70</b>



**R Remembering, U Understanding, A Applying and Above (Bloom's revised taxonomylevels)**

**NOTE:** This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

**12 COURSE EXPERT COMMITTEE MEMBERS**

Sr. No.		NAME	SIGNATURE
1	Internal	R.R.Ambade	
2	Internal	A.D.Bebe	
3	Internal	S.B.Wasnik	
4	External	Swapnil Kamble	



## 1. COURSE DETAILS

<b>Programme: ME/PE ENGG.</b> <b>Course: Strength of Materials</b> <b>Course Code: SOM190015</b>	<b>Semester: III</b> <b>Group: C*/C</b> <b>Duration: 16 Weeks</b>
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## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs. L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks (ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
04	02	----	----	06	03	70	20	10	70	50	--	--	150

## 3. COURSE OBJECTIVE

Strength of material is core technology subject which aims at enabling the student to understand and analyze various types of loads, stresses, and strains along with main cause of change in physical properties and failure of machine parts.

## 4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

**Estimate stresses in structural members and mechanical properties of materials.**

## 5. COURSE OUTCOMES (COs) At the end of the semester student will be able to :-

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Understand mechanical properties of materials.	Understand
CO2	Compute Moment of Inertia of symmetrical and asymmetrical structural sections.	Apply
CO3	Estimates stresses and strains in machine components	Apply
CO4	Compute shear force and bending moment and corresponding shear force and bending stresses in beams subjected to point and uniformly distributed load.	Apply
CO5	Estimate stresses in shafts under twisting moments.	Apply



## 6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	<b>1.0 SIMPLE STRESSES &amp; STRAINS</b> 1.1 Definition of rigid body, plastic body and elasticity 1.2 Definition of strain, stress, modulus of elasticity 1.3 Classification of stress, strain. 1.4 Deformation of body due to axial load 1.5 Deformation of body of varying c/s due to axial load, max. Stress and min. stress induced (no tapering sections) Stresses in bars of composite section. 1.6 Temperature stress and strain, coefficient of thermal expansion 1.7 Temperature Stress in bars of composite section. 1.8 Shear stress, complementary shear stress, state of simple shear, modulus of rigidity	10	10	CO1 CO3
2	<b>2.0 ELASTIC CONSTANTS</b> 2.1 Definition of lateral strain, Poisson's ratio. 2.2 Change in lateral dimensions 2.3 Volumetric strain due to axial force and change in volume 2.4 Bi axial and Tri axial stresses and volumetric strain 2.5 Definition of Bulk Modulus, change in volume 2.6 Relation between Modulus of Elasticity Modulus of rigidity and bulk modulus	05	06	CO3
3	<b>3.0 STRAIN ENERGY</b> 3.1 Types of loading – gradual, sudden & Impact load 3.2. Definition of strain energy, modulus of resilience and proof resilience 3.3 Comparison of stresses due to gradual load, sudden load and impact load. Instantaneous stress induced in the body 3.4 Strain energy stored due to gradual, sudden & impact load in the body	05	06	CO3
4	<b>4.0 PRINCIPAL PLANES AND STRESSES</b> 4.1 Stresses on oblique plane i.e. normal stress and tangential stress 4.2 Definition of principal planes and principal stresses 4.3 Principal planes and principal stresses due to Biaxial Stress System (Analytical and graphical method) 4.4 Principal plane and principal stresses due to complex stress system (Analytical and graphical method)	06	06	CO3
5	<b>5.0 MOMENT OF INERTIA</b> 5.1 Concept of moment of inertia M.I. of plane areas such as rectangle, triangle, circle, semicircle and quarter circle 5.2 Parallel axis and perpendicular axis theorem M.I of composite sections, built up sections, symmetrical and unsymmetrical sections, radius of gyration polar moment of inertia	06	06	CO2
6	<b>6.0 SHEAR FORCE &amp; BENDING MOMENT DIAGRAMS</b> 6.1 Definition of Shear Force and Bending Moment Force, relation between SF & BM and Load. 6.2. SF & BM Diagram for simply supported, Cantilever, and Over Hang beams subjected to combination of Point Load, Uniformly Distributed Load.	10	10	CO4



7	<b>7.0 BENDING STRESSES IN BEAMS</b> 7.1 Concept of pure bending, Theory of Simple Bending, assumptions in Theory of Bending, Neutral Axis, Bending Stresses and their nature, Bending Stress Distribution Diagram. 7.2 Application of theory of bending to Symmetrical and asymmetrical beam sections.	06	06	CO3 CO4
8	<b>8.0 DIRECT AND BENDING STRESSES.</b> 8.1 Concept of direct (concentric) and eccentric load. 8.2 Uniaxial and biaxial bending of short compression member 8.3 Stress distribution across the section, resultant stress, condition for no tension, middle third rule, core of the section.	05	06	CO3
9	<b>9.0 TORSION</b> 9.1 Definition of torsion, theory of pure torsion, Assumptions, equation of torsion, angle of twist, torsional rigidity, polar section modulus. 9.2 Torque transmitted by shaft Strength of shaft and stiffness of shaft, Power transmitted by the shaft, design of shaft.	06	08	CO5
10	<b>10.0 STRESSES IN SHELLS</b> 10.1 Definition of thin & thick shells. Stresses in the walls of thin cylindrical shells due to internal pressure, circumferential (hoop) & longitudinal stresses	05	06	CO3
	Total	64	70	

### 7. LIST of PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx. Hrs required	COs
1	Study of Universal Testing Machine & Extensometer	04	CO1
2	Tension test on standard mild steel specimen	04	CO1
3	Tension test on standard tor steel specimen	02	CO3
4	Shear test on standard mild steel specimen.	02	CO3
5	Izod Impact test	02	CO1
6	Brinell's Hardness test	02	CO1
7	Bend test on bars and flats.	04	CO4
8	Transverse test on beam	02	CO3
9	Deflection test	02	CO3
10	Torsion Test	02	CO5
11	Graphics (Mohr's Stress Circles Minimum 6)	02	CO3
12	Shear force diagram and Bending Moment diagram ( Minimum 6)	04	CO4
	<b>Total</b>		



## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Lesson Planning
2. Use of Projector and Smart board.
3. Demonstration (AV Resources)
4. Use of hand tools and machine tools

## 9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Strength of Materials	Khurmi R.S.	S.Chand & Co. Mumbai
2	Strength of Materials	Ramamurtha	Dhanpatrai Pub. 3917,
3	Strength of Materials	S S Bhavikatti	Vikas Publishing House
4	Strength of Materials	K Srinivas Rao	Central Techno Publications





## 10. WEB REFERENCES

- a) <https://www.douglasequipment.com/blog/>
- b) <http://elearning.nokomis.in>

## 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	SIMPLE STRESSES & STRAINS	06	04		10
2	ELASTIC CONSTANTS	03	03		06
3	STRAIN ENERGY		03	03	06
4	PRINCIPAL PLANES AND STRESSES			06	06
5	MOMENT OF INERTIA		02	04	06
6	SHEAR FORCE & BENDING MOMENT DIAGRAMS		04	06	10
7	BENDING STRESSES IN BEAMS			06	06
8	DIRECT AND BENDING STRESSES.			06	06
9	TORSION	02	02	04	08
10	STRESSES IN SHELLS		02	04	06
	TOTAL	11	20	39	70

## 12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	S.A. Kamble	
2	Internal	A.S. Shukla	
3	Internal	V.A. Timbadia	
4	External	Prof. E. Narayanan	
		Organization: D.J. Sanghvi College of engineering	



## 1. COURSE DETAILS

Programme: Chemical/Plastic/Mechanical Engineering	Semester: II/II/III
Course: Basics of Electrical and Electronics	Group: B*/B
Course Code: BEE190016	Duration: 16 Weeks

## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
4	2	-	-	6	3	70	20	10	70	25	-	25	150

## 3. COURSE OBJECTIVE

This Course deals with the basics of Electrical and Electronics Engineering. It aims at making the student familiar with various electrical circuits, electrical machines, electronic components and their applications.

## 4. SKILL COMPETENCY

The aim of this course is to help the students to attain the following industry identified competency through various teaching learning experiences.

Use the electrical and electronics equipment in the industry.

## 5. COURSE OUTCOMES (COs) at the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's Level
1	State principles and laws used in basic electrical Engineering.	R
2	Understand the working of different electrical Motors and their applications.	U, A
3	Explain working and applications of the Transformer.	U, A
4	Name the components in electronic circuits	R
5	Explain the need of amplifier and rectifier	U
6	Identify digital electronics circuit	A



## 6. COURSE CONTENTS

Sr.No.	Topic /Sub-Topics	Hours	Marks	COs
1	<b>Basic concept and principle of Electrical Engineering</b> 1.1 Voltage, Electric current, Power and their relation. Resistance, Ohm's Law, Resistance in series and parallel. 1.2 Kirchoff's Laws (Only statement.) Faraday's Laws of Electromagnetic Induction 1.3 Alternating Current and Voltage. Terms related with alternating quantity. Concept of 1 $\phi$ & 3 $\phi$ AC Supply.	10	11	CO1
2	<b>D.C. Motors</b> 2.1 Construction and working Principle. 2.2 Types of D.C. Motor. 2.3 Significance of back emf. Torque, Speed and back emf ( No derivation. Only equation) 2.4 Characteristics & Applications.	7	8	CO2
3	<b>Transformer</b> 3.1 Construction and Working Principle. 3.3 Core type & Shell type transformer. 3.4 EMF Equation (simple numerical). 3.5 Turn ratio, Current ratio & Voltage ratio. 3.6 Concept of Auto transformer, 3 $\phi$ transformer and their applications.	8	8	CO3
4	<b>A.C. Motors</b> 4.1 Classification of A.C motors. 4.2 Principle, construction, Types & Applications of 3 $\phi$ Induction Motors. 4.3 1 $\phi$ Induction Motors and their applications.	7	8	CO2
5	<b>Introduction to Electronics</b> 5.1 Conductors ,Semiconductors, Insulators (definitions and example) 5.2 Electronic Components :Resistor, capacitors and inductors Symbol ,Working principle , applications and specifications 5.3 Semiconductor: Intrinsic and Extrinsic 5.4 PN Junction diode- Symbol, working, characteristics and applications. 5.5 Zener diode- Symbol, working, characteristics and application. 5.6 Construction and working principle of light emitting diode (LED) 5.7 Bipolar junction transistor (BJT) Symbol construction and working principle of NPN transistor , Characteristics (CE configuration only) Regions cut off, active and saturation. Transistor parameters in CE configuration.	12	12	CO4





6	<b>Rectifier and filter circuits</b> 6.1 Rectifier: Half wave , full wave and bridge type circuit, waveform and working. Performance parameters, PIV , ripple factor and efficiency. 6.2 Filter definition. Need for filters Circuit diagram of Capacitor and inductor filter and its working	6	08	CO5
7	<b>Amplifier</b> 7.1 Concept 7.2 Single stage transistor amplifier in CE configuration, circuit, working principle and frequency response	6	06	CO5
8	<b>Digital Electronics</b> 8.1 Digital signal Binary Number system Boolean algebra 8.2 Study of logic gates ( AND,OR,NOT,NOR,NAND) symbols and truth table 8.3 Digital displays Seven segment display LED, LCD display (Working principle and application only.)	8	09	CO6
<b>Total</b>		64	70	

## 7. LIST OF PRACTICALS/ASSIGNMENTS

Term work consists of Journal containing minimum no of 10 experiments

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1	Verification of ohm's law.	2	CO1
2	Verification of Kirchhoff's current law.	2	CO1
3	Verification of Kirchhoff's Voltage law.	2	CO1
4	Voltage ratio test on single phase Transformer.	2	CO3
5	Load test on D.C shunt motor.	2	CO2
6	Study of electronic components	2	CO4
7	Study of PN junction diode characteristics	2	CO4
8	Study of zener diode Characteristics	2	CO4
9	Study of CE configuration	2	CO4
10	Study of Half wave rectifier	2	CO5
11	Study of logic gates	2	CO6
12	Study of full wave rectifier	2	CO5
13	Study of filters	2	CO5



## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan.
2. Assignments.
3. Slides.
4. Any other method adopted.

## 9. LEARNING RESOURCES

Sr. No.	Title Of Book	Author	Publication
1.	Electrical Technology. Volume – I&II	B.L.Theraja	S.Chand and Co. New Delhi.
2	Basic Electrical Engineering	V.N.Mittal	Tata McGraw-Hill. New Delhi.
3	Principles of Electronics	V K Mehta	S Chand and company
4	Digital Electronics	R P Jain	TMH
5	Basic Electronics and Linear circuits	N N Bhargava D C Kulshreshta S C Gupta	T T T I Chandigarh

## 10. WEB REFERENCES

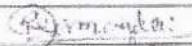
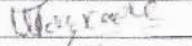


- 1) [www.nptel.ac.in](http://www.nptel.ac.in)
- 2) [www.electricaltechnology.org](http://www.electricaltechnology.org)
- 3) [www.electrical4u.com](http://www.electrical4u.com)
- 4) [www.learningaboutelectronics.com](http://www.learningaboutelectronics.com)
- 5) <https://www.electronics-tutorials.ws>.

## 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Basic concept and principle of Electrical Engineering	05	06	-	11
2	D.C. Motors	03	03	02	08
3	Transformer	03	03	02	08
4	A.C. Motors	03	03	02	08
5	Introduction to Electronics	06	06	-	12
6	Rectifier and filter circuits	02	04	02	08
7	Amplifier	02	02	02	06
8	Digital Electronics	02	05	02	09
	<b>TOTAL</b>	<b>26</b>	<b>32</b>	<b>12</b>	<b>70</b>



## 12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Shri Dinesh G. Rajmandai	
2	Internal	Shri Nitin G. Farkade	
3	Internal	Shri Nilesh R. Nagose	
4	External	MR. C. K. BERAL	
		Organization: Dr. Sahebji College of Engg. Vileparle.	



## 1. COURSE DETAILS

Programme: Mechanical Engineering  
 Course: #Automation  
 Course Code: AUT190208

Semester: IV  
 Group: A\*  
 Duration: 16 Weeks

## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks (ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	--	--	05	03	70	20	10	70	50	--	50	200

## 3. COURSE OBJECTIVE

Automation is a process of technological development that will proceed into the foreseeable future. Oriented shorter time cycle manufacturing. Robots are probably most recognized tools in the industry. This course will enable the students to understand importance of automation in industry and use automation for manufacturing and assembly systems.

## 4. SKILL COMPETENCY

This aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

**Use different types of automation systems for engineering applications.**

## 5. COURSE OUTCOMES(COs) At the end of the semester student will be able

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Describe the components of automation systems.	Remember, Understand, Apply
CO2	Interlink the different components of automation systems.	Remember, Understand, Apply
CO3	Describe general layout of automation system.	Remember, Understand, Apply
CO4	Use sensors, controllers, drivers, actuators and self-regulated mechanism	Remember, Understand, Apply



## 6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	<b>Introduction to Automation System</b> 1.1 Definition of Automation, semi and fully automatic machine 1.2 Information Processing Cycle-Business functions ,Design, Planning and Control 1.3 Types of Automation- fixed, programmable and fixed. 1.4 Reasons of Automation and USA principal of Automation. 1.5 Strategies of Automation 1.6 Basic Elements of Automated System 1.7 Advance Automated functions 1.8 Levels of Automation	08	10	CO3
2	<b>Hardware components of Automation</b> 2.1 Sensors 2.2 Actuators 2.3 Analog to Digital Converters 2.4 Digital to Analog converters 2.5 Input/output Devices for Discrete data	06	06	CO4
3	<b>Robotics</b> 3.1 Robot Anatomy and Related Attributes- Joints and links, Common robot configurations, Joint drive systems 3.2 Robot control Systems 3.3 End Effectors- grippers and tools 3.4 Industrial Robot Applications- Material handling, processing, assembly and inspection. 3.5 Robot Accuracy and Repeatability	08	12	CO1
4	<b>PLC</b> 4.1 PLC configuration-processor, mounting rack, input output Modules, power supply, programming unit. 4.2 System block diagram, internal relays, oscillators, holding contacts, 4.3 Counters, sequencers, timers, flashers, master control relays, AC motor Starter, AC motor overload protection 4.4 Wiring techniques- PLC power connection, input wiring, Output wiring, and relay outputs. 4.5 Sensor output classification, proximity sensors, encoders, transducers 4.6 comparison between limit switch and proximity switch. 4.7 comparison between conventional relay system and PLC	08	12	CO1



5	<b>Automated Production lines and Automated Assembly systems</b> Fundamentals of automated production systems 5.1 Applications of Automated production lines 5.2 Fundamentals of automated Assembly Systems 5.3 Applications of Automated Assembly Systems	08	12	CO3
6	<b>Automatic Material Transport, storage, Identification, Data capture and Inspection Systems</b> 6.1 AGVS: types, applications , vehicle guidance technology, Vehicle management and Vehicle safety 6.2 Automated storage systems-AS/RS: types, applications, components and operating features - Carousel : types, technique and applications 6.3 Bar code technology 6.4- Radio frequency identification, magnetic stripe, OCR 6.5 Machine vision	10	18	CO2
<b>TOTAL</b>		<b>48</b>	<b>70</b>	

## 7. LIST OF PRACTICALS/ASSIGNMENTS/DRAWINGS

Term Work consists of Journal containing following experiments/exercises.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approximate Hrs required	COs
1	Use of automation in industry.	04	CO1
2	Use of hardware components in automation	04	CO1
3	Use of robot in automation	04	CO2
4	Use of automated production and assembly lines	02	CO3
5	Use of PLC industry	04	CO4
6	Use of AVGS industry	02	CO4
7	Use of AS/RS techniques in industry	04	CO2
8	Use of Carousel in industry	04	CO2
9	Use of bar code and other identification techniques in industry	02	CO4
10	Use of machine vision in industry.	02	CO4
<b>Total</b>		<b>32</b>	

## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Slides
3. Online Resources
4. Industry Visit
5. Guest lecture



## 9. LEARNING RESOURCES

Sr.No.	Title of Book	Author	Publication
1	Automation, production systems and CIM	Mikell grover	Pentice publications
2	PLC	John hackworth	Pearson
3	CAD, CAM and CIM	P Radhakrishnan	New age publication



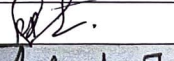
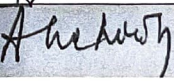
## 10. WEB REFERENCES

1. Automation <https://nptel.ac.in>
2. AGVS <https://www.dematic.com>
3. Robot <https://www.my.ilstu.edu>

## 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Automation System	6	04	-	10
2	Hardware components of Automation	04	02	--	06
3	Robotics	4	04	04	12
4	PLC	--	04	08	12
5	Automated Production lines and Automated Assembly systems	02	04	06	12
6	Automatic Material Transport, storage, Identification, Data capture and Inspection Systems	04	06	08	18
	Total	20	24	26	70

## 12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Shri A. K. Chore	
2	Internal	Shri G.B Deshpande	
3	Internal	Shri P.P. Sawant	
4	External	Shri A.K Chaudhary Organisation: Total Tools Pvt Ltd	



## 1. COURSE DETAILS

<b>Programme: Mechanical Engineering</b> <b>Course: Theory of Machine</b> <b>Course Code: TOM190209</b>	<b>Semester: IV</b> <b>Group: C *</b> <b>Duration: 16 Weeks</b>
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## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks (ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	-----	-----	5	3	70	20	10	70	50	--	25	175

## 3. COURSE OBJECTIVE

The overall objective of this course is to learn how to analyze the motions of mechanisms, develop competency in drawing cam profile for given motions and understand the basic concepts, types and working of various mechanical drives and their applications.

## 4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use principles of kinematics and dynamics in maintenance of various equipment.

## 5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Identify links and mechanisms for various engineering applications	Remember, Understand
CO2	Draw cam profile	Understand, Apply
CO3	Select suitable mechanisms, mechanical drives and devices such as mechanical brakes, friction bearings, Clutches, flywheels and governors	Understand, Apply
CO4	Use velocity and acceleration diagram to find velocities and acceleration of parts of mechanism	Understand, Apply





## 6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	<b>Kinematics</b> 1.1. Statics, Dynamics, Kinetics and Kinematics 1.2. Kinematic links, Kinematic pair and its types, Constrained Motion, Kinematic chain, Mechanism and Inversion 1.3. Simple mechanisms and their inversions, working, applications	04	06	CO1
2	<b>Velocity and Acceleration in Mechanism</b> 2.1 Concept of absolute velocity, relative velocity, absolute acceleration and relative acceleration of a point on a link 2.2 Linear velocity, angular velocity, relation between linear velocity and angular velocity, relation between linear acceleration and angular acceleration 2.3 Graphical method to determine velocity and acceleration of different links in quadric cycle chain and single slider crank chain mechanism 2.4 Numerical on determination of velocity and acceleration of point and link by relative velocity method (up to four link only)	08	08	CO4
3	<b>Cam Drive</b> 3.1 Introduction to Cam drive, applications 3.2 Classifications of Cam and followers 3.3 Terminology in Cam drive, types of follower motion and their displacement diagrams 3.4 Drawing of profile of a radial cam for knife edge, roller and flat faced follower having uniform velocity, simple harmonic motion and uniform acceleration and retardation motion	06	08	CO2
4	<b>Gear Drive</b> 4.1 Introduction to gear drive and applications, advantages and disadvantages of gear drive 4.2 Classifications of gear drive, Spur gear terminology, 4.3 Law of gearing, Introduction to gear train, types of gear train and applications, Train value and velocity ratio for simple, compound, reverted and epi-cyclic gear train 4.4 Numerical on determination of speed of gear wheels in gear trains	06	12	CO3
5	<b>Belt and Chain drive</b> 5.1 Introduction to belt drive, applications, advantages, disadvantages, classification 5.2 Velocity ratio, effect of slip and creep in belt drive, length of belt, working tension, initial tension, centrifugal tension,	08	12	CO3



	<p>5.3 Condition for maximum power transmission</p> <p>5.4 Chain drive and its comparison with belt and gear drive, types of chain</p> <p>5.5 Numerical to find out tensions, power transmission, dimensions of pulleys in Flat belt, V-belt and Rope drive</p>				
6	<p><b>Brake</b></p> <p>6.1 Introduction to brake, classification and application, brake materials</p> <p>6.2 Construction and working of Shoe brake, Band brake, Band and Block brake and Internal Expanding Shoe brake</p> <p>6.3 Numerical to determine braking torque and power transmission in shoe brake, band brake and band and block brake</p>		06	08	CO3
7	<p><b>Friction Bearing</b></p> <p>7.1 Introduction to friction bearing, types of pivot and collar bearings</p> <p>7.2 Uniform Pressure and Uniform Wear Theory</p> <p>7.3 Numerical to determine power lost in friction, dimensions of collar</p>		02	04	CO3
8	<p><b>Clutches</b></p> <p>8.1 Introduction to clutch, types, applications</p> <p>8.2 Construction and working of Single Plate clutch, Multi Plate clutch, Cone clutch and Centrifugal clutch</p> <p>8.3 Numerical to determine dimensions of clutch plate, pressure in plate clutch and power transmitted by clutch. No numerical on centrifugal clutch.</p>		04	08	CO3
9	<p><b>Flywheel and Governor</b></p> <p>9.1 Introduction to Flywheel, functions and applications</p> <p>9.2 Introduction to Governor, function and classification, comparison of Flywheel and Governor</p> <p>9.3 Construction and working of different types of Governor</p>		04	04	CO3
		<b>TOTAL</b>	<b>48</b>	<b>70</b>	



## 7. LIST OF PRACTICAL

Term Work consists of Journal containing minimum ten experiments.

Sr. No.	Title of Experiment	Approximate Hrs required	COs
1	Kinematics Terminology	02	CO1
2	Simple Mechanisms and their Inversions	04	CO3
3	Velocity Diagram	04	CO4
4	Acceleration Diagram	04	CO4
4	Gear Classification	02	CO3
5	Spur Gear terminology	02	CO3
6	Epi-cyclic gear train	02	CO3
7	Cam Drive	02	CO3
8	Cam Profile	04	CO2
9	Belt Drives classification	04	CO3
10	Slip and Creep in Belt Drive	02	CO3
11	Differential gear box	02	CO3
12	Mechanical drives	02	CO3
13	Flywheel and Governor	04	CO3

## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Slides
3. Online Resources
4. Demonstration of models

## 9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Theory of Machines	Khurmi R.S., Gupta J.K.	S.Chand and Company Ltd., New Delhi.
2	Theory of Machines	Ratan S.S.	McGraw-Hill Education
3	Theory of Machines	Ballaney P.L.	Khanna Publishers, New Delhi.
4	Theory of Machines	Bevan Thomas	Pearson Education India, New Delhi
5	A Text Book of Theory of Machines	Bansal R.K. and Brar J.S.	Laxmi Publication, New Delhi





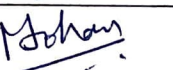

## 10. WEB REFERENCES

1. [www.technologystudent.com/gears1/geardex1.htm](http://www.technologystudent.com/gears1/geardex1.htm)
2. <http://www.technologystudent.com/>
3. <https://engineering.library.cornell.edu/kmoddl>
4. <https://www.tecquipment.com/theory-of-machines>
5. [https://en.wikipedia.org/wiki/Canadian\\_Committee\\_for\\_the\\_Theory\\_of\\_Machines\\_and\\_Mechanisms](https://en.wikipedia.org/wiki/Canadian_Committee_for_the_Theory_of_Machines_and_Mechanisms)

## 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Kinematics	06	---	---	06
2	Velocity and Acceleration in Mechanism	----	----	08	08
3	Cam Drive	---	02	06	08
4	Gear Drive	02	10	----	12
5	Belt and Chain drive	02	04	06	12
6	Brake	----	08	----	08
7	Friction Bearing	-----		04	04
8	Clutches		08	----	08
9	Flywheel and Governor		04		04
	Total	10	36	24	70

## 12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Shri G.J.Badwe	
2	Internal	Shri A.D. Bele	
3	Internal	Shri S.B.Wasnik	
4	External	Shri Mangesh Mohan	
		Organisation: Fr. Agnel Polytechnic, Bandra	



## 1. COURSE DETAILS

<b>Programme: Mechanical Engineering</b> <b>Course: #Industrial Fluid Power</b> <b>Course Code: IFP190210</b>	<b>Semester: IV</b> <b>Group: A*</b> <b>Duration:16 Weeks</b>
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## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks (ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hou	Marks							
03	02	--	--	05	03	70	20	10	70	50	--	50	200

## 3. COURSE OBJECTIVE

Hydraulic and pneumatic operated machines and equipment are widely used in various industries due to its versatility and adaptability to automation. Diploma engineers has to operate and maintain such systems in different segments of industries. This competency needs the knowledge of construction and working of different components of hydraulic and pneumatic systems. This course will give the students, the basic skills and knowledge to use and maintain different types of hydraulic systems and pneumatic systems.

## 4. SKILL COMPETENCY

This aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

**Use different types of hydraulic and pneumatic systems for engineering applications.**

## 5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Identify various components of hydraulic & pneumatic systems.	Remember, Understand, Apply
CO2	Select pump and actuators for given fluid operated system.	Remember, Understand, Apply
CO3	Select appropriate control valves for given fluid operated system.	Remember, Understand, Apply
CO4	Select compressor and appropriate accessories for given fluid operated system.	Remember, Understand. Apply
CO5	Develop different hydraulic circuits for given simple application.	Remember, Understand. Apply
CO6	Develop different pneumatic circuits for given simple application.	Remember, Understand. Apply



## 6. COURSE CONTENTS

Ch. No.	TOPIC/Sub-topic	Hours	Marks	COs
1.	<b>Introduction to Hydraulic System</b> 1.1 General Layout of Hydraulic System. 1.2 Merits & Demerits of Hydraulic System. 1.3 Applications of Hydraulic System. 1.4 Properties of fluid, ISO and SAE grades of oil 1.5 ISO symbols used in hydraulic and pneumatic system	02	04	CO1
2.	<b>Pumps and Control Valves for Hydraulic System</b> 2.1 Introduction, Classification and Symbols of pump. 2.2 Construction and working of <i>Gear Pump</i> : External, Internal and Gerotor pump. <i>Vane Pump</i> : Balanced vane and unbalanced vane pump. <i>Piston Pump</i> : Axial, Radial and Bent axis piston pump. 2.3 Performance characteristics and Selection criteria for pump 2.4 Classification and function of different types of control valves. 2.5 Construction, Working & Symbols of <i>Pressure Control Valves</i> : Simple Pressure Relief, Pressure Reducing and Pressure Unloading valve, Sequence Valve (Counter Balance), Pressure Override. <i>Direction Control Valves</i> : 2/2, 3/2, 4/2, 4/3 closed center direction control valve (Spool Type/Seat & Poppet Type). Symbolic representation of methods of actuation for DCV. <i>Flow Control Valves</i> : Pressure compensated, Non-Pressure Compensated FCV and check valve.	08	12	CO2 CO3
3.	<b>Actuators &amp; Accessories for Hydraulic System</b> 3.1 Classification 3.2 Construction, Working & Symbols of <i>Linear Actuators</i> : Single Acting, Double Acting, Double Acting with Double Piston Rod, Tandem & Telescopic cylinder. <i>Rotary Actuators</i> : Hydraulic Motors (Symbol). 3.3 Calculation of Force acting on piston during forward and return stroke, velocity etc. (Simple Numerical) 3.4 Accessories: Pipes, Hoses, Fittings, Oil Filters, Seals & Gasket, Accumulators (Dead Weight, Spring Loaded, Gas Pressurized).	04	06	CO2 CO4
4.	<b>Hydraulic Circuits</b> 4.1 Symbols and their labels of components. Construction and working of basic hydraulic circuits such as meter-in, meter-out, bleed off, regenerative circuits. 4.2 Construction & Working of Sequential Circuit for a given sequence (Max up to Two Actuators) 4.3 Step Displacement Diagram, Construction & Working of hydraulic circuits used in Shaper, Milling etc. 4.4 Trouble Shooting of Various Components of Hydraulic Circuit/System	10	14	CO5



Ch. No.	TOPIC/Sub-topic	Hours	Marks	COs
5.	<b>Introduction to Pneumatic System</b> 5.1 General Layout of Pneumatic System. 5.2 Merits & Demerits of Pneumatic System. 5.3 Applications of Pneumatic System. 5.4 Comparison of Pneumatic System with Hydraulic System	02	04	CO1
6.	<b>Control Valves for Pneumatic System</b> 6.1 Classification and function of control valves. 6.2 Construction, Working and Symbol of Pressure Regulator (Without its types) and its selection criteria <i>Direction Control Valves:</i> 5/2 direction control valve (Sliding spool type and Pilot operated). <i>Flow Control Valves:</i> Fixed and Variable FCV, Shuttle valve, Quick Exhaust Valve, Pilot operated Check Valve 6.3 Time Delay Valve.	04	06	CO3
7.	<b>Actuators and Accessories for Pneumatic System</b> 7.1 Classification. 7.2 Construction, Working & Symbols of <i>Linear Actuators:</i> Single Acting, Double Acting cylinder <i>Rotary Actuators:</i> Air Motor (Symbol). 7.3 Calculation of Force acting on piston during forward and return stroke, velocity (Simple Numerical) 7.4 <i>Accessories:</i> Pipes, Hoses, Fittings, Air Filters, Water trap, F-R-L Unit, cylinder mountings. 7.5 Selection criteria for Compressor (Without its types) 7.6 Comparison of Air motor with hydraulic and electric motor.	04	06	CO2 CO4
8.	<b>Pneumatic Circuits</b> 8.1 Symbols and their labels of components. 8.2 Pneumatic circuit to control of single acting and double acting cylinder using pilot operated valve, flow control valve, solenoid valve, roller operated valve etc., Impulse Circuit, Delay circuits 8.3 Step Displacement Diagram, Construction & Working of Sequential Circuit for a given sequence (Max up to Two Actuators) 8.4 Sequential circuit using shift register and cascade method (with repeating stroke of same actuator with/ without delay) for different applications 8.5 Pneumatic circuit to control speed of unidirectional & bi-directional motor	14	18	CO6
	<b>Total</b>	<b>48</b>	<b>70</b>	



## 7. LIST OF PRACTICALS/ASSIGNMENTS/DRAWINGS

Term Work consists of Journal containing following experiments/exercises.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx. Hrs. required	COs
1	Identify the components of hydraulic and pneumatic trainers.	02	CO1
2	List and draw ISO symbols used in hydraulics and pneumatics.	02	CO1
3	Use of pump and actuators mounted on hydraulic trainer.	02	CO2
4	Use of control valves in hydraulics and pneumatics.	02	CO3
5	Use of compressor, FRL unit, special valves and accessories of pneumatics.	02	CO4
6	Construct and actuate hydraulic circuit for single acting, double acting cylinder and hydro motor.	02	CO4
7	Construct and actuate meter-in, meter-out and sequencing hydraulic circuit.	04	CO5
9	Develop circuit for simple machine tool applications such as milling machine, shaper machine, grinding machine.	02	CO5
10	Construct and actuate pneumatic circuit for single acting cylinder, double acting cylinder and Air motor.	02	CO6
11	Construct and actuate speed control pneumatic circuits.	02	CO6
12	Construct and actuate indirect/ pilot control pneumatic circuits.	02	CO6
13	Develop any suitable sequencing pneumatic circuit.	02	CO6
14	Construct and actuate pneumatic circuit for Logic functions (AND/ OR)	02	CO6
15	Individual presentation on following topic(s) <ul style="list-style-type: none"> <li>• Accessories</li> <li>• Recent trends</li> <li>• Rotary actuators</li> <li>• Application</li> </ul>	04	CO2 CO4 CO5 CO6
16	Mini Project (model) on Industrial application/ components etc. and circuit simulation on Fluidsim Software.	Parallel	CO5 CO6
<b>Total</b>		<b>32</b>	

## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Slides
3. Online Resources
4. Industry Visit
5. Guest lecture





## 9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Oil Hydraulic System- Principles and Maintenance	Majumdar S.R.	Tata McGraw Hill, ISBN:9780074637487
2	Pneumatics Systems Principles and Maintenance	Majumdar S.R.	Tata McGraw Hill, ISBN-978-0-07-460231-7
3	Fluid Power with applications	Anthony Esposito	Pearson Education, Inc 2000, ISBN 81-7758580-0
4	Hydraulics and Pneumatics	Harry Stewart	Taraporewala Publication, ISBN:978-0672234125
5	Pneumatic Controls	Joji B.	Wiley India Pub. ISBN:978-8126515424
6	Hydraulics & Pneumatics A Technicians & Engineers Guide	Andrew Parr	Butterworth-Heinemann Publisher, ISBN: 9780080966755
7	Industrial Hydraulics Manual	--	Vickers Systems International (Company Manual)
8	Product Catalogue of FESTO	--	Company catalogue
9	Animation softwares for hydraulics and pneumatics	--	

## 10. WEB REFERENCES


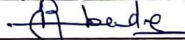

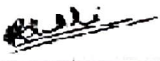
- Hydraulic Pumps: [https://en.wikipedia.org/wiki/Hydraulic\\_pump](https://en.wikipedia.org/wiki/Hydraulic_pump)
- <https://www.hydraulicspneumatics.com/fluid-power-basics>
- Animation of Hydraulic pumps: <https://www.youtube.com/watch?v=Qy1iV6EzNHg>
- Animation of Hydraulic pumps: <https://www.youtube.com/watch?v=pWuxYnqYDnk>
- Eaton Pump assembly: <https://www.youtube.com/watch?v=sEVTIRYHoGg>
- Video lectures of IIT Faculty :<http://nptel.ac.in/courses/112105047/>
- Lecture series and notes by IIT faculty: <http://nptel.ac.in/courses/112106175/>
- Pneumatic control valves animation: <https://www.youtube.com/watch?v=XAItnsUcES0>
- Control valve symbol generation: <https://www.youtube.com/watch?v=yIot4shcOkE>
- Animation of D.C Valve: <https://www.youtube.com/watch?v=jsMJbJQkGTs>
- Animation of 4/2,4/3 D.C Valves: <https://www.youtube.com/watch?v=CQPwwWXbV3w>
- Animation of Hydraulic cylinder: <https://www.youtube.com/watch?v=bovfDsAYSbc>
- Telescopic cylinder animation: <https://www.youtube.com/watch?v=icaqvFAccY>



## 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Hydraulic System	02	02	-	4
2	Pumps and Control Valves for Hydraulic System	04	04	04	12
3	Actuators & Accessories for Hydraulic System	01	04	01	06
4	Hydraulic Circuits	04	04	06	14
5	Introduction to Pneumatic System	-	--	04	04
6	Control Valves for Pneumatic System	02	02	02	06
7	Actuators and Accessories for Pneumatic System	02	02	02	06
8	Pneumatic Circuits	04	04	10	18
	<b>Total</b>	19	22	29	70

## 12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Shri Virag A. Timbadia	
2	Internal	Shri Roshan R. Ambade	
3	Internal	Shri Ashutosh S. Shukla	
4	External	<b>Shri Abrar Khulli</b> Organization: L & T Ltd	



### 1. COURSE DETAILS

<b>Programme: Mechanical Engineering</b> <b>Course: Power engineering and refrigeration</b> <b>Course Code: PER190211</b>	<b>Semester:IV</b> <b>Group:C*</b>  <b>Duration:16 Weeks</b>
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### 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	----	----	05	03	70	20	10	70	25	---	25	150

### 3. COURSE OBJECTIVE

Automobile, power and cold storage are crucial field for mechanical engineering. Power engineering and refrigeration course will help to analyse working, performance of I C engine, air compressor, gas turbine and jet propulsion and refrigeration to effectively render services in industries. This course will also enlighten about impact of the emission on environment and its control.

### 4. SKILL COMPETENCY :

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

**Maintain power engineering and refrigeration devices**

### 5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Identify different components and working of IC engines and its auxiliaries	Remember, Understand and apply
CO2	Test the performance of IC engine and its exhaust emission and control	Understand and apply
CO3	Test the performance of air compressor.	Remember, Understand and apply
CO4	Identify different components and working of gas turbine and jet propulsion	Remember and Understand
CO5	Identify different components, working of refrigeration	Remember and Understand



## 6. COURSE CONTENTS

Sr No	Topic/Subtopic and contents	Hours	Marks	CO%
1	<p><b>Internal combustion engine</b></p> <p><b>1.1 Basic of IC engine:</b> Engine terminology, classification of IC engine, construction and working of 2 stroke and 4 stroke engines, necessity of scavenging, comparison of 2 stroke and 4 stroke engines, comparison of SI and CI engines.</p> <p><b>1.2 Power cycles:</b> Calculation for air standard efficiency of Otto cycle, diesel cycle and dual cycle, actual indication diagrams for 4 stroke SI and CI engine.</p> <p><b>1.3 IC engine auxiliaries:</b> valve timing diagram for 4 stroke SI and 2 stroke CI engine, introductory concept of VTVT, VVT &amp; VVT-I and I-VTEC engines.</p> <p><b>1.4 Supercharging and turbocharging:</b> Concept and advantages,</p> <p><b>1.5 Electronic MPFI:</b> components (no explanation), working and various sensors used, pump and injectors, EGR layout and working, Electronic common rail direct injection diesel engines CRDI, BS 6 standards for SI and CI engine</p>	14	20	CO1
2	<p><b>Testing and emission control of IC engine</b></p> <p><b>2.1 IC engine testing parameter:</b> Calculation of IP, BP, thermal and Mechanical efficiency, BSFC, Morse test(simple numerical), heat balanced sheet(simple numerical)</p> <p><b>2.2 Combustion in IC engine:</b> stages of combustion in SI and CI engine, firing order and its importance, Knocking in SI engine and its effect on engine, Octane and Cetane number</p> <p><b>2.3 Exhaust emission and control:</b> IC engine emission and their pollutants, effect on environment, exhaust emission measurement techniques, NDIR,</p> <p><b>2.4 Emission control:</b> catalytic converter, SCR. Engine control unit( ECU): working</p>	10	16	CO2
3	<p><b>Air compressors</b></p> <p><b>3.1 Reciprocating compressor:</b> Applications, working of single stage and two stage compressors with PV diagrams and intercooling.</p> <p><b>3.2 Testing of reciprocating air compressors:</b> Pressure ratio, compressor capacity, FAD, volumetric efficiency, isothermal efficiency,</p> <p><b>3.3 Rotary compressors:</b> screw, centrifugal, lobe type, vane type compressors and axial flow compressors. Comparison of rotary and reciprocating compressor</p>	08	14	CO3



4	<b>Gas turbine and Jet propulsion</b> <b>4.1 Types of gas turbines:</b> Constant pressure, open cycle and closed cycle gas turbine comparison, Joule or Brayton cycle, applications. Numerical for finding efficiency. <b>4.2 Jet propulsion:</b> classification, working of turbojet, turbo prop and turbo shaft engine. <b>4.3 Rocket propulsion:</b> liquid and solid propellant systems.	08	10	CO4
5	<b>Refrigeration</b> <b>5.1 Basic of refrigeration:</b> Definitions Tone of refrigeration (TR), refrigerating effect, EER (COP), and refrigerant. Methods of refrigeration, <b>5.2 Refrigeration cycle:</b> reverse Carnot cycle, simple Vapour compression cycle and numerical on finding COP for the given enthalpies, definitions of global warming potential (GWP), ozone depletion potential (ODP), total equivalent warming impact (TEWI), Life cycle climate performance (LCCP). <b>5.3 Application:</b> construction and working of domestic refrigerator	08	10	CO5
<b>Total</b>		48	70	

## 7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

It contains study based practical and the practice on assignment to understand the topic in detail.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx. Hrs required	COs
1	Study of two stroke and four stroke engine with working model/ Testing on Three Cylinder Four Stroke Petrol Engine Test Rig	04	CO1
2	Testing on PC Based Single Cylinder Four Stroke Diesel Engine Test Rig	04	CO1
3	Dismantling/ mantling of I C engine	04	CO1
4	Study of study of exhaust gas recirculation and analyzer	04	CO1
5	Study of gas turbine and jet propulsion	04	CO3
6	Study of air compressor	04	CO4
7	Study of domestic refrigerator	04	CO5
8	Assignments on power cycle, IC engine testing, testing of reciprocating compressor	04	CO1, CO2, CO3
<b>Total</b>		<b>32</b>	

## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Slides
3. Online Resources



## 9. LEARNING RESOURCES

Sr. No	Title of Book	Author	Publication
1	Internal combustion engine.	Mthur M L, Sharma R P	Dhanpatrai publications (p) ltd, New Delhi
2	A textbook of internal combustion engine	Rajput R K	Lakshmi publications New Delhi
3	Fundamentals of internal combustion engine	H N Gupta	PHI learning private ltd
4	Thermal engineering	P L Ballaney	Khanna publisher, Delhi
5	Refrigeration and air conditioning	R S Khurmi J K Gupta	S Chand publication, New Delhi

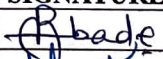



## 10. WEB REFERENCES

1. <https://aermech.com/mpfi-multi-point-fuel-injection-systemelectronic-fuel-injection/>
2. ARAI Indian Emission Control Regulations
3. <https://soaneemrana.org/onewebmedia/GAS%20TURBINE%20AND%20JET%20&%20ROCKET%20PROPULSION1.pdf>

## 11 SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Internal combustion engine	06	08	06	20
2	Testing and emission control of IC engine	-	06	10	16
3	Air compressors	04	06	04	14
4	Gas turbine and Jet propulsion	04	06	-	10
5	Refrigeration	04	06	-	10
	Total	18	32	20	70

## 12 COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Shri R R Ambade	
2	Internal	Shri S B Wasnik	
3	Internal	Shri A D Bele	
4	External	Dr. Balawant Bhasme	
		Organisation: Sardar Patel College of Engineering	



### 1. COURSE DETAILS

<b>Programme: Mechanical engineering</b> <b>Course: Machining Processes</b> <b>Course Code: MPR190212</b>	<b>Semester: IV</b> <b>Group: C*</b> <b>Duration:16 Weeks</b>
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### 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week													
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
02	04	--	--	06	--	--	--	--	--	50	-	50	100

### 3. COURSE OBJECTIVE

It helps the students to understand various types of machines and processes used in manufacturing industry. It also helps to understand about various types of work holding and tool holding devices and tools used on machines to improve various machining parameters.

### 4. SKILL COMPETENCY

This course helps the students to understand working and applications of conventional manufacturing processes to produce quality components as per specifications.

### 5. COURSE OUTCOMES (COs)

At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Identify and Describe various manufacturing processes for manufacturing different components.	Remember Understand
CO2	Produce component using lathe machine with safety practices	Understand Apply
CO3	Produce component using milling machine with safety practices	Understand Apply
CO4	Prepare CNC Part programs for simple components	Remember Understand Apply



## 6. COURSE CONTENTS

Sr. No.	TOPIC /Sub-Topics	Hours	Marks	COs
1	<p><b>The Lathe</b></p> <p>1.1 Introduction</p> <p>1.2 Types of Lathe – Speed, Engine, Capstan &amp; Turret - turret indexing mechanism, tool holding devices, differentiation, Automatic, Bench, Tool room</p> <p>1.3 Screw Cutting Mechanism, Feed Mechanism</p> <p>1.4 Accessories and Attachments: Lathe Centers, Catch Plates and Carriers, Chucks: Three jaw, Four jaw and Magnetic, Face Plate, Angle Plate, Mandrel- Plane, Step and Collar</p> <p>1.5 Lathe Operations: Taper Turning, Thread Cutting, Drilling, knurling, Chamfering, Reaming, Boring, And Grooving.</p> <p>1.6 Single Point Cutting Tool: Nomenclature, Applications</p> <p>1.7 Introduction to Process Parameters (Speed, Feed, Depth of Cut)</p>	06	-	CO1 CO2
2	<p><b>Drilling</b></p> <p>2.1 Introduction</p> <p>2.2 Types: Portable, Sensitive, Upright, Radial, Gang Drilling, multiple spindle and automatic drilling machine</p> <p>2.3 Work Holding Devices: T-bolt and clamp, Drill press, Vice, Step Block, V-block, Angle Plate, Drill Jig</p> <p>2.4 Tool Holding Devices: Spindle, Sleeve, Socket, and Chuck, Special attachment Drill Machine Operations: Drilling, Reaming, Boring, Counter-boring, Counter-sinking, Spot Facing, Tapping, Lapping.</p> <p>2.5 Drilling Machine Tools: Drill, Types of drill- Flat, Straight Fluted, Center, Taper shank drill</p>	04	-	CO1





	2.6	Twist Drill Nomenclature, Drill Material, Cutting Parameters (Speed, Feed, Depth of Cut, machining time)			
3	3.1	<b>Milling</b> Introduction, Types: Column and Knee, Fix bed, Planer and special	06	-	CO1 CO3
	3.2	Work Holding Devices: T bolt and Clamps, Angle Plate, V-block, Vice, Fixture.			
	3.3	Cutter Holding Devices: Arbor, Collets, Adapter, Spring Collet, Bolted Cutters and milling machine attachments			
	3.4	Standard milling cutter, its classification and applications, Nomenclature of plain milling cutter and cutting parameters			
	3.5	Milling machine Operations: Plain, Face, Side, Straddle, Angular, Gang, Form, Profile and End milling, Milling keyways, grooves and slots			
	3.6	Dividing Head, Types, function of dividing Head, Method of Indexing, Index Plate			
4	4.1	<b>Hot and Cold Working</b> Hot Working: Introduction, Methods: Rolling, Drawing Extrusion, Spinning, Forging	04	-	CO1
	4.2	Cold Working: Introduction, Methods: Rolling, Forging, Drawing, Bending, Spinning, Squeezing			
5	5.1	<b>Other Machining Processes</b> Introduction, basic construction & working of Planer, Broaching, Boring, Slotting, Sawing machines and its advantages, limitations and applications	06	-	CO1
6	6.1	<b>CNC Turning</b> Introduction, CNC Machine- Types, classification, working, constructional features, advantages, limitations.	06	-	CO1 CO4
	6.2	Elements of CNC- Types, Working			



	6.3	CNC Tooling- tool presenting, tool holder, types, Position & Motion control in NC machine			
	6.4	CNC part programming: Programming format, Structure of part programming G- code, M- code for various lathe operations.			
		Total	32	-	

## 7. LIST OF PRACTICALS/JOB/DEMONSTRATIONS/ASSIGNMENTS

Term Work consists of Journal containing minimum 06 nos of Assignments and minimum 02 nos of practical jobs.

Sr. No.	Topic	Practical exercises	Approx. Hrs. Required	COs
1	<b>Lathe</b>	Individual Job consisting of following activities and operations:		CO1 CO2
		Demonstration of Lathe machine and its parts, tools used and its Settings, Safety precautions to be followed	02*	
		Study of job/ part drawing and planning the sequence of operation	02*	
		Facing	02*	
		Straight turning	02*	
		Step Turning	04*	
		Taper turning	02*	
		Eccentric turning	02	
		Parting Off	02	
		Knurling	02	
		Under Cutting	02	
		Thread Cutting	02*	
		Chamfering	02*	
		Forming	02	
2	<b>Milling</b>	Demonstration of Job consisting of following activities and doing the same in a group of Four Students:		CO1 CO3



		Study of Drawing, preparing a process plan, selection of tools, setting of speed, feed and depth of cut	02*	
		Plane Milling or Slab Milling	02*	
		Producing Flat Surface	04*	
		Producing Slots	02	
		Producing Grooves	02	
3	Drilling	Understanding Construction of Drilling	02*	CO1
		Job consisting drilling and or reaming operations	02	
4	CNC Turning	Understanding construction of CNC Turning and function of various parts	02*	CO1 CO4
		Setting of Tool and Job in the Fixture	02	
		Preparing/Feeding CNC programme	02	
		Demonstration of Job consisting of operations such as Facing, Turning, Taper Turning, Step Turning	02*	
		Preparing CNC part programme for two jobs for individual students consisting of Part Drawing Sequence of Operations Programming using G and M code	12*	
	<b>Total</b>		64	

**Note:** A judicial mix of minimum 48 or more practical need to be performed, the practical's marked as \* are compulsory.

1. The instructor shall give demonstration to the students by preparing a specimen job as per the job drawing.
2. The workshop diary shall be maintained by each student duly signed by instructor of respective shop and certified by charge man/foreman in-charge
3. Workshop diary should contain
  - a. Safety precautions in Machine shop.
  - b. Part Drawings/Designs of the job and procedure/methodology adopted for preparing respective jobs
4. Journal consisting of Study assignments should be certified by the lecturer in-charge.

## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Demonstration
3. Preparation of jobs



## 9. LEARNING RESOURCES


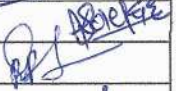

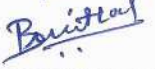
Sr. No.	Title Of Book	Author	Publication
1.	Workshop Technology Vol-I (Manufacturing Processes)	S.K. Hajara Chaudhary	Media Promotors and Publishers ,New Delhi
2.	Production Technology	R K Jain	Khanna Publishers, New Delhi
3.	Workshop Technology	H.S.Bawa	Tata McGraw Hill Publishers,New Delhi
4.	Workshop Technology	B.S. Raghuwanshi	Dhanpat Rai and Sons, New Delhi
5.	Workshop Technology Vol- II (Machine Tools)	S.K. Hajara Chaudhary	Media Promotors and Publishers ,New Delhi

## 10. WEB REFERENCES

1. <https://nptel.ac.in/courses/112105127/pdf/LM-23.pdf>
2. <https://nptel.ac.in/courses/112105126/1>
3. <https://nptel.ac.in/courses/112105127/pdf/LM-18.pdf>
4. [https://www.unidue.de/~kte010/modularte/html/main\\_modules/thoughtData/98/lathe%20son.pdf](https://www.unidue.de/~kte010/modularte/html/main_modules/thoughtData/98/lathe%20son.pdf)
5. <https://archive.hnsa.org/doc/pdf/lathe.pdf>
6. <https://nptel.ac.in/courses/112103174/38>
7. [https://www.engr.uvic.ca/~mech410/CAM\\_references/CNC\\_Computer\\_Numerical\\_Control\\_Programmig\\_Basics.pdf](https://www.engr.uvic.ca/~mech410/CAM_references/CNC_Computer_Numerical_Control_Programmig_Basics.pdf)
8. [http://www.iitg.ac.in/engfac/ganu/public\\_html/Metal%20forming%20processes\\_full.pdf](http://www.iitg.ac.in/engfac/ganu/public_html/Metal%20forming%20processes_full.pdf)
9. <http://rajanmital.tripod.com/sitebuildercontent/sitebuilderfiles/hotandcoldworking.pdf>
10. <https://nptel.ac.in/courses/112105127/pdf/LM-20.pdf>
11. <http://mechanical.srpec.org.in/Labs/LEXEQ/L4.pdf>



## 11. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Shri Pravin R. Parate	
2	Internal	Shri Shankar C. Kolekar	
3	Internal	Shri Pratik P. Sawant	
4	External	Shri Mahendra Bhor Organisation- MCGM- Sub Engineer	



## 1. COURSE DETAILS

<b>Programme: Mechanical Engineering</b> <b>Course: #Automobile Engineering</b> <b>Course Code:AEG190213</b>	<b>Semester: IV</b> <b>Group: A* Elective</b> <b>Duration:16 Weeks</b>
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## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	-----	-----	05	03	70	20	10	70	50	-----	50	200

## 3. COURSE OBJECTIVE

The Automobile industry has got its recognition as the prime industry by virtue of its contribution to the overall economy and generation of employment. Automotive professional is responsible for a wide variety of tasks, requiring strong technical knowledge and mechanical skill. This course provides broad knowledge about different vehicle layouts, transmission systems, control systems, electrical systems and steering systems, vehicle maintenance. This knowledge will be helpful to the student in co-relating various automobile systems with each other and provide good practical input with theoretical knowledge for technological advancement of society.

## 4. SKILL COMPETENCY:

The aim of this course is to help the students to develop required knowledge and skills to attain the following industry identified competency through various teaching learning experiences.

**“Knowledge and skills regarding basic concepts, principles, constructional details and working of an automobile vehicle; interpret and prepare preventive maintenance plan, supervise production and maintenance of automobile vehicles in automobile industry”.**

## 5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	Course Outcome	Bloom's level
CO 1	Interpret different types of automobiles, vehicle layouts and different systems, subsystems used in automobile.	Remembering Understanding
CO 2	Trouble shoot mechanism of transmission system, control system.	Remembering Understanding
CO 3	Select an appropriate type of wheel, tyre and suspension system	Understanding Apply
CO 4	Trace simple electrical-electronic circuits relevant to automobile systems	Remembering Understanding
CO 5	Select the appropriate Service tools for relevant service operation in automobile shops.	Understanding Apply



## 6. COURSE CONTENTS

Sr. No.	Topic/Sub-topic	Hours	Marks	COs
1	<p><b>Introduction to Automobile</b></p> <p>5.1. <b>Definition of Automobile-</b> Classification of automobiles, Major components of automobiles with their function and location</p> <p>5.2. <b>Vehicle Layout</b> - Layout of vehicle such as front engine rear wheel drive, front engine front wheel drive, rear engine rear wheel drive, four wheels drive their advantages and comparisons. Two and four wheeler chassis layout of an automobile vehicle.</p> <p>5.3. <b>Function of Chassis, Frame and Body</b> - Types and basic Nomenclature of car body. Introduction to aerodynamic body shapes, Basic terms related with Car Aerodynamics (e.g. Drag, Lift, Skin Friction, Form Drag, Wake, Coefficient of Drag etc.) classification of chassis, frame with advantages, disadvantages. Requirement of Chassis Frame and Body, load acting on frame.</p> <p>5.4. <b>Introduction to alternative energy sources</b> – LPG/CNG - Need, Cost, Advantages, Limitations Emission, Safety</p> <p>5.5. <b>Layout, Working, Advantages, Limitations-</b> Electrical, Hybrid vehicle.</p>	07	12	CO1
2	<p><b>Transmission Systems</b></p> <p>2.5 <b>Function and Necessity of Clutch</b> and purpose of clutch, types and construction of clutches as coil spring type and diaphragm type.</p> <p>2.6 <b>Need and Requirement of Transmission system</b> - Components and their functions(Gear Box) - Working,</p> <p>2.7 Construction Classification of Gear Box (Manual, Semi-Automatic and Automatic Transmission)</p> <p>2.8 <b>Manual Transmission</b> – Construction and working of Constant Mesh and Synchromesh Gear Box with power flow diagrams, Trouble Shooting of Manual Transmission. Synchromesh, Epicyclic, Torque converter, Overdrive, Transfer case, Freewheel unit.</p> <p>2.9 <b>Semi-Automatic Transmission</b> – Construction and working of Over Drive.</p> <p>2.10 <b>Automatic Transmission</b> – Construction, working and Function of – Torque Converter and Epicyclic gear Train.</p> <p>2.11 <b>Propeller shaft-</b> Necessity, Construction, Working, and functions of Propeller Shaft, universal and slip joints.</p> <p>2.12 <b>Final Drive</b> – Function, Need, Principle, Construction, Working and function of Differential</p> <p>2.13 <b>Axle</b> – Significance of Live and Dead Axle, Types of Front Axle – Construction, Working and Function of - Hotchkiss and torque tube drives, Types of Rear Axle – Construction, Working, Function of - full floating axle, semi floating and three quarter floating axle.</p>	10	14	CO2
3	<p><b>Control Systems</b></p> <p>3.1 <b>Braking System</b></p> <p>3.1.1 <b>Function and Requirement of braking system</b> -Types of automotive braking systems for four Wheeler vehicles.</p>			



Sr. No.	Topic/Sub-topic	Hours	Marks	COs
	<p>Leading and trailing brakes. Basic Terms related to Braking system (Stopping Distance, Braking Efficiency, and Fading of Brakes.</p> <p>3.1.2 <b>Types of Braking System</b> - Layout, Construction, Working and Comparison of Drum and Disc Brakes, Hydraulic and Air Brakes. Construction and Working of Master Cylinder, Tandem Master Cylinder, Introduction to ABS, Layout of ABS, Need and general procedure of Bleeding of Brake, Trouble Shooting of Braking System, Properties and Types of Braking Fluid.</p> <p>3.2 <b>Automobile Steering System</b> -</p> <p>3.2.1 <b>Requirement of steering system Wheel Geometry-</b> caster, camber, king pin inclination, Toe In and Toe Out, castor and their effect, Over steering, Under Steering.</p> <p>3.2.2 <b>Steering Gear Box construction and working of -</b> Recirculating Ball Type and Rack and Pinion. Introduction to Power steering.- Construction and Working - Hydraulic.</p>	07	09	CO2
4	<p><b>Suspension System</b></p> <p>4.1 <b>Automobile Suspension System</b> Necessity and Classification of Suspension System.</p> <p>4.1.1 <b>Function and Requirement of Rigid Suspension System</b> - Basic Terms Related with Suspension System: (Jounce, Rebound, Sprung and Unsprung Weight, Spring Rate, Elasticity), Construction, Working and Types of Leaf Springs.</p> <p>4.1.2 <b>Function and Requirement of Independent Suspension System</b> -Advantages of Front Wheel Independent Suspension, Construction and working of Wishbone type, MacPherson type.</p> <p>4.1.3 <b>Shock Absorbers and Air Suspension</b> -Layout of Air Suspension, Construction and Working of Air Suspension, Function and Types of Shock Absorber, Principle of Hydraulic Shock Absorber, Construction and Working of Telescopic Shock Absorber, Constructional Features of Gas Filled Shock Absorber.</p> <p>4.2 <b>Wheels, Rims and Tyres</b> -</p> <p>4.2.1 <b>Function, Necessity and Requirement of Wheel, Rim and Tyres:</b> Types of Wheels - spoked, disc, light alloy cast, Rims and Tyres, Construction and Working of Different Types of Wheels, Rims and Tyres. Tyres- types-redial ply, cross ply, tubeless.</p> <p>4.2.2 <b>Tyre Economy:</b> Consideration in Tyre Tread Design, Desirable properties, Factors affecting to Tyre Life, Tyre Wear and Rotation, Tyre Designation, Tyre specifications.</p> <p>4.2.3 <b>Wheel Alignment and Balancing:</b> Purpose of Wheel Alignment, Procedure of Wheel Alignment, Tools and equipment used for Wheel Alignment and Balancing.</p>	09	16	CO3





Sr. No.	Topic/Sub-topic	Hours	Marks	COs
5	<p><b>Electrical Systems</b></p> <p>5.1 <b>Battery</b> - Function and requirements of battery, types of battery, principle, construction and operation of lead acid automotive battery, battery capacity, Battery ratings, Battery tests - Battery Open Volt and Specific Gravity Test, Salient Features of Maintenance Free Battery.</p> <p>5.2 <b>Charging System</b> - Need of charging system, construction and operation of charging system, alternator principle, construction and working.</p> <p>5.3 <b>Starting System</b> - Need of starting system, layout, and construction of starting motor, standard Bendix drive.</p> <p>5.4 <b>Lighting System</b> - Layout of lighting system of two wheeler and four wheeler, Wiring harness, cable color codlings.</p> <p>5.5 <b>Ignition System and their Components</b> - Function and Requirement of Ignition System, Types of Ignition System, Construction and Working of Battery Ignition, Magneto Ignition and Electronic Ignition System with advantages, disadvantages, application and sketches, Salient Features of CDI</p> <p>5.6 <b>Lighting System</b> - Function and Requirements of Lighting Systems, Types of Lights, Necessity and Importance of Cable Color Codes, Wiring Harness, Layout of Lighting Systems used in 4 Wheelers. Windscreen wiper, electrical horn, Power windows,</p> <p>5.7 <b>Gauges</b>- construction &amp; working of Fuel level gauge, oil gauge and water temperature gauge.</p> <p>5.8 <b>Miscellaneous</b> - Windscreen wiper, electrical horn, Sensors and Actuators used in modern automobiles.</p>	12	15	CO4
6	<p><b>Motor Vehicle Maintenance and Road Safety</b></p> <p>6.1 Role and Responsibilities of Service Manager, Service Supervisor, Customer Care Manager in Service Stations.</p> <p>6.2 Automobile Maintenance Systems: Concept of Garage, Workshop, Service Station, Dealership, Types of Maintenance, Need &amp; importance of Record Keeping, List of Records to be kept in Service Stations, Different types of Automobile Service Tools (Hand Tools, Measuring Tools, Power Tools).</p> <p>6.3 <b>Passenger Comfort and Safety</b>: Function and requirements of Safety System. Features of Air Bags, Seat Belts, Collapsible Steering Column.</p>	03	04	CO5
<b>Total</b>		<b>48</b>	<b>70</b>	



## 7. LIST OF PRACTICALS

Term work consists of Journal containing a judicious mix of minimum 10 practicals.

Sr. No.	Title of experiment	Approx.hrs required	COs
1	Observe the chassis of following vehicle like LCV or HCV or Jeep. Draw and describe various components mounted on it.	02	CO1
2	Observe the layout of following vehicle like Electrical/Hybrid/CNG. Draw and describe various components mounted on it.	02	CO1
3	Dismantle, Inspect and Reassemble the Single Plate Clutch. (Coil Spring Type/Diaphragm Type)	02	CO 2
4	Dismantle, Inspect and Reassemble the Multiplate Clutch.	02	CO 2
5	Dismantle, Inspect and Reassemble the Synchromesh Gear Box.	02	CO 2
6	Dismantle, Inspect, and Reassemble the Differential.	02	CO 2
7	Dismantle, Inspect and Reassemble the Propeller shaft Assembly.	02	CO 2
8	Dismantle, Inspect and Reassemble the Steering Gear box. (Rack & Pinion/Recirculating Type/Worm & Wheel)	02	CO 2
9	Dismantle, Inspect, Reassemble the hydraulic Disc brake system.	02	CO 2
10	Inspect the Leaf Spring assembly.	02	CO 3
11	Remove, Inspect and Reassemble the Wheel & Tyre assembly.	02	CO 3
12	Study of battery and charging system.	02	CO 4
13	Prepare a simple electrical circuit for Automobile Lighting / Horn System. (2 or 4 Wheeler Electrical System)	02	CO 4
14	Carrying out preventive maintenance plan for two wheeler.	02	CO 5
15	Carrying out preventive maintenance plan for four wheeler.	02	CO 5
16	Select the various Hand tools for regular dismantling & assembly work in your Lab.	02	CO 5
	TOTAL	32	

## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. PPT
3. Minimum number of practicals/ Demonstrations
4. Videos

## 9. LEARNING RESOURCES

Sr. No.	Title of book	Author	Publication
1.	Automobile Engineering	K. K. Jain and R.B. Asthana	Tata Mcgraw hill
2.	Automobile Mechanics	William Crouse	Tata Mcgraw hill
3.	Automobile Mechanics	Srinivasan	Tata Mcgraw hill
4.	Automotive Technology	H.M.Sethi	Tata Mcgraw hill
5.	Automobile Engineering	G.B.S. Narang	Khanna Publication
6.	Auto Mechanics	Harold T. Glenn	Mechanics Bennett & Mckknight
7.	Automobile Engineering Vol. I and Vol. II	Kirpal Singh	Standard Publication



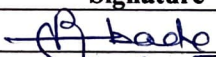



## 10. WEB REFERENCES

- a. <http://nptel.ac.in/course> (NPTEL)
- b. [https://www.araiindia.com/Draft\\_AIS\\_Standards.asp](https://www.araiindia.com/Draft_AIS_Standards.asp) (AIRI Pune)
- c. [http://www.cirtindia.com/testing\\_universalTyreTestingMachine.html](http://www.cirtindia.com/testing_universalTyreTestingMachine.html)
- d. [www.pcra.org/pages/view/220](http://www.pcra.org/pages/view/220)
- e. <https://www.saeindia.org/>
- f. <https://msrtc.maharashtra.gov.in/>
- g. <https://www.howstuffworks.com>
- h. <https://www.youtube.com/watch?v=Y1zbE21PzIO>. (Automatic Transmission)
- i. [https://www.youtube.com/watch?v=u\\_y1S8COHmc](https://www.youtube.com/watch?v=u_y1S8COHmc). (Automatic Transmission)
- j. <https://www.youtube.com/watch?v=aNGA5Ejq8A4>. (Differential)
- k. <https://www.youtube.com/watch?v=IrBE8k9lr8>. (Radial and Tubeless Tyre)
- l. [https://www.youtube.com/watch?v=mLCGI\\_ecC3g](https://www.youtube.com/watch?v=mLCGI_ecC3g). (Tubeless Tyre)

## 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	Topic	Distribution of theory marks			
		R level	U level	A level	TOTAL Marks
1	Introduction of Automobile	02	04	06	12
2	Transmission Systems	02	06	06	14
3	Control Systems	02	03	04	09
4	Suspension System	02	06	08	16
5	Electrical Systems	04	06	05	15
6	Motor Vehicle Maintenance	---	---	04	04
<b>TOTAL</b>		<b>12</b>	<b>25</b>	<b>33</b>	<b>70</b>

## 12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		Name	Signature
1	Internal	Shri R.R.Ambade	
2	Internal	Shri G.B.Deshpande	
3	Internal	Shri A.S. Shukla	
4	External	Shri Nayan Shid	
		Director, Chamunda Auto services.	



## 1. COURSE DETAILS

<b>Programme</b> : Mechanical Engineering	<b>Semester</b> : IV
<b>Course</b> : #Mechatronics	<b>Group</b> : A*
<b>Course Code</b> : MEC190214	<b>Duration</b> : 16 Weeks

## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions & Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs. L	Practical Hrs. P	Drawing Hrs. D	Tutorial Hrs. T	Credit (L+ P+ D+ T)	Theory Paper Duration and		SSL	TA	TH	TW	PR	OR	TOTAL
					Hrs	Marks							
03	02	--	--	05	03	70	20	10	70	50	--	50	200

## 3. COURSE OBJECTIVE

Mechatronics helps in generation of simpler, more economical, reliable and versatile commercial and industrial products which is a combination of mechanics, electronics, controls and computers. It also helps to control the advanced hybrid systems, hydraulics, pneumatics, Electro-hydraulic and electro-pneumatic systems.

## 4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Build technology-based systems through the interdisciplinary approach.
- Use modern tools in order to solve real life problems embedding different disciplines of engineering.
- Develop hydraulic, pneumatic and electro-pneumatic circuits.

## 5. COURSE OUTCOMES(COs) At the end of the semester student will be able to :-

CO No.	Course Outcome	Bloom's Level
CO1	Define, identify and list various types of systems and its elements along with its symbolic representation.	Remember, Understand
CO2	Select and explain the working, function, features, principle and laws of various system and its elements/ components like sensors, logic gates, microprocessor and microcontroller.	Understand
CO3	Use of appropriate components, sketch the symbol and develop various types of pneumatic/ electro-pneumatic circuits for industrial applications.	Apply, Create
CO4	Solve control system transfer function, steady state error and resolve the complex systems to block diagram for further reduction. Interpret stability of the system using various tools and criterion.	Understand, Apply



## 6. COURSE CONTENTS

Sr. No.	Topics/ Sub-Topics	Hours	Marks	COs
1.	<b>Introduction to Mechatronics</b> 1.1 Overview of Systems, Measurement Systems & Control Systems 1.2 Elements of Measurement System 1.3 Overview of Mechatronics System 1.4 Elements of closed loop system: Comparison Element, Control Element, Correction Element, Process Element & Measurement Element 1.5 Mechatronics systems in factory, business & home automation	03	04	CO1
2.	<b>Sensors and Transducers</b> 2.1 Introduction to sensors, transducers and Digital Logic 2.2 Performance terminology of transducer 2.3 Working of Potentiometer sensor, Differential Transformer, Pneumatic sensor, Tachogenerator, Load cell, Piezoelectric sensor, Temperature Sensor: Bimetallic strip, RTD and Thermistor, thermocouple and its laws. 2.4 Selection of sensors 2.5 Number Systems: Decimal system, Binary system, Octal system and Hexadecimal system (Simple conversions based on listed number systems) 2.6 Binary Mathematics and Logic Gates like AND, OR, NOT, NAND, NOR, XOR (Symbol, Boolean equation and Truth table for gates) 2.7 Laws of Boolean Algebra, Simplification of Boolean equations, truth table for Boolean equation	06	08	CO2
3.	<b>Microprocessors and Microcontroller</b> 3.1 Microprocessor system and Microcontroller, its advantages and limitations 3.2 General Architecture of Microprocessor, Various parts of microprocessor like ALU, Registers and Control unit 3.3 Buses and its types: Data bus, Address bus and Control bus, 3.4 Types of Memory: ROM, PROM, EPROM, EEPROM, RAM 3.5 Input and Output Operations 3.6 Architecture of 8085 Microprocessor and its configuration, Functional units of 8085 Microprocessor, 40 pin diagram of 8085 and its functions 3.7 Features of 8086 microprocessor, comparison between 8085 and 8086 microprocessor 3.8 Comparison between Microprocessor and Microcontroller, Types of microcontrollers and its application 3.9 Block diagram of architecture of 8051 Microcontroller, 40 pin diagram of 8051 and its functions	08	12	CO1 CO2



Sr. No.	Topics/ Sub-Topics	Hours	Marks	COs
4.	<b>Fluid Power Systems</b> 4.1 Introduction to Hydraulics, Pneumatics, Electro-Pneumatic Systems 4.2 Solenoids, Comparison between AC and DC Solenoid Valves, Introduction to servo valves, working of Torque motor 4.3 Construction and Working of Switches: Push button switches, Limit switches, Pressure switches, Relays, Time Delay Relays – ON & OFF delay timer, Temperature switch, Reed Proximity switches, symbols 4.4 Memory Latch: Dominant FF, Dominant ON 4.5 Logic or sequential control and its comparison with analog control 4.6 Developing Sequential Pneumatic Circuits (circuits having at least 3 actuators) using shift register method and cascade method 4.7 Developing Sequential Electro-Pneumatic Circuits using single solenoid or double solenoid valve and with or without grouping	12	18	CO1 CO3
5.	<b>Basics of Control Systems, its Transfer Function and Block Diagram Representation</b> 5.1 Definitions, Classification of control systems (only listing) 5.2 Comparison of Open Loop and Closed Loop Control system 5.3 Concept of Transfer Function (TF), Definition, advantages and features, limitations of TF, Terminology related to TF: Poles of a TF, Characteristic Equation of a TF, Zeros of TF, Pole-Zero Plot 5.4 Introduction, Advantages and limitations of Block diagram 5.5 Simple or Canonical Form of Closed loop system 5.6 Rules for Block Diagram Reduction, Simple problems on Block diagram reduction (No numerical on critical rules) 5.7 Derivation of steady state error, Effect of Input (step, ramp and parabolic) on steady state error (Static Error Co-efficient) (simple numerical on steady state error and error co-efficient)	09	14	CO1 CO4
6.	<b>Stability of the system</b> 6.1 Concept of Stability: Absolutely Stable System, Unstable System, Conditionally Stable System, Critically Stable or Marginally Stable System and Relative Stability 6.2 Routh-Hurwitz criterion, Hurwitz's criterion and its limitations 6.3 Routh's Stability criterion: Routh's Criterion and special cases of Routh's criterion (Simple Numerical) 6.4 Basic concept of Root Locus and Bode Plot, Advantages of Root Locus & Bode Plot 6.5 Construction of Root Locus, rules for construction of Root Locus, General steps to solve the problem on Root Locus 6.6 Magnitude Plot and Phase Angle Plot, Steps to sketch Bode Plot, Calculation of Gain Margin and Phase Margin from Bode Plot (Simple Numerical on Root Locus and Bode Plot)	10	14	CO4
<b>TOTAL</b>		<b>48</b>	<b>70</b>	



## 7. LIST OF PRACTICALS/ ASSIGNMENTS

Term work consists of Journal containing following experiments.

Sr. No.	Title of Experiment/ Assignment/ Exercise/ Tutorial/ Drawings	Approximate Hrs. Required	COs
1.	Presentation on use of sensors/ transducer for recent trends and technology in mechanical industries.	03	CO2
2.	Simple numerical on simplification of Boolean equation with its truth table using laws of Boolean Algebra.	02	CO2
3.	Study assignment on A/D and D/A Converter, Integrated Circuits and types of transmission.	02	CO1
4.	Development of pneumatic circuits using at least 3 actuators, for industrial application(s) to understand pneumatic components and their working using shift register method.	02	CO3
5.	Development of pneumatic circuits using at least 3 actuators, for industrial application(s) to understand pneumatic components and their working using cascade method.	02	CO3
6.	Development of sequential operation for two or three actuators using electro-pneumatic circuits with/ without grouping.	02	CO3
7.	Simple numerical on Block diagram reduction to obtain its transfer function using its rules. (No critical rules)	02	CO4
8.	Simple numerical on stability of control system and steady state error with its static co-efficient.	02	CO4
9.	Simple numerical on Root Locus to analyze stability of the system.	02	CO4
10.	Simple numerical on Bode Plot Locus to analyze stability of the system.	02	CO4
11.	Simulation of simple sequential pneumatic circuits of at least 2 actuators using software.	03	CO3
12.	Mini-project in group of at least 3 students, on a application(s) of mechatronics, integrating branch of mechanical, electrical, electronics and computer engineering along with its report.	08 (Parallel activity through-out the term)	CO1, CO2, CO3, CO4

## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Slides
3. Online Resources



## 9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1.	Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering	W. Bolton	Pearson education
2.	Principles of Control Systems	S. C. Goyal, U. A. Bakshi	Technical Publication
3.	Mechatronics	Kenji Uchino and Jayne R. Giniewicz	Marcel Dekker, Inc
4.	Applied Mechatronics	A. Smaili and F. Mrad	OXFORD university press
5.	Mechatronics System Design	Shetty and Kolk	Cengage Learning, India Edition
6.	Introduction to Mechatronics and Measurement Systems	Alciatore and HistanTata	McGraw-Hill
7.	Mechatronics	Necsulescu	Pearson education
8.	Mechatronics – Electro-mechanics and Control Mechanics	Denny K. Miu	Mill Springer-Verlag
9.	Introduction to Mechatronics	AppuKuttan K.K.	OXFORD Higher Education
10.	Pneumatic Circuits and Low Cost Automation	Fawcett J. R.	Trade & Technical Press, 1968
11.	Mechatronics - Mechanical System Interfacing	Auslander and Kempf	Prentice Hall

## 10. WEB REFERENCES

- <https://www.scribd.com/document/323067526/W-Bolton-Mechatronics>
- <https://www.scribd.com/doc/154943442/125683683-Control-System-Engineering-u-a-Bakshi>
- <https://www.tutorialspoint.com/>
- <https://www.electronics-tutorials.ws/>
- <https://nptel.ac.in/course.php>
- <https://nptel.ac.in/courses/112103174/3#>
- <https://nptel.ac.in/courses/112106175/Module%204/Lecture%2040.pdf>
- <https://nptel.ac.in/courses/112106175/Module%204/Lecture%2041.pdf>
- [https://www.youtube.com/watch?v=fS7FFOaC\\_iQ](https://www.youtube.com/watch?v=fS7FFOaC_iQ)
- <https://www.youtube.com/watch?v=ig1PI7-R8n0>
- <https://www.youtube.com/watch?v=I78iyzXQrP4>




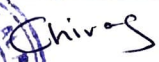


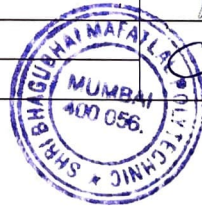


11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			Total Marks
		R Level	U Level	A Level	
1	Introduction to Mechatronics	02	02	--	04
2	Sensors, Transducers & Digital Logic	02	06	--	08
3	Microprocessor and Microcontroller	04	08	--	12
4	Fluid Power System	02	08	08	18
5	Basics of control systems, its Transfer Function and Block Diagram Representation	02	10	02	14
6	Stability of the System	02	04	08	14
	<b>Total</b>	14	38	18	70

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Shri Virag A. Timbadia	
2	Internal	Shri Pratik P. Sawant	
3	Internal	Shri Girish B. Deshpande	
4	External	Shri Chirag Kachalia, Director Organization: Mihir Industries	



### 1. COURSE DETAILS

**Programme: Mechanical Engineering**  
**Course: #Material Handling Systems**  
**Course Code: MHS190215**

**Semester: IV**  
**Group: A\***  
**Duration:16 Weeks**

### 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks (ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	-----	-----	05	03	70	20	10	70	50	-----	50	200

### 3. COURSE OBJECTIVE

Material handling equipment is an integral part of modern industrial enterprise. The flow of material in industry depends on a rational choice of the material handling equipment, correct determination of its main parameters and efficient operation. Every diploma technician must know the operational features of the equipment & its practical application.

### 4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

**Identification, application and maintenance of material handling equipment.**

### 5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO NO.	COURSE OUTCOME	Bloom's LEVEL
CO1	Understand constructional & operational features of various materials handling systems.	Remember Understand
CO2	Distinguish different material handling processes used in industry.	Understand, Apply
CO3	Apply safety measures in material handling system.	Understand, Apply
CO4	Select proper material handling equipment for specific applications.	Understand, Apply



## 6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	<b>Introduction to Material Handling System</b> 1.1 Main types of material handling equipment & their applications 1.2 Range of material handling 1.3 Types of movements 1.4 Methods of stacking, loading & unloading systems 1.5 Principles of material handling systems	06	10	CO1 CO2
2	<b>Hoisting Machinery &amp; Equipment</b> 2.1 Construction, working and troubleshooting of different types of Hoists such as lever operated hoist, portable hand chain hoist, differential hoists, worm geared and spur geared hoists, electric & pneumatic hoists, jumper 2.2 Construction, working of different types of cranes such as rotary cranes, trackless cranes, mobile cranes, bridge cranes, cable cranes, floating cranes & cranes traveling on guide rails 2.3 Construction, working & trouble shooting of elevating equipments such as stackers, industrial lifts, freight elevators, passenger lifts	10	14	CO1
3	<b>Conveying Machinery &amp; Surface Transportation Equipment</b> 3.1 Construction, working of traction type conveyors such as belt conveyors, chain conveyors, bucket elevators, escalators 3.2 Construction, working & trouble shooting of traction less type conveyors such as gravity type conveyors, vibrating & oscillating conveyors, screw conveyors, pneumatic & hydraulic conveyors, hoppers gates & feeders	12	16	CO1 CO4
4	<b>Components of material handling systems</b> 4.1 Flexible hoisting appliances such as welded load chains, roller chains, hemp ropes, steel wire ropes, fastening methods of wire & chains, eye bolts, lifting tackles lifting & rigging practices 4.2 Load handling attachments. 4.2.1 Various types of hooks-forged, triangular eye hooks, appliances for suspending hooks 4.2.2 Crane grab for unit & piece loads 4.2.3 Electric lifting magnet, vacuum lifter 4.2.4 Grabbing attachment for loose materials 4.2.5 Crane attachment for handling liquids / molten metals 4.3 Arresting gear & Brakes. 4.3.1 Arresting gear construction & working 4.3.2 Construction & use of electromagnetic shoe brakes, Thruster	08	12	CO1 CO2



5	<b>Mechanism used in material handling equipment</b> 5.1 Steady state motion, starting & stopping of motion in following Mechanisms. 5.1.1 Hoisting mechanism 5.1.2 Lifting Mechanism 5.1.3 Traveling Mechanism 5.1.4 Slewing Mechanism 5.1.5 Rope & chain operated Cross- Traverse Mechanism	04	06	CO3 CO4
6	<b>Selection of material handling equipment</b> 6.1 Factors affecting choice of material handling equipment such as type of loads, hourly capacity of the unit, direction & length of travel 6.2 Methods of stocking at initial, final & intermediate points 6.3 Nature of production process involved 6.4 specific load conditions & economics of material handling system	03	04	CO2 CO3
7	<b>Material Handling Cost Concepts &amp; Determination</b> 1 Difficulties, Reasons & Need for determining material handling Costs. 2 Factors affecting material handling costs 3 Types of costs & its evaluation 4 Simple numerical on transportation	05	08	CO4
	<b>TOTAL</b>	48	70	----

## 7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term work consists of Journal containing following experiments.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
A	1) Study of any one type of conveyor belt, Screw, pneumatic, hydraulic. 2) Study of any one type of crane (working model or actual). 3) Study of fork lift truck (using electric drive or diesel engine) or hoisting equipment. 4) Study of preventive maintenance schedule of major materials handling equipment. 5) Power point presentation on recent material handling system & system design.	16	CO1 CO2
B	Note: Select any three-mini project from following and submit report of the same (min. 5 pages) 1. Collect and write detail specifications of any two major material handling devices. 2. Collect and write information about manufacturer, Cost, Capacity range, availability, application of any one material handling equipment like Hoisting equipment, Conveying equipment, Surface transportation equipment. 3. Collect photographs of ten different types of cranes used in industries. Write name and specific utility of each.	10	CO3 CO4



	<p>4. Collect photographs of ten different types of conveyers used in industries. Write name and specific utility of each</p> <p>5. Write name of material handling devices and their utility after visiting any big industry nearby area</p> <p>6. Using internet collect and write information about six major manufacturer of material handling equipment</p> <p>7. Write report about testing of overhead crane for its lifting capacity.</p>		
C	<p>Visit to coal handling plant of thermal power plant or cement industry to observe working of different types of bulk material handling devices (at least three equipment). Write report of the visit.</p> <p>OR Visit to steel industry or automobile manufacturing unit or sugar industry to observe different types of roller conveyors, Bucket elevators, overhead cranes load handling attachments, electric lifting magnet (at least 3 equipment). Write report of the visit.</p>	06	CO1 CO4
	Total	32	

## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Lesson Planning
2. Use of Projector and Smart board.
3. Demonstration (AV Resources)
4. Use of hand tools and machine tools

## 9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Material handling equipment	N. Rundenko	Peace Publisher, Moscow
2	Material handling equipment	M. P. Alexandrov	MIR Publisher, Moscow
3	Material handling equipment	Y. I. Oberman	MIR Publisher, Moscow
4	Material handling equipment	R. B. Chowdary & G. R. N. Tagore	Khanna Publisher, Delhi
5	Material handling (Principles & Practice)	Allegrì T. H.	CBS Publisher, Delhi
6	Materials handling systems design	James M Apple	JohnWiley & sons, Newyork.
7	Berlin Encyclopedia of materials handling	Daylas R. W. Pergaman,	
8	Material handling	Immer J. R.	Mc Graw Hill, New York
9	Material handling equipment C.D.C.in Mechanical Engg.,	Parameshvaran M.A	I.I.T., Chennai
10	Material Handling Traffic and Transportation	Elias S. Tyler & E.J Corenthal	Mc Graw Hill, New York






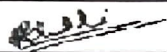
## 10. WEB REFERENCES

- <http://www.mhi.org/fundamentals/material-handling>
- <https://www.douglasequipment.com/blog/different-types-material-handling-equipment/>
- <https://www.managementstudyguide.com/material-handling.htm>
- <http://elearning.nokomis.in>

## 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	Topic	Distribution of theory marks			
		R level	U level	A level	TOTAL Marks
1	Introduction to Material Handling System	02	02	06	10
2	Hoisting Machinery & Equipment	02	06	06	14
3	Conveying Machinery & Surface Transportation Equipment	04	06	06	16
4	Components of material handling systems	02	04	06	12
5	Mechanism used in material handling equipment	02	02	02	06
6	Selection of material handling equipment	---	---	04	04
7	Material Handling Cost Concepts & Determination	04	-	04	08
	<b>TOTAL</b>	16	20	34	70

## 12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Shri A.S. Shukla	
2	Internal	Shri P.R. Parate	
3	Internal	Shri G.B. Deshpande	
4	External	Shri Abrar Khulli	
		Organisation: L&T Ltd, Powai	



## 1. COURSE DETAILS

<b>Programme: Mechanical Engineering</b> <b>Course: # Energy Conservation &amp; Audit</b> <b>Course Code: ECA190216</b>	<b>Semester: IV</b> <b>Group: A*</b> <b>Duration: 16 Weeks</b>
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## 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks (ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	--	--	05	03	70	20	10	70	50	--	50	200

## 3. COURSE OBJECTIVE

Energy Conservation & Audit helps in understanding the concept of energy conservation and its benefits, different energy conservation techniques, acts and codes, the procedure of energy audit and the procedure of techno-economic evaluation of an energy conservation project.

## 4. SKILL COMPETENCY

This aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

**Perform Energy Audit for an Industry and suggest Energy Conservation measures.**

## 5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Identify the energy consumption & demand supply gap of energy in Indian scenario.	Remember
CO2	Carry out energy audit of an industry/organization.	Apply
CO3	Describe the energy conservation methods in industries, power generation, transmission and Distribution.	Understand
CO4	Select appropriate energy conservation method to reduce the wastage of energy.	Understand
CO5	Determine the techno economic feasibility of the energy conservation technique adopted.	Understand, Apply



## 6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	<b>Energy Conservation and Management</b> 1.1 Sector wise Energy consumption & Demand supply gap in Indian Scenario, Scope for energy conservation and its benefits. 1.2 Energy conservation Principle – Maximum energy efficiency, Maximum cost effectiveness. 1.3 Mandatory provisions & various features of Energy Conservation Act, Energy Conservation Building Codes (ECBC). 1.4 Energy management concept and objectives.	06	08	CO1
2	<b>Energy Conservation In Industries</b> 2.1 Energy saving opportunities in electric motors; Benefits of Power factor improvement and its techniques; Energy conservation by Variable Speed Drive. 2.2 Energy conservation in ventilation and air conditioning systems / equipment such as compressors, pumps, fans and blowers; Insulating the Heating / cooling fluid pipes, automatic door closing- Air curtain, Thermostat Control. 2.3 Energy conservation in electric furnaces, ovens and boilers. 2.4 Lighting techniques – Natural, CFL, LED lighting sources and fittings.	09	14	CO4
3	<b>Energy Conservation in Power Generation, Transmission and Distribution</b> 3.1 Performance improvement of existing power plant: co- generation, small hydro, DG Set, Waste Heat Recovery. 3.2 Demand side management & Load response programmes. 3.3 Types of tariff and restructuring of electric tariff. 3.4 Technical measures to optimize transmission and distribution losses.	09	14	CO3
4	<b>Energy Audit</b> 4.1 Energy audit and its benefits. 4.2 Energy flow diagram. 4.3 Preliminary & Detailed energy audit. 4.4 Methodology of Preliminary energy audit and Detailed energy audit – Phase I(Pre audit), Phase II(Audit) and Phase III(Post audit) 4.5 Energy audit report. 4.6 Electrical Measuring Instruments - Power Analyser, Combustion analyzer, fuel efficiency monitor, Thermometer-contact, infrared, Pitot tube and manometer, water flow meter, leak detector, tachometer and luxmeter 4.7 IE rules and regulations for energy audit 4.8 Case study/ Numerical on Energy Audit	14	20	CO2





5	<b>Techno-Economic Evaluation of Energy Conservation Project</b> 5.1 New equipment - technology, staffing & training. 5.2 Calculation and costing of energy conservation project. 5.3 Depreciation cost, Sinking Fund method. 5.4 Cost evaluation by Return on Investment (ROI) and Pay Back method. 5.5 Risk analysis. 5.6 Case study/ Numerical on Techno-Economic Evaluation of Energy Conservation Project.	10	14	CO3 CO5
		<b>TOTAL</b>	<b>48</b>	<b>70</b>

## 7. LIST OF PRACTICALS/ASSIGNMENTS

Term Work consists of Journal containing the following experiment/assignment

Sr. No.	Title of Experiment/Assignment	Approximate Hrs required	COs
1	Study of various energy management systems prevailing in a particular industry/organization.	03	CO3
2	Study of Energy Conservation Act 2003.	03	CO1
3	Study of Energy Conservation Building Codes.	03	CO1
4	Study of various energy conservation methods useful in a particular industry.	03	CO3, CO4
5	Study of various energy conservation methods useful in power generation, transmission and distribution.	03	CO3, CO4
6	Preparation of energy flow diagram for an industry/commercial premises.	02	CO2
7	Study of various measuring instruments used for energy audit.	03	CO2
8	Preparation of sample energy audit questionnaire.	02	CO2
9	Case study on energy audit for an industry/commercial premises.	03	CO2
10	Determination of payback period for a given energy conservation project/equipment.	02	CO5
11	Determination of depreciation cost of a given energy conservation project/equipment.	02	CO5
12	Case study on Techno-Economic Evaluation of Energy Conservation Project.	03	CO5
	Total	32	

## 8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Guest Lecture
3. Industrial Visit
4. Online Resources



## 9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	General Aspects of Energy Management and Energy Audit	Shri J. Nagesh Kumar	Bureau of Energy Efficiency, Fourth Edition, 2015
2	Energy Efficiency in Electrical Utilities	Shri J. Nagesh Kumar	Bureau of Energy Efficiency, Fourth Edition, 2015
3	Energy Efficiency in Thermal Utilities	Shri J. Nagesh Kumar	Bureau of Energy Efficiency, Fourth Edition, 2015
4	Energy Performance Assessment for Equipment and Utility Systems	Shri J. Nagesh Kumar	Bureau of Energy Efficiency, Fourth Edition, 2015

## 10. WEB REFERENCES


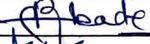


1. <https://www.beeindia.gov.in/>
2. <https://www.beeindia.gov.in/content/buildings>
3. <https://www.beeindia.gov.in/content/pat-3>
4. <https://www.beeindia.gov.in/content/standards-labeling>
5. <http://pcra.org/>
6. <http://pcra.org/pages/display/180-Energy-Audit>
7. <http://pcra.org/sectors/index/33>
8. <https://nptel.ac.in/courses/112105221/>

## 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Energy Conservation and Management	8	--	--	8
2	Energy Conservation In Industries	--	14	--	14
3	Energy Conservation in Power Generation, Transmission & Distribution	--	14	--	14
4	Energy Audit	--	--	20	20
5	Techno-Economic Evaluation of Energy Conservation Project	--	14	--	14
	Total	8	42	20	70



## 12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Shri P P Sawant	
2	Internal	Shri R R Ambade	
3	Internal	Shri S B Wasnik	
4	External	Professor Santosh Dalvi	
		Organisation: Lokmanya Tilak College of Engg.	



### 1. COURSE DETAILS:

<b>Program: Mechanical Engineering</b> <b>Course: Mechanical Measurements &amp; Control</b> <b>Course Code:MMC190217</b>	<b>Semester: IV</b> <b>Group: A</b> <b>Duration:16 Weeks</b>
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### 2. TEACHING AND EXAMINATION SCHEME:

Scheme of Instruction & Period per week					Theory Paper duration & Marks		Scheme of Examination						
L	P	D	T	Cr	Hrs	Mks	SSL	TA	Th	TW	PR	OR	TOTAL
3	2	-	-	5	03	70	20	10	70	25	-	25	150

### 3. COURSE OBJECTIVE:

Measurement activities are given prime importance in industry. The art of measurement plays an important role in all branches of engineering. With advances in technology, measurement techniques have also taken rapid strides, with many types of instrumentation devices, innovations & refinements. The course aims at making a mechanical engineering students familiar with principle of instrumentation, transducers & measurement of nonelectrical parameters like temperature, pressure, flow, speed, force etc. for engineering applications.

### 4. SKILL COMPETANCY:

The aim of this course is to help the students is to attain the following industry identified competency through various teaching learning experiences:

**Use relevant analog & digital measuring devices in mechanical engineering related applications.**

### 5. COURSE OUTCOMES:

The theory, practical experiences & relevant soft skill associated with this course are to be taught & implemented, so that students demonstrates the following industry oriented Cos associated with above mentioned competency.

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Use relevant Characteristics of measurement & pressure measuring devices.	Remember
CO2	Use relevant instrument for measuring Displacement measuring devices.	Understand
CO3	Use relevant temperature measuring instruments.	Understand
CO4	Use relevant Flow measuring devices.	Understand
CO5	Select relevant measuring devices for speed measurement.	Apply
CO6	Select relevant measuring devices for humidity & liquid level measurement.	Apply



## 6. COURSE CONTENTS:

Sr. No.	TOPIC/Sub-topic	Hours	Marks	Cos
1	<p><b>Introduction to measurement:</b> Significance of measurement, Methods of measurement, <b>Static characteristics:</b> - Range and Span, Accuracy and Precision, Reliability, Calibration, Hysteresis and Dead zone, Drift, Sensitivity, Threshold and Resolution, Repeatability and Reproducibility, Linearity. <b>Dynamic characteristics:</b> Speed of response, Fidelity and Dynamic errors &amp; Overshoot. <b>Errors:</b> Classification of errors. Gross error, observation error, operation error, environmental error etc. <b>Transducers :</b> Classification of Transducers, active &amp; passive, contact &amp; noncontact, mechanical transducers.</p>	10	12	CO1
2	<p><b>Pressure &amp; Displacement Measurement:</b></p> <p><b>2.1 Pressure Measurement:</b> All types tube gauges like piezometer, simple U –tube manometer, Differential manometer etc. High Pressure gauge: Diaphragm, Bellows, Bourdon tube pressure gauge.</p> <p><b>2.2 Displacement Measurement:</b> Potentiometers, LVDT,</p>	08	10	CO1      CO2
3	<p><b>Flow measurement:</b> 2.1 Variable head meters Application &amp; Construction &amp; working of Venturimeter, Orifice meters, Pitot Tube etc. 2.2 Variable Area meters Application &amp; Construction &amp; working of Rota meter., Anemometer.</p>	04	06	CO4



4	<b>Control System :</b> 3.1 Definition of System, Control 3.2 Term used in control system 3.3 Examples of control system. 1.2 Classification of control system, open loop & closed loop control system, examples of open loop & closed loop control system, 1.3 Feed back & feed forward control system.			04	06	CO1
5	<b>Temperature Measurements :</b> 3.2 Non- electrical methods 3.2.1 Liquid in glass thermometers 3.2.2 Pressure thermometer 3.2.3 Bi-metallic thermometer 3.3 Electrical Methods 3.3.1 Resistance Temperature Detector 3.3.2 Thermistors 3.3.3 Thermoelectric methods- elements of Thermocouple, Seebeck series, Law of intermediate temperature, law of intermediate metals			06	10	CO3
6	<b>Speed Measurements:</b> 6.1 Mechanical Tachometers: 6.1.1 Revolution counter & timer, 6.1.2 Hand Speed Indicator , 6.1.3 Centrifugal Force Tachometer. 6.1.4 Slipping Clutch Tachometer,			06	08	CO5
7	<b>Miscellaneous Measurement:</b> 7.1 Humidity Measurement Type of humidity measuring devices like Resistive Hygrometer, Capacitive Hygrometer, Crystal Hygrometer, Aluminum oxide Hygrometer 7.2 Liquid level Measurements: direct and indirect methods. Sight glass, Float type, Bubbler & Purge type, Capacitive type.			10	18	CO6
	<b>Total</b>			<b>48</b>	<b>70</b>	



## 7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS:

Term Work consists of Journal containing the following experiment/assignment

Sr. No.	Title of Experiment/Assignment	Approximate Hrs required	COs
1	Determination of co-efficient of discharge for Venturimeter.	04	CO4
2	Determination of co-efficient of discharge for orifice plate.	04	CO4
3	Determination of co-efficient of discharge for Rota-Meter.	04	CO4
4	Demonstration of measurement of speed on gear pump test rig by using digital tachometer.	04	CO5
5	Study of Pressure Measuring Devices.	04	CO1
6	Study of Temperature Measuring Devices.	04	CO3
7	Study of Humidity Measuring Devices.	04	CO6
8	Study of Strain Measuring Devices.	04	CO2
	Total	32	

## 8. IMPLEMENTATION STRATEGY (PLANNING):

In depth study and understanding of the Course will be implemented by adopting the Following strategy. (Teaching plan)

Lesson plan.

Use of charts, models.

Use of actual devices.

## 9. EARNING RESOURCES :

Sr.	Author	Title	Publisher
1	Rajput R.K.	Mechanical Measurement & Instrumentation	S.K.Kataria & Sons . New Delhi.
1	D.S. Kumar	Mechanical Measurement & Control 2nd 1989	Himalaya Publishers, Delhi-06
2	Paranjape & Kasare	Instrumentation & Control 1 <sup>st</sup> 2008	Central Techno Publication.
3	Gavhale S.L.	Mechanical Measurement & Control 1 <sup>st</sup> 2009	Nirali Prakashan.
4	A.K.Sawney	Electrical & Electronic Measurement & Instrumentation.	Dhanpat Rai & Company




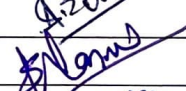
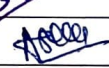
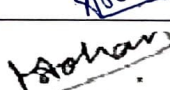
## 10. WEB REFERENCES:

- [www.nptel.ac.in/courses/112106138](http://www.nptel.ac.in/courses/112106138)
- [www.cosmolearning.org](http://www.cosmolearning.org)
- [www.youtube.com/watch?v=xcvNHHHY90](http://www.youtube.com/watch?v=xcvNHHHY90)
- [www.youtube.com/watch?v=DxdFilDrFBc](http://www.youtube.com/watch?v=DxdFilDrFBc)
- [www.youtube.com/watch?v=KeZ5CfPOIBc](http://www.youtube.com/watch?v=KeZ5CfPOIBc)

## 11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

SN	TOPIC	Distribution of theory marks			
		R LEVEL	U LEVEL	A LEVEL	TOTAL MARKS
1	Introduction to measurements	04	-	08	12
2	Displacement & pressure measurements	04	-	06	10
3	Flow measurements	-	-	06	06
4	Control system	-	06	-	06
5	Temperature measurement	02	08	-	10
6	Speed measurement	04	04	-	08
7	Miscellaneous measurements	02	10	06	18
	<b>TOTAL</b>	<b>16</b>	<b>28</b>	<b>26</b>	<b>70</b>

## 12. COURSE EXPERT COMMITTEE MEMBERS:

Sr. No.	Examiners	NAME	SIGNATURE
1	Internal	Shri Amol D. Bele	
2	Internal	Shri S.B. Wasnik	
3	Internal	Shri A.S Shukla	
4	External	Shri Mangesh Mohan Organisation: Fr. Agnel Polytechnic, Bandra	





### 1. COURSE DETAILS

<b>Programme: Mechanical Engineering</b> <b>Course: Heating Ventilation and Air Conditioning</b> <b>Course Code: HVA190218</b>	<b>Semester:IV</b> <b>Group:A</b>  <b>Duration:16 Weeks</b>
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### 2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	-----	-----	05	03	70	20	10	70	25	----	25	150

### 3. COURSE OBJECTIVE

RAC deals with the process of cooling, heating and ventilation by removing and adding heat to and from the space and maintaining quality of air. Its scope of application lies in railways, theaters, and hospitals, domestic application, industries, aircraft and rockets etc. makes the diploma students necessary to learn this subject. Because of ozone depletion, which is global problem, special attention has been given on this subject.

### 4. SKILL COMPETENCY :

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Apply basic principle of thermodynamic for refrigeration and air conditioning

### 5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Apply the principle of refrigeration for air craft cooling application	Remember, understand and apply
CO2	Select refrigeration system and refrigerant for a given application	Remember, understand and apply
CO3	Select components for a given refrigeration system	Remember, understand and apply
CO4	Calculate psychrometry properties and cooling and heating load using psychrometry chart	Remember, understand and apply
CO5	Select air conditioning system and the components for air distribution system	Remember, understand and apply



## 6. COURSE CONTENTS

Sr No	Topic/Subtopic and contents	Hours	Marks	CO%
1	<p><b>Refrigeration</b></p> <p><b>1.1 Basics of Refrigeration:</b> Necessity of refrigeration, unit of refrigeration, concept of COP( actual and theoretical)</p> <p><b>1.2 Air Refrigeration cycles:</b> Reversed CARNOT cycle and its representation on PV and TS diagram with simple numerical, Bell Coleman cycle and its representation on PV and TS diagram with simple numerical to find COP.</p> <p><b>1.3 Air refrigeration system:</b> Advantages and disadvantages, sources of heat in aircraft, working and application of boot strap air cooling system with TS diagram.</p>	08	12	CO1
2	<p><b>Refrigeration cycles and Refrigerant</b></p> <p><b>2.1 Dry Vapour compression refrigeration cycle (VCR):</b> Principle, working and components, PV, TS and PH diagram, factors affecting COP, calculation of COP and Power, comparison with air compression refrigeration cycle. Cascade refrigeration system (2 stage), Application</p> <p><b>2.2 vapour absorption refrigeration system (VARs):</b> Components, working of simple ammonia VARs, properties of ideal refrigerant-absorbent combination, comparison between VCRS and VARs</p> <p><b>2.3 Refrigerant:</b> Classification, desirable properties of refrigerant, designation of refrigerant, selection criteria for refrigerant, charging process, leak testing method,</p> <p><b>2.4 Environment factors:</b> EPA, Montreal protocol, Kyoto protocol, concept of Ozone Layer depletion, greenhouse effect, global warming, Eco Friendly refrigerants.</p> <p><b>2.5 Application:</b> House hold refrigerator, water cooler, ice plant</p>	12	18	CO2
3	<p><b>Refrigeration system components:</b></p> <p><b>3.1 Compressors:</b> Function, Classification, comparison between open semi Hermetic and hermetic compressor, application of reciprocating, rotary, screw and scroll compressor.</p> <p><b>6.2 Condensers:</b> Function, Classification, working of air cooled water cooled condenser their comparison and application</p> <p><b>6.3 Evaporators:</b> Function, Classification, working of dry, flooded and plate type evaporator, shell and tube type evaporator</p> <p><b>6.4 Expansion devices:</b></p>	10	18	CO3



	Function, classification, working of capillary and thermostatic expansion devices and their application			
4	<b>Basics of air conditioning and load calculation:</b> <b>4.1 Air conditioning:</b> Need of air conditioning, factors affecting human comfort. Sources of heat, BEE, star rating. <b>4.2 Psychrometry:</b> Dalton's law of partial pressure, air properties, psychrometry processes and its representation on psychrometry chart, calculation of cooling and heating load and mass of water vapour on psychrometric processes, BPF and SHF, calculation of enthalpy and humidity ratio in mixing of two air stream	12	14	CO4
5	<b>Air conditioning systems:</b> <b>5.1</b> Classification OF AC system, application and comparison, Construction and working of window and split AC <b>5.2</b> Insulation: purpose types of insulation, material and their properties <b>5.3 Components:</b> Humidifiers, dehumidifiers, fans, blowers, grill and registers, diffusers, filters, duct classification, calculation of mean velocity pressure and pressure loss due to friction in duct. <b>5.4</b> Introduction to automobile air conditioning system	06	08	C05
	<b>Total</b>	48	70	

## 7 LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing the following experiment/assignment

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1	Test rig on Refrigeration trainer and fault tutor	06	CO1
2	Test rig heat pump trainer	04	CO1
3	Test rig on vapour absorption system	04	CO3
4	Test rig on air conditioning fault trainer	06	CO4
5	Study of different components of window/split air conditioner and repairing of machine	06	C05
6	Assignments on air compression, vapour compression and psychrometry	06	CO1, CO2, CO4
	<b>Total</b>	32	

## 8 IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Slides
3. Online Resources



### 9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Refrigeration and Air conditioning	Arora and Domkundwar	Dhanpat Rai (P) Ltd., New Delhi
2	Refrigeration and Air conditioning	R S Khurmi	S Chand publication,
3	Basic Refrigeration and Air onditioning	Dr P M Ananthnarayan	Tata McGrawHill Publication
4	Principles of refrigeration	R J Dossat	John Wiley and sons Ltd
	Refrigeration and Air conditioning	S N Sapali	PHI publication,





### 10. WEB REFERENCES

- <https://nptel.ac.in/courses/112105129//>
- <https://beeindia.gov.in/sites/default/files/3Ch4.pdf>
- <http://www.temis.nl/protocols/protocols.html>

### 11 SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Refrigeration	04	04	04	12
2	Refrigeration cycles and Refrigerant	04	08	06	18
3	Refrigeration system components:	04	10	04	18
4	Basics of air conditioning and load calculation:	04	06	04	14
5	Air conditioning systems:	02	02	04	08
	Total	18	30	22	70

### 12 COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Shri S B Wasnik ( Lect Mech Engg Dept)	
2	Internal	Shri P. P Sawant ( Lect Mech Engg Dept)	
3	Internal	Shri R.R Ambade	
4	External	Dr. Balawant Bhasme	
		Organisation: Sardar Patel College of Engineering	

