SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE - 2019 PATTERN

SECOND YEAR to FINAL YEAR B. TECH.

LIST OF ABBREVIATIONS			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
ES	Engineering Science	HSMC	Humanity Science
PC	Professional Core	CA	Continuous Assessment
PE	Professional Elective	OR	End Semester Oral Examination
OE	Open Elective	PR	End Semester Practical Examination
ISE	In-Semester Evaluation	TW	Continuous Term work Evaluation
ESE	End-Semester Evaluation	BSC	Basic Science Course
PRJ	Project	MC	Mandatory Course

COURSE STRUCTURE- 2019 PATTERN
SECOND YEAR B. TECH: MECHANICAL ENGINEERING

SEMESTER-III

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks						
			L (hrs)	T (hrs)	P (hrs)		Theory			OR	PR	TW	Total
							ISE	ESE	CA				
PRJ	ME201	General Prof. Skills	-	-	2	1	-	-	-	-	-	50	50
BSC	BS202	Vector Calculus and Differential Equations	3	1	-	4	30	50	20	-	-	-	100
PC	ME203	Basic Thermodynamics	3	-	-	3	30	50	20	-	-	-	100
PC	ME204	Manufacturing Processes	3	-	-	3	30	50	20	-	-	-	100
PC	ME205	Strength of Materials	3	-	-	3	30	50	20	-	-	-	100
HSMC	HS206	Universal Human Values & Ethics	3	-	-	3	30	50	20	-	-	-	100
PC	ME207	Basic Thermodynamics Lab	-	-	2	1	-	-	-	50	-	-	50
PC	ME208	Machine Shop - I	-	-	2	1	-	-	-	-	50	-	50
PC	ME209	Strength of Materials Lab	-	-	2	1	-	-	-	50	-	-	50
MC	MC210	Mandatory Course-III	2	-	-	No	-	-	-	-	-	-	-
		Total	17	1	8	**20**	**150**	**250**	**100**	**100**	**50**	**50**	**700**

SEMESTER-IV

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks						
			L (hrs)	T (hrs)	P (hrs)		Theory			OR	PR	TW	Total
							ISE	ESE	CA				
PC	ME211	Numerical Methods	3	-	-	3	30	50	20	-	-	-	100
PC	ME212	Fluid Mechanics	4	-	-	4	30	50	20	-	-	-	100
PC	ME213	Materials Science & Metallurgy	3	-	-	3	30	50	20	-	-	-	100
PC	ME214	Kinematics of Machines	4	-	-	4	30	50	20	-	-	-	100
PRJ	ME215	Seminar	-	-	2	1	-	-	-	50	-	-	50
PC	ME216	Machine Drawing & Geometrical Modeling	1	-	4	3	-	-	-	-	-	50	50
PC	ME217	Numerical Methods Lab	-	-	2	1	-	-	-	-	50		50
PC	ME218	Fluid Mechanics Lab	-	-	2	1	-	-	-	-	50	-	50
PC	ME219	Materials Science & Metallurgy Lab	-	-	2	1	-	-	-	50	-	-	50
PC	ME220	Kinematics of Machines Lab	-	-	2	1	-	-	-	50	-	-	50
MC	**MC221**	**Mandatory Course-IV**	**2**	**-**	**-**	**No**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
		Total	17	-	14	**22**	**120**	**200**	**80**	**150**	**100**	**50**	**700**

MC210	**Mandatory Course-III**	**Constitution of India – Basic features and fundamental principles**
MC221	**Mandatory Course-IV**	**Innovation - Project based – Sc., Tech, Social, Design & Innovation**

Note: *For evaluation of Oral/Practical/TW, students should submit the journal regularly. Non submission of journal will be treated as absentees in concern head.*

T.Y.B. Tech SEM V

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
			L	T	P		Theory			OR	PR	TW	Total
							ISE	ESE	CIA				
PRJ	ME301	Professional Internship-I	-	-	-	2	-	-	-	50	-	-	50
PCC	ME302	Production Technology	3	-	-	3	30	50	20	-	-	-	100
PCC	ME303	Machine Design –I	3	-	-	3	30	50	20	-	-	-	100
PCC	ME304	Metrology and QC	3	-	-	3	30	50	20	-	-	-	100
PCC	ME305	Heat Transfer	3	-	-	3	30	50	20	-	-	-	100
PEC	ME306	Professional Elective-I	3	-	-	3	30	50	20	-	-	-	100
PCC	ME307	Machine Design –I Lab	-	-	2	1	-	-	-	-	-	25	25
PCC	ME308	Metrology and QC Lab	-	-	2	1	-	-	-	25	-	-	25
PCC	ME309	Heat Transfer Lab	-	-	2	1	-	-	-	-	50	-	50
PRJ	ME310	Skill based Credit Course/PBL	1	-	-	1	-	-	50	-	-	-	50
MLC	ME311	Mandatory Learning Course	1	-	-	NC	-	-	-	-	-	-	-
		Total	**17**		**06**	**21**	**150**	**250**	**150**	**75**	**50**	**25**	**700**

T.Y.B. Tech SEM VI

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
			L	T	P		Theory			OR	PR	TW	Total
							ISE	ESE	CIA				
PCC	ME312	Applied Thermodynamics	3	-	-	3	30	50	20	-	-	-	100
PCC	ME313	Machine Design –II	3	-	-	3	30	50	20	-	-	-	100
PEC	ME314	Professional Elective-II	3	-	-	3	30	50	20	-	-	-	100
OE	ME315	Open Elective-I	4	-	-	4	30	50	20	-	-	-	100
PRJ	PR316	IPR & EDP	2	-	-	2	15	25	10	-	-	-	50
PRJ	PR317	IPR & EDP Lab	-	-	2	1	-	-	-	-	-	50	50
HSMC	HS318	Corporate Readiness	1	-	2	2	-	-	-	-	-	50	50
PCC	ME319	Applied Thermodynamics Lab	-	-	2	1	-	-	-	-	50	-	50
PCC	ME320	Machine Design –II Lab	-	-	2	1	-	-	-	50	-	-	50
PCC	ME321	Machine Shop-II Lab	-	-	2	1	-	-	-	-	-	50	50
MLC	ME322	Mandatory Learning Course	1	-	-	NC	-	-	-	-	-	-	-
		Total	**17**	**-**	**10**	**21**	**135**	**225**	**90**	**50**	**50**	**150**	**700**

Professional Elective – I		Professional Elective – II	
ME306A	Refrigeration System	ME314A	Turbo Machinery
ME306B	Reliability Engineering	ME314B	Operation Research
ME306C	Industrial Tribology	ME314C	Process Equipment Design

Open Electives-I			
ME315A	IoT (Internet of Things)	ME315C	Digital Marketing
ME315B	Artificial Intelligence	ME315D	Enterprise Resource Planning
ME315E	Renewable Energy Sources	ME315F	OOP-C++/JAVA/Python

ME311	**Mandatory Learning Course**	**Proficiency Skills (Design Thinking)**
ME322	**Mandatory Learning Course**	**Proficiency Skills (Programing Skills)**

Final. B.Tech SEM VII

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
							Theory			OR	PR	TW	Total
			L	T	P		ISE	ESE	CIA				
PRJ	ME401	Professional Internship-II	-	-	-	2	-	-	-	50	-	-	50
PCC	ME402	Finite Element Analysis	3	-	-	3	30	50	20	-	-	-	100
PCC	ME403	Mechatronics	3	-	-	3	30	50	20	-	-	-	100
PEC	ME404	Professinal Elective-III	3	-	-	3	30	50	20	-	-	-	100
OE	ME405	Open Elective-II	3	-	-	3	30	50	20	-	-	-	100
OE	ME406	Open ELECTIVE-III [Online through MOOCs]	-	-	-	2	-	-	100*	-	-	-	100 *
PCC	ME407	Finite Element Analysis Lab	-	-	2	1	-	-	-		25	-	25
PCC	ME408	Mechatronics Lab	-	-	2	1	-	-	-	25	-	-	25
PRJ	ME409	Project Stage-I	-	-	4	2	-	-	-	50	-	-	50
MLC	ME410	Mandatory Learning Course	(1)	-	-	Non-Credit	-	-	-	-	-	-	-
		Total	**13**	**-**	**8**	**20**	**120**	**200**	**180**	**125**	**25**	**-**	**650**

Final. B.Tech SEM VIII

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
							Theory			OR	PR	TW	Total
			L	T	P		ISE	ESE	CIA				
PCC	ME411	HVAC Heating Ventilation and Air Conditioning	3	-	-	3	30	50	20	-	-	-	100
PCC	ME412	Hydraulic and Pneumatics	3	-	-	3	30	50	20	-	-	-	100
PCC	ME413	Dynamics of Machines	3	-	-	3	30	50	20	-	-	-	100
PEC	ME414	Professional Elective-IV	3	-	-	3	30	50	20	-	-	-	100
PCC	ME415	HVAC Heating Ventilation and Air Conditioning Lab	-	-	2	1	-	-	-	-	50	-	50
PCC	ME416	Hydraulic and Pneumatics Lab	-	-	2	1				50	-	-	50
PRJ	ME417	Project Stage-II	-	-	8	4				50	-	100	150
MLC	ME418	Mandatory Learning Course	(1)	-		Non-Credit	-	-	-	-	-	-	-
		Total	**13**	**-**	**12**	**18**	**120**	**200**	**80**	**100**	**50**	**100**	**650**

Professional Elective – III		**Professional Elective – IV**	
ME404A	Additive Manufacturing	ME414A	Advanced Finite Element Analysis
ME404B	Computational Fluid Dynamics	ME414B	Power Plant Engineering
ME404C	Robotics and Automation	ME414C	Automobile Engg

Open Electives-II		**Open Electives-III**	
ME405A	Optimization Techniques	ME406A	**Industrial Safety**
ME405B	Artificial Neural Networks and Fuzzy Systems	ME406B	Logistics & ware-housing
ME405C	Cyber Law and Ethics	**3**	
ME405D	Speech and Image Processing	**4**	
ME405E	Fire Safety (Health Safety and Environment)	**5**	
ME405F	Quality Management System	**6**	

ME410	**Mandatory Learning Course**	
ME418	**Mandatory Learning Course**	

Credit Structure

Semester	No of Credits	Total Marks	Oral Heads	Pr Heads	TW Heads
I	21	650	-	-	5
II	21	650	-	-	6
III	20	700	2	1	1
IV	22	700	3	2	1
V	21	700	1	1	1
VI	21	700	1	1	3
VII	20	650	3	1	-
VIII	18	650	2	1	1
Total	164	5400	12	7	18

Note: *For evaluation of Oral/Practical/TW, students should submit the journal regularly. Non submission of journal will be treated as absentees in concern head.*

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE - 2019 PATTERN

SECOND YEAR B. TECH.

LIST OF ABBREVIATIONS			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
ES	Engineering Science	HSMC	Humanity Science
PC	Professional Core	CA	Continuous Assessment
PE	Professional Elective	OR	End Semester Oral Examination
OE	Open Elective	PR	End Semester Practical Examination
ISE	In-Semester Evaluation	TW	Continuous Term work Evaluation
ESE	End-Semester Evaluation	BSC	Basic Science Course
PRJ	Project	MC	Mandatory Course

COURSE STRUCTURE- 2019 PATTERN
SECOND YEAR B. TECH : MECHANICAL ENGINEERING

SEMESTER-I

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks						
			L (hrs)	T (hrs)	P (hrs)		Theory			OR	PR	TW	Total
							ISE	ESE	CA				
PRJ	ME201	First Year Internship	-	-	-	2	-	-	-	50	-	-	50
BSC	BS202	Vector Calculus and Differential Equations	3	1	-	4	30	50	20	-	-	-	100
PC	ME203	Basic Thermodynamics	3	-		3	30	50	20	-	-	-	100
PC	ME204	Manufacturing Processes	3	-		3	30	50	20	-	-	-	100
PC	ME205	Strength of Materials	3	-		3	30	50	20	-	-	-	100
HSMC	HS206	Universal Human Values & Ethics	3	-	-	3	30	50	20	-	-	-	100
PC	ME207	Basic Thermodynamics Lab			2	1	-	-	-	50		25	75
PC	ME208	Machine Shop - I			2	1	-	-	-	25		25	50
PC	ME209	Strength of Materials Lab			2	1	-	-	-	50		25	75
MC	MC210	**Mandatory Course-III**	2	-	-	No	-	-	-	-	-	-	-
		Total	17	1	6	**21**							**750**

SEMESTER-II

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks						
			L (hrs)	T (hrs)	P (hrs)		Theory			OR	PR	TW	Total
							ISE	ESE	CA				
PC	ME211	Numerical Methods	3	-		3	30	50	20	-	-	-	100
PC	ME212	Fluid Mechanics	4	-		4	30	50	20	-	-	-	100
PC	ME213	Materials Science & Metallurgy	3	-		3	30	50	20	-	-	-	100
PC	ME214	Kinematics of Machines	4	-		4	30	50	20	-	-	-	100
PRJ	ME215	Seminar	-	-	4	2	-	-	-	25	-	25	50
PC	ME216	Machine Drawing & Geometrical modeling	1	-	4	3	-	-	-	-	-	50	50
PC	ME217	Numerical Methods Lab			2	1	-	-	-	-	25		25
PC	ME218	Fluid Mechanics Lab			2	1	-	-	-	-	50	25	75
PC	ME219	Materials Science & Metallurgy Lab			2	1	-	-	-	50	-	25	75
PC	ME220	Kinematics of Machines Lab			2	1	-	-	-	50	-	25	75
MC	**MC221**	**Mandatory Course-IV**	**2**	-	-	**No**	-	-	-	-	-	-	-
		Total	17	-	16	**23**							**750**

MC210	**Mandatory Course-III**	**Constitution of India – Basic features and fundamental principles**
MC221	**Mandatory Course-IV**	**Innovation - Project based – Sc., Tech, Social, Design & Innovation**

SANJIVANI RURAL EDUCATION SOCIETY'S
SANJIVANI COLLEGE OF ENGINEERING, KOPARGAON

VECTOR CALCULUS AND DIFFERENTIAL EQUATION (BS202)

==========

Teaching Scheme
Lectures: 03 Hrs./ Week
Practical: ----------
Tutorials: 01 Hrs./ Week
Total: 100 Marks

Examination Scheme
In-Sem Exam : 30 Marks
End Sem Exam: 50 Marks
Teacher Assessment: 20 Marks
Credits: 04

==========

COURSE OBJECTIVES

1. To describe and recall the basics of Vector Calculus and differential equations.
2. To understand the concept for solving problems based on vector and differential calculus in the universe.
3 To apply core concepts for the solution of engineering problems based on Vector calculus and differential equations.
4 To analyze the problems of which kind and their solution methods available in Vector and differential calculus and use a particular method for finding a solution in the engineering field.

COURSE OUTCOMES

The Students are able to

1 Know and recall the basics of Vector Calculus and differential equations.
2 Understand the concept used for solving problems based on vector and differential calculus in the universe.
3 Apply core concepts for the solution of engineering problems based on Vector calculus and differential equations.
4 Analyze the problems of which kind and their solution methods available in Vector and differential calculus and use a particular method for finding a solution in the engineering field.

CO's	Course Outcomes	Bloom's Taxonomy	
		Level	Descriptor
CO1	Know and recall the basics of Vector Calculus and differential equations	**1**	**Remember**
CO2	Understand the concept used for solving problems based on vector and differential calculus in the universe	**2**	**Understand**
CO3	Apply core concepts for the solution of engineering problems based on Vector calculus and differential equations	**3**	**Apply**
CO4	Analyze the problems of which kind and their solution methods available in Vector and differential calculus and use a particular method for finding a solution in the engineering field	**4**	**Analyse**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	2	2	1	-	1	-	-
CO2	3	2	-	-	1	-	-	2	2	1	-	1	-	-
CO3	3	2	-	-	1	-	-	2	2	1	-	1	-	-
CO4	3	2	-	-	1	-	-	2	2	1	-	1	-	-

(Specify values as : 3: High Level, 2: Medium Level, 1: Low Level for mapping of Cos to POs)

COURSE CONTENTS

Unit-I	VECTOR DIFFERENTIATION	No.of Hours	COs
	Scalar and vector point function, Derivative of a vector point function, Gradient of scalar function ∅, Directional derivative, Divergence and Curl of vector point function, Solenoidal and irrotational vector field and scalar potential, vector identities.	08	1,3
Unit-II	**VECTOR INTEGRATION**	**No.of Hours**	**COs**
	Line integral, Green's theorem, Work done, Conservative field, surface integral, Stokes theorem, volume integral, Gauss Divergence theorem.	08	3,4
Unit-III	**HIGHER ORDER DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	Homogeneous and non-homogeneous linear differential equation of n^{th} order and its solution, Method of variation of parameter, operator method for particular integral, solution of certain types of linear differential equation:-Cauchy's and Legendre's differential equation, Applications Branch wise (Simple Electrical Circuits, Mass spring system and Bending moments).	08	1,2,3
Unit-IV	**SERIES SOLUTION OF DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	Linear differential equations with variable coefficients, solution about ordinary point, about singular point (Frobenius method) series solution of Bessel's equation, series solution of Legendre's equation,	08	3,4
Unit-V	**PARTIAL DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	Formation of partial differential equation, Partial differential equation of order one (linear and nonlinear), Charpit method, PDE of higher order with constant coefficient	08	2,3,4
Unit-VI	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION**	**No.of Hours**	**COs**
	One dimensional heat equation, Wave equation, Two dimensional heat equation (Laplace equation), Telephone equation, Radio equations	08	1,3,4
Books:			
Text Book(s)			
1. B. S. Grewal, Higher Engineering Mathematics, 42/e, Khanna Publishers, 2012, **ISBN-13: 978-8174091154.**			
2. N. P. Bali and Manish Goyal, A TextBook of Engineering, Mathematics, 8/e, Lakshmi			

Publications, 2012. **ISBN: 9788131808320.**

3. H. K. Das, Engineering Mathematics, S Chand, 2006, **ISBN-8121905209**

References

1. K.A. Stroud & D. S. Booth, Advanced Engineering Mathematics, Industrial Press, 5/e, 2011, **ISBN-9780831134495**
2. P. C. Matthews, Vector Calculus, Springer, 2/e, 2012, **ISBN-9783540761808**
3. Robert C. Wrede, Introduction to vector and tensor analysis, Dover, 2013, **ISBN-048661879X**
4. W. E. Boyce, R. C. Diprima, Elementary differential equation and boundary value problems.
5. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House, 2014. **ISBN-13: 978-1842653418.**
6. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, 9/e, 2013, **ISBN-13: 978-0471488859.**

Sanjivani College of Engineering Kopargaon

(An Autonomous Engineering Institute)

S.Y. B.Tech

Subject Name: Basic Thermodynamics (ME203)

Teaching Scheme	-	**Examination Scheme**
Lectures: 03 Hrs./Week		In-Sem Exam : 30 Marks
Practical: 02 Hrs./Week		End Sem Exam : 50 Marks
		Teacher's Assessment (TA) : 20 Marks
		Oral: 50 marks
		Term Work: 25 Marks
		Total marks: 175 Marks
		Total Credits: 04

Prerequisite Course: Applied Physics, Mathematics, Basic Mechanical Engineering

Course Objectives:

1. To acquire knowledge about the basic terms used in classical thermodynamics and zeroth law of thermodynamics.
2. To know and apply first law of thermodynamics to various processes, cycles.
3. To understand and apply second law of thermodynamics to various processes, cycles.
4. To learn how to make use of steam tables and Mollier diagram.
5. To learn about ideal gases and vapour power cycles & gas power cycles.
6. To learn measurements of calorific values of fuels and properties of lubricants.

Course Outcomes (COs):

1. Determine work transfer for thermodynamic processes. (BTL-3)
2. Apply first law of thermodynamics to non-flow and steady flow processes/devices. (BTL-3)
3. Determine the change in entropy for reversible and irreversible processes. (BTL-3)
4. Calculate heat transfer, work done, change in internal energy, change in entropy, change in enthalpy for processes using ideal gas and analyse the performance of thermodynamic power cycles. (BTL-4)
5. Estimate the properties of pure substances using steam table and Mollier diagram (BTL-3)
6. Determine the calorific value of solid/liquid/ gaseous fuels and properties of lubricants (BTL-3)

Mapping of Course Outcome (CO) and Programme Outcome (PO)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2									2		1			2
CO2	3									2		1			2
CO3	3									2		1			2
CO4	3				2		2			2		1			2
CO5	3	2		2		2		2	2	2		1			2
CO6	2			2				2	2	2		1			2

Course Contents

Unit-I	Thermodynamic Concepts and Basic Definitions	No. of Hours
	Introduction to Thermodynamics: system, properties, states, processes, cycle & equilibrium, Zeroth law of thermodynamics. Definition of work & heat, types of work and their evaluation for various thermodynamics processes , Comparison of heat & work	06
Unit-II	**First Law of Thermodynamics**	**No. of Hours**
	First law of thermodynamics, Joules experiment, Applications of first law to flow and non flow processes and cycles. Perpetual motion machine of the first kind (PMM-I). Steady Flow Energy Equation (SFEE) Application of SFEE for devices such as nozzle and diffuser, throttling device, turbine and compressor, heat exchanger.	06.
Unit-III	**Second Law of Thermodynamics**	**No. of Hours**

	Second Law Statements: Kelvin–Planck and Clausius Statement, Heat engine, Heat pump & refrigerator. Perpetual motion machine (PMM – II), Concept of Reversibility and Irreversibility. Entropy as a property , Clausius' theorem, Clausius inequality, Change in entropy in reversible and irreversible processes, Principle of increase of entropy, Introduction to third law of thermodynamics	06
Unit-IV	**Ideal Gas Processes & Thermodynamic Cycles**	**No. of Hours**
	Ideal Gas Laws, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas processes- on P-V and T-S diagrams. Calculations of heat transfer, work done, internal energy. Change in entropy, enthalpy. Concept of availability **Thermodynamic Cycles: Gas Power Cycles:-** Introduction to Carnot Cycle, Diesel Cycle, Otto Cycle, Brayton cycle **Vapour Power Cycles:-** Introduction to Carnot Cycle, Rankine cycle.	08
Unit-V	**Properties of Pure Substance**	**No. of Hours**
	Formation of steam, phase-change phenomenon of a pure substance, Properties of steam, Use of Steam Tables, Study of P-v,T-s diagram. Mollier diagram for steam, Dryness fraction of steam and its determination.	08
Unit-VI	**Introduction to Fuels and Combustion**	**No. of Hours**
	Fuels: Definition & classification of fuels, Its composition & calorific value, Bomb and gas calorimeters, **Combustion :**Introduction, combution equations-stiochiometry, combustion analysis by mass and by volume,stiochiometric mass & volume of air for the complete combustion of a fuel, products of combution by mass & volume, conversion of volumetric to gravimetric (mass) analysis, conversion of volumetric to gravimetric analysis. Dry flue or exhaust gas, excess air.	08

Text Books:

1) P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publications, 4th Edition.
2) Yonus A Cengel and Michale A Boles, "Thermodynamics: An Engineering Approach", McGraw Hill Education, 8th Edition.

3) R.K. Rajput, “Engineering Thermodynamics”, Laxmi Publications Pvt Ltd, 3rd Edition.
4) Onkar Singh, “Applied Thermodynamics”, New Age International Publishers, 3rd Edition.

Reference Books:

1. Moran & Shapiro, “Fundamentals of Engineering Thermodynamics”, John Wiley & Sons Inc., 7th edition, 2012
2. Sonntag, Borgnakke& Van Wylen, “Fundamentals of Thermodynamics”, John Wiley & Sons Inc., 7thedition, 2012
3. Y. V. C. Rao, “Theory and Problems in Thermodynamics”, 2nd edition, 2012
4. Jones J.B. and Hawkins G.A., “Engineering Thermodynamics”, John Wyley and Sons. 2nd Edition
5. Kenneth. Wark,”Thermodynamics”, McGraw-Hill,5th Edition
6. J.P. Holman, “Thermodynamics”, McGraw-Hill, 4th Edition.
7. A.Venkatesh, “Basic Engineering Thermodynamics”, TMH, 2012
8. Reyner Joel, “Basic Engineering Thermodynamics”, Pearson Publication, 5th Edition
9. Sadhu Singh, “Thermal Engineering”, Pearson India Education Services Pvt. Ltd

List of Practical (Any 8)

1. Study of Joule’s paddle wheel experiment
2. Performance estimation of air standard cycle using software.
3. Determination of dryness fraction of steam using calorimeter.
4. Determination of calorific value of solid/liquid fuel using Bomb calorimeter
5. Visit to any industry which uses steam for process heating/power generation
6. Determination of calorific value of gaseous fuel using gas calorimeter
7. Determination of flash and fire point of a given sample oil
8. To determine thermal efficiency of internal combustion Engine.
9. To determine coefficient of performance (COP) of ice plant.

1. Syllabus Structure - Manufacturing Processes

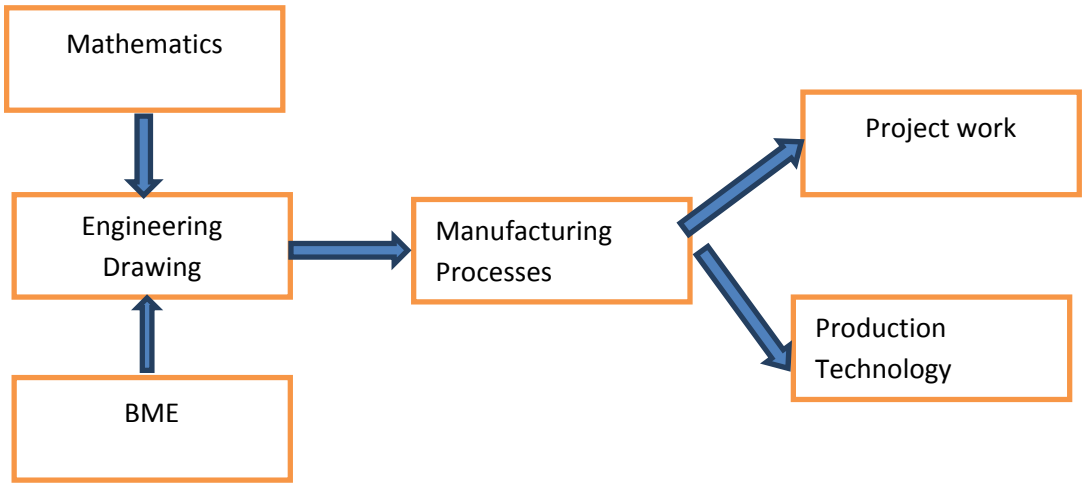
Sanjivani College of Engineering, Kopargaon Department of Mechanical Engineering			
Semester	III	**Subject credit**	03+01
Subject	Manufacturing Processes (ME204)	**No. of Lectures /Week**	3
Faculty Incharge	Mr.Jalees Ahemad	**No. of Practical /Week**	1
Examination Scheme	In Sem (30) End Sem (50) CA (20)	TW (25)	Oral (25)
Assignment (One Each Unit)	06	**Class Test** (One on two units)	03

2. Course Overview:

The subject of manufacturing processes has become increasing important to the mechanical engineer. It has been established since long that the ability to work skillfully, with hands, can be developed more readily and accurately when the work to be performed in the production shop is understood both in practical and theoretical aspects. Manufacturing processes subject deals with the study and practical work of various manufacturing processes like casting, forming, welding, plastic processing and additive manufacturing.

3. Pre and Post-requisites of the subject

The subject Manufacturing Processes has pre requisite as Engineering drawing, Mathematics and Basics of mechanical engineering as major subjects. Post-requisite has the application and practice of this knowledge in the subject like Production technology, Metrology and quality control and Project work.



4. **Course Objectives:**

a) To understand basics of foundry processes, pattern making and sand casting, die casting and calculate solidification time of castings.

b) To understand various metal forming processes such as forging, rolling, extrusion and wire drawing and calculate forces, power and work done for these processes.

c) To study different types of plastic molding processes.

d) To study various metal joining processes, their parameters and applications.

e) To understand various sheet metal working operations analyze and design dies.

f) To study various types of Additive manufacturing processes and to understand lathe machine.

5. **Course Outcome: On completion of the course,**

Course Outcome	Statements
CO1	Students will be able to describe various types of pattern ,pattern allowances ,core, castings and apply knowledge to calculate solidification time of casting.[BTL-03]
CO2	Students will be able to understand and describe various types forming processes and calculate amount of forces acting and work done .[BTL-3]
CO3	Student will be able to compare various types of plastic processing methods and their applications.[BTL-04]
CO4	Students will be able to differentiate various types of joining processes ,their applications and parameters.[BTL-04]
CO5	Students will be able to design dies for sheet metal working operations.[BTL-04]
CO6	Students will be able to describe types of additive manufacturing processes and compare them. [BTL-04]
CO7	Students will be able to operate lathe machine and perform turning, facing, taper turning operations.[BTL-03]

6. **Mapping of Course Outcomes and Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2		02	2	3	1	3	3	3	2	3	03
CO2	3	3	2	2				2	1	1		1		3	03
CO3	2							1		1		1	2	3	02
CO4	2					02	2	3	2	3	3	3		3	03

CO5	3	3	3	2				1		1		1		3	02
CO6	2				2	02	2	3	2	3	3	3	2	3	02

7. **Contents of the Syllabus**

Unit I	**Casting Processes**	No. of Hours	COs
	SAND CASTING – Pattern- types, material and allowances, Molding sand-types, properties and testing **Molding** – types, equipment's, tools and machines, Core – types and manufacturing, Gating system and Riser – types and design (Numerical), Heating and pouring, cooling and solidification-process and time estimation (Numerical), Defects and remedies, Inspection techniques. **Die casting**, Investment casting, Centrifugal Casting, Continuous Casting.	08 Hrs.	C01
Unit-II	**Metal Forming Processes**	No. of Hours	COs
	Hot and Cold Working – Concepts and comparative study, Material behavior in metal forming, friction and lubrication in metal forming **Rolling** – Types of rolling mills, flat rolling analysis, power required (Simple Numerical) **Forging** – Types, process parameter, Analysis of open die forging (Numerical) **Extrusion** – Types, process parameter, Extrusion dies, Shape factor (Numerical), **Drawing** – Wire drawing and its analysis (Numerical), tube drawing	08 Hrs.	CO2
Unit-III	**Plastic Processing**	No.of Hours	COs
	Molding – Compression molding, Transfer molding, Blow molding, Injection molding – Process and equipment. Extrusion of Plastic – Type of extruder, extrusion of film, pipe, cable and sheet Thermoforming – Principle, pressure forming and vacuum forming	04 Hrs.	C03
Unit-IV	**Joining Processes**	No.of Hours	COs

	Surface preparation and types of joints. Welding Classification, Defects and Applications. 1. **Gas welding** - Oxy acetylene gas welding, Hydrogen gas welding. 2. **Arc welding** - Metal arc welding(SMAW), Gas metal arc welding, (MIG, MAG) Tungsten inert gas welding, (TIG) Submerged arc welding,(SAW) Flux cored arc welding(FCAW), Electrode slag metal arc welding, etc 3. **Resistance welding** - Resistance but welding, seam welding, spot welding, percussion welding. **4. Thermit welding -** 5. **Solid state welding** - Forge welding, Friction welding, Pressure welding etc	08 Hrs.	C04
Unit-V	**Sheet Metal Working**	No.of Hours	COs
	Types of sheet metal operations, **Types of dies** and punches, material for dies and punches, Die design for **Progressive and Drawing Die**, clearance analysis, center of pressure, blank size determination (Numerical), strip layout, sheet utilization ratio (Numerical), methods of reducing cutting forces.	08 Hrs.	C05
Unit-VI	**Additive manufacturing Processes**	No.of Hours	COs
	Definition, need, raw materials, types of processes: Photopolymerization , Binder jetting, Material extrusion, Powder Bed Fusion, Sheet Lamination and Direct Energy Deposition. Limitations, strengths Programming methods.	06 Hrs.	C06

9. Reference Books

Text Books:
1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. I &II , Asian Publishing House. 2. D. K. Singh – Fundamentals of Manufacturing Engineering – Ane's Books. Pvt. Ltd. 3. P.N.Rao – Manufacturing technology – The Mc Graw hill companies.

Reference Books:

1. B. Ravi – Metal Casting – Computer Aided design and analysis- Prentice Hall of India
2. Reikher – Casting: An analytical approach – Springer
3. Wang – Rapid tooling guidelines for sand casting – Springer
4 J. T. Black – Degormos Materials and process in manufacturing – John Willey and sons
5 M.P Grover – Fundamentals of modern manufacturing: Materials and systems
6 Material and Processes in Manufacturing by DeGarmo E P and J T Kohser R A
7 Injection Mold Design by David O Kazmer.
8 Serope Kalpakjian Stevn- Maufactucring processes for Engineering materials.
9 John O. Milewski, Additive manufacturing Processes,Springer publications.

STRENGTH OF MATERIALS (ME205)

Teaching Scheme
Lectures: 3 Hrs. / Week
Practical: 2 Hrs./ Week
Tutorials: - Hrs./Week (if applicable)
Credits: 4

Examination Scheme
In-Sem Exam : 30 Marks
End Sem Exam: 50 Marks
Continuous Assessment: 20 Marks
Total: 100 Marks

==========

Prerequisite Course: Applied Mechanics, Mathematics

==========

Course Objectives: (Please specify Six Objectives)

To study the concepts of stress, strain, principal stresses and principal planes.
To study the concept of shearing force and bending moment due to external loads in determinate beams.
To compute slopes and deflections in determinate beams
To determine stresses and deformation in circular shafts due to torsion.
To determine safe load for columns for different end conditions

Course Outcomes (COs): Students will be able

Course Outcome	Statements
CO1	to solve problems based on stresses and strains for engineering materials [BT3]
CO2	to calculate the principal stresses and strains developed in different mechanical structures based on different theories of failures [BT3]
CO3	to calculate shear force and bending moment diagrams for determinate beams due to external loads [BT3]
CO4	to differentiate the bending stresses, shear stresses and their distribution diagrams [BT3]
CO5	to calculate slope and deflection due to external loads in determinate beams. [BT3]
CO6	to differentiate the torque developed based on strength and weight of the shaft. [BT3]

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	3		1	2	1		1	3		2
CO2	3	2	2	2	3	1		2	2	2		2	3		3
CO3	2	2	2		1	3		2	2	1	2	1	3		2
CO4	3	3	2	2	2	2		2	2	2		2	2		3
CO5	3	3	1	2	2	1		1	2	1		1	2		3
CO6	3	3	2	3	2	2		2	1	2	2	2	2		3

Course Contents

Unit	Contents	No.of Hours	COs
1	**Stresses and strains**		
	Stress, strain, Stress-strain diagram for ductile and brittle materials, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, factor of safety. Temperature stresses in simple beams, stresses in Fiber-Reinforced Composites	6 Hrs.	CO1
2	**Principal stresses and strains**		
	Principal stresses and strains: Normal and shear stresses on any oblique plane. Derivation of expression for principal stresses and maximum shear stress. Graphical solution using Mohr's circle of stresses. **Theories of elastic failure:** Maximum principal stress theory, maximum shear stress theory, maximum distortion energy theory.	6 Hrs.	C02
3	**Shear force and bending moment diagrams**		
	Shear force and bending moment diagrams for statically determinate beams due to concentrated load, uniformly distributed load, uniformly varying load and couple, Relationship between rate of loading, shear force and bending moment. Maximum bending moment and point of contra flexure.	6 Hrs.	C03
4	**Bending and Shear Stresses**		
	Bending stresses: Theory of simple bending, assumptions, derivation of flexural formula, second moment of area for (circular, Hollow, rectangular, I,T) sections with respect to centroidal and parallel axes, bending stress distribution diagrams, **Shear stresses:** Derivation of shear stress distribution formula, shear stress distribution diagrams for (circular, Hollow, rectangular, I,T) sections.	6 Hrs.	C04
5	**Slope and deflection of beams**		
	Slope and deflection of beams: Slope and deflection of determinate beams, double integration method, Macaulay's method, derivation of formula for slope and deflection for standard cases.	6 Hrs.	C05
6	**Buckling and Torsion**		
	Buckling of columns: Derivation of Euler's formula for buckling load for column with hinged ends, concept of equivalent length for end conditions-both ends hinged, both ends fixed, one end hinged and one end is fixed, limitations of Euler's formula, Rankine's formula, safe load on columns. **Torsion:** Stresses, strain and deformations in determinate shafts of solid and hollow, homogeneous and subjected to twisting moment, derivation of torsion equation, stresses due to combined torsion, bending and axial loads.	6 Hrs.	CO6

List of Practical:(All practical should be conducted)

Sr. No.	Title	CO	PO	PSO
1	Tension test on a ductile material	1	1,2, 4,5, 6,9, 10,12	1
2	Tension test on a brittle material	1		1
3	Compression test on any material (Virtual Lab)	1		1
4	Shear test (single and double) on a ductile material	4		1
5	Bending test on ductile material for simply supported beam.	4		1
6	Plotting of shear force and bending moment diagrams for different boundary conditions and loading conditions of beam (using software)	3		1
7	Comparison of numerical and analytical analysis on Slope and deflection (by using software)	5		1
8	Determination of Principal stresses by graphical method and verification through analytical method	2		1

1) Tension test for ductile materials on Universal Testing Machine
   Objectives: To determine the tensile behavior of the given specimen. Mechanical properties such as ′ 1. Stress Strain Diagram of specimen 2. Limit of proportionality 3. Elastic Limit 4. Yield Strength 5. Young's modulus 6. Ultimate strength 7. Percentage elongation 8. Percentage reduction in area.
2) Tension test for brittle materials on Universal Testing Machine
   Objectives: To determine the tensile behavior of the given specimen. Mechanical properties such as ′ 1. Stress Strain Diagram of specimen
3) Compression test for Brittle material on Universal Testing Machine. ′
   Objectives: To conduct compression test on a specimen using a UTM to determine ultimate compressive strength of the material., Draw stress strain diagram of specimen
4) Shear test (single and double) of ductile material on Universal Testing Machine
   Objectives: To verify shear strength of the material
5) Bending test on ductile material for simply supported beam on Universal Testing Machine
   Objectives: To verify flexural formula
6) Shear force and bending moment diagrams for different boundary conditions and loading conditions of beam (using software)
7) Objectives: To increase the usage of modern tools
   Numerical verification of Slope and deflection with software
8) Objectives: To increase the usage of modern tools
   Principal stresses through graphical and analytical method.
9) Objectives: To increase the usage of modern tools

Reference Books

Text Books:

1) R K Bansal, “A Textbook of Strength of Materials”, 6th Edition, Laxmi Publications, 2010 (620.112)
2) S.S. Rattan “ Strength of Materials” Tata McGraw Hill Education (India) Pvt. Ltd., 2nd Edition (Sixth reprint 2013) (620.113)
3) Ramamurtham - Strength of material - Dhanpat Rai Publication.(620.112)
4) S.S. Bhavikatti, Mechanics of Solids, The New Age International Publishers, 2010 (620.18)
5) B.K. Sarkar - Strength of material - Tata McGraw-Hill Education Publication. (620.12)

Reference Books:

- Ferdinand P. Beer, E. Russell Johnston and Jr.John T. DeWolf “Mechanics of Materials”, Tata McGraw-Hill, Sixth Edition, 2012 (620.112)
- G. H. Ryder- Strength of Materials- 3rd Edition, Macmillan Pub, India (620.119)
- E.P. Popov - Engineering Mechanics of Solids - Prentice Hall Publication. (620.104)
- Singer and Pytel - Strength of materials - Harper and row Publication. (620.113)
- Andrew Pytel & Jaan Kiusalaas, Mechanics of Materials, Second Edition, Publisher, Global Engineering, 2012 (620.113)
- R. C. Hibbeler - Mechanics of Materials - Prentice Hall Publication.

Web contents –

Strength of Materials: Mechanical Engineering By Dr. Satish C Sharma (IIT Roorkee)

Video content: Strength of Materials: Prof. S.K. Bhattacharyya (IIT Kharagpur)

Coursera: Course offered by Georgia Institute of Technology Mechanics of Materials I: Fundamentals of Stress, Strain and Axial Loading https://www.coursera.org/learn/mechanics-1

Georgia Institute of Technology-Online Course_https://www.coursera.org/lecture/materials-structures/module21-solve-a-combined-static-loading-problem-9bvsj

CO assessment table

Course	Direct Assessment									Indirect Assessment
	Assignment	Test I	Test II	Test III	PPT	In sem	End sem	Term work	Oral	Course Exit Survey
CO1	10	10			10	10	4	25	50	
CO2	10	10				10	3			
CO3	10		10			10	3			
CO4	10		10				13			
CO5	10			10			13			
CO6	10			10			14			
Total	60	20	20	20	10	30	50	25	50	

Internal assessment Tools with Rubrics

1) **Practical assessment (Rubrics)**

Weightage	Criteria	Exceeds Expectation (Level 3)	Meets Expectation (Level 2)	Needs Improvement (Level 1)
30%	A. Remembering & Understanding (Experiment Procedure)	Able To Remember And Understand All The Concepts Explained	Able To Remember And Understand Most Of The Concepts Explained	Able To Remember And Understand Few Concepts Explained
30%	B. Performance (Performance During Practicals)	Can Apply All The Concepts Effectively To Complete Experiment	Can Apply Most Of The Concepts To Complete Experiment	Can Apply Few Concepts To Complete Experiment
30%	C. Report Preparation Or Writeup (Contents Like Principle, Diagram, Observation Table, Calculations, Conclusion Etc.)	Excellent Presentation Of Writeup With All Contents.	Good Presentation Of Writeup With All Contents	Moderate Presentation Of Writeup With All Contents.
10%	D. Submission Of Writeup	Checking Of Writeup On Given Time	Checking Of Writeup One Week Late	Checking Of Writeup Two Or More Week Late

2) Assignments (One topic to a group of 4 students)- 5 marks
3) Class Test (One on each unit, Total 6)- 10 marks
4) Presentation on Topics: (One topic to a group of 4 students)-5 Marks

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS (HS206)

Teaching Scheme
Lectures: 03 Hrs./ Week
Credits: 03

Examination Scheme
In-Sem Exam: 30 Marks
End Sem Exam: 50 Marks
Teacher's Assessment: 20 Marks
Total: 100 Marks

==========

Course Objectives:

1. To make the students aware about the concept and need of value education.
2. To help the students appreciate the essential complementarity between values and skills to ensure sustained happiness and prosperity.
3. To facilitate the development of a holistic perspective among the students towards life and profession.
4. To facilitate the understanding of harmony at various levels staring from self and going towards family, society and nature.
5. To make the students aware about the correlation between engineering ethics and social experimentation in various situations.
6. To highlight the importance of professional ethics in the wake of global realities.

Course Outcomes (COs) :

After successful completion of this course, the students should be able to:

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand the concept of self exploration as the process of value education.	2	Understand
CO2	Understand the human being as the coexistence of self and body.	2	Understand
CO3	Apply the holistic approach for fulfilling human aspirations for the humans to live in harmony at various levels.	3	Apply
CO4	Analyze the universal human order in correlation with professional ethics.	4	Analyze
CO5	Apply ethical practices in engineering profession.	3	Apply
CO6	Evaluate the importance of various ethical practices in the wake of global realities.	5	Evaluate

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	-	3	-	1	-	2	-	-
CO2	-	-	-	-	-	2	-	3	-	1	-	2	-	-
CO3	-	-	-	-	-	3	-	3	-	1	-	2	-	-
CO4	-	-	-	-	-	3	-	3	-	1	-	2	-	-
CO5	-	-	-	-	-	3	-	3	-	1	-	2	-	-
CO6	-	-	-	-	-	3	-	3	-	1	-	2	-	-

COURSE CONTENTS

Unit-I	Introduction to Value Education	No. of Hours	COs
	Values, Morals and Ethics; Concept and need of value education; Self-exploration as the process for value education; Guidelines for value education; Basic human aspirations and their fulfillment	06	CO1
Unit-II	Harmony in Human Being	No. of Hours	COs
	Human being as the coexistence of self and the body; Discrimination between the needs of the self and the body; The body as an instrument; Harmony in the self; Harmony of the self with the body	06	CO2
Unit-III	Harmony in the family, society and nature	No. of Hours	COs
	Harmony in the family- The basic unit of human interaction; Values in the human to human relationship; Harmony in the society; Vision for the universal human order; Harmony in the nature; Realizing existence as coexistence at all levels	06	CO3
Unit-IV	Professional Ethics	No. of Hours	COs
	Natural acceptance of human values; Definitiveness of ethical human conduct; Humanistic education and universal human order; Competence in professional ethics; Transition towards value-based life and profession	06	CO4
Unit-V	Engineering Ethics and Social Experimentation	No. of Hours	COs
	Need of engineering ethics; Senses of engineering ethics; Variety of moral issues; Moral autonomy; Utilitarianism; Engineering as experimentation; Engineers as responsible experimenters; Codes of ethics	06	CO5
Unit-VI	Global Issues	No. of Hours	COs
	Globalization and multi-national corporations; Cross-cultural issues; Business ethics; Environmental ethics; Computer ethics; Bio-ethics; Ethics in research; Intellectual property rights and plagiarism	06	CO6

Books:
Text Books:
1. R. R. Gaur, R. Sangal, G. P. Bagaria, “A Foundation Course in Human Values and Professional Ethics”, Excel Books Pvt. Ltd.

2. R. S. Naagarazan, “A Textbook on Professional Ethics and Human Values”, New Age International (P) Ltd. Publishers

Reference Books:

1. B. P. Banerjee, “Foundations of Ethics and Management”, Excel Books Pvt. Ltd.
2. P. L. Dhar, R. R. Gaur, “Science and Humanism”, Commonwealth Publishers
3. M. K. Gandhi, “The Story of my Experiments with Truth”, Discovery Publisher
4. http://uhv.org.in/

Considering the specific nature of this course, the methodology is explorational and thus universally adaptable. In order to connect the content of this course with practice, minimum 6 group activities should be conducted with active involvement of the students. The teacher’s assessment should be strictly based on the participation of the students in these activities.

Sanjivani College of Engineering Kopargaon

(An Autonomous Engineering Institute)

S.Y. B.Tech

Subject Name: Basic Thermodynamics (ME207)

Teaching Scheme	-	**Examination Scheme**
Lectures: 03 Hrs./Week		In-Sem Exam : 30 Marks
Practical: 02 Hrs./Week		End Sem Exam : 50 Marks
		Teacher's Assessment (TA) : 20 Marks
		Oral: 50 marks
		Term Work: 25 Marks
		Total marks: 175 Marks
		Total Credits: 04

Prerequisite Course: Applied Physics, Mathematics, Basic Mechanical Engineering

Course Objectives:

1. To acquire knowledge about the basic terms used in classical thermodynamics and zeroth law of thermodynamics.
2. To know and apply first law of thermodynamics to various processes, cycles.
3. To understand and apply second law of thermodynamics to various processes, cycles.
4. To learn how to make use of steam tables and Mollier diagram.
5. To learn about ideal gases and vapour power cycles & gas power cycles.
6. To learn measurements of calorific values of fuels and properties of lubricants.

Course Outcomes (COs):

1. Determine work transfer for thermodynamic processes. (BTL-3)
2. Apply first law of thermodynamics to non-flow and steady flow processes/devices. (BTL-3)
3. Determine the change in entropy for reversible and irreversible processes. (BTL-3)
4. Calculate heat transfer, work done, change in internal energy, change in entropy, change in enthalpy for processes using ideal gas and analyse the performance of thermodynamic power cycles. (BTL-4)
5. Estimate the properties of pure substances using steam table and Mollier diagram (BTL-3)
6. Determine the calorific value of solid/liquid/ gaseous fuels and properties of lubricants (BTL-3)

Mapping of Course Outcome (CO) and Programme Outcome (PO)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	**2**									**2**		**1**			**2**
CO2	**3**									**2**		**1**			**2**
CO3	**3**									**2**		**1**			**2**
CO4	**3**				**2**		**2**			**2**		**1**			**2**
CO5	**3**	**2**		**2**		**2**		**2**	**2**	**2**		**1**			**2**
CO6	**2**			**2**				**2**	**2**	**2**		**1**			**2**

List of Practical (Any 8)

1. Study of Joule's paddle wheel experiment
2. Performance estimation of air standard cycle using software.
3. Determination of dryness fraction of steam using calorimeter.
4. Determination of calorific value of solid/liquid fuel using Bomb calorimeter
5. Visit to any industry which uses steam for process heating/power generation
6. Determination of calorific value of gaseous fuel using gas calorimeter
7. Determination of flash and fire point of a given sample oil
8. To determine thermal efficiency of internal combustion Engine.
9. To determine coefficient of performance (COP) of ice plant.

Text Books:

1) P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publications, 4th Edition.
2) Yonus A Cengel and Michale A Boles, "Thermodynamics: An Engineering Approach", McGraw Hill Education, 8th Edition.
3) R.K. Rajput, "Engineering Thermodynamics", Laxmi Publications Pvt Ltd, 3rd Edition.

4) Onkar Singh, “Applied Thermodynamics”, New Age International Publishers, 3rd Edition.

Reference Books:

1. Moran & Shapiro, “Fundamentals of Engineering Thermodynamics”, John Wiley & Sons Inc., 7th edition, 2012
2. Sonntag, Borgnakke& Van Wylen, “Fundamentals of Thermodynamics”, John Wiley & Sons Inc., 7thedition, 2012
3. Y. V. C. Rao, “Theory and Problems in Thermodynamics”, 2nd edition, 2012
4. Jones J.B. and Hawkins G.A., “Engineering Thermodynamics”, John Wyley and Sons. 2nd Edition
5. Kenneth. Wark,”Thermodynamics”, McGraw-Hill,5th Edition
6. J.P. Holman, “Thermodynamics”, McGraw-Hill, 4th Edition.
7. A.Venkatesh, “Basic Engineering Thermodynamics”, TMH, 2012
8. Reyner Joel, “Basic Engineering Thermodynamics”, Pearson Publication, 5th Edition
9. Sadhu Singh, “Thermal Engineering”, Pearson India Education Services Pvt. Ltd

1. Syllabus Structure - Manufacturing Processes

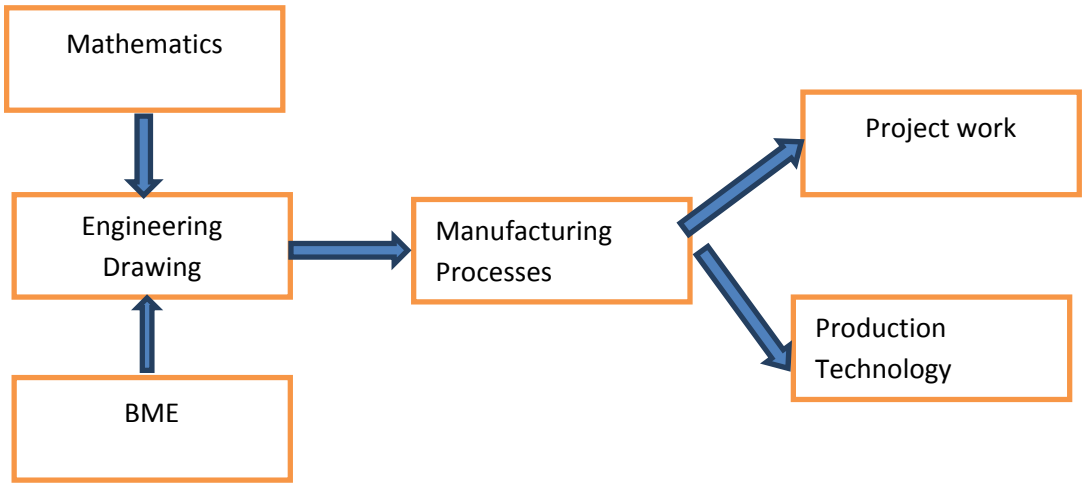
Sanjivani College of Engineering, Kopargaon Department of Mechanical Engineering			
Semester	III	**Subject credit**	03+01
Subject	Manufacturing Processes (ME208)	**No. of Lectures /Week**	3
Faculty Incharge	Mr.Jalees Ahemad	**No. of Practical /Week**	1
Examination Scheme	In Sem (30) End Sem (50) CA (20)	TW (25)	Oral (25)
Assignment (One Each Unit)	06	**Class Test** (One on two units)	03

2. Course Overview:

The subject of manufacturing processes has become increasing important to the mechanical engineer. It has been established since long that the ability to work skillfully, with hands, can be developed more readily and accurately when the work to be performed in the production shop is understood both in practical and theoretical aspects. Manufacturing processes subject deals with the study and practical work of various manufacturing processes like casting, forming, welding, plastic processing and additive manufacturing.

3. Pre and Post-requisites of the subject

The subject Manufacturing Processes has pre requisite as Engineering drawing, Mathematics and Basics of mechanical engineering as major subjects. Post-requisite has the application and practice of this knowledge in the subject like Production technology, Metrology and quality control and Project work.



4. **Course Objectives:**

a) To understand basics of foundry processes, pattern making and sand casting, die casting and calculate solidification time of castings.

b) To understand various metal forming processes such as forging, rolling, extrusion and wire drawing and calculate forces, power and work done for these processes.

c) To study different types of plastic molding processes.

d) To study various metal joining processes, their parameters and applications.

e) To understand various sheet metal working operations analyze and design dies.

f) To study various types of Additive manufacturing processes and to understand lathe machine.

5. **Course Outcome: On completion of the course,**

Course Outcome	Statements
CO1	Students will be able to describe various types of pattern ,pattern allowances ,core, castings and apply knowledge to calculate solidification time of casting.[BTL-03]
CO2	Students will be able to understand and describe various types forming processes and calculate amount of forces acting and work done .[BTL-3]
CO3	Student will be able to compare various types of plastic processing methods and their applications.[BTL-04]
CO4	Students will be able to differentiate various types of joining processes ,their applications and parameters.[BTL-04]
CO5	Students will be able to design dies for sheet metal working operations.[BTL-04]
CO6	Students will be able to describe types of additive manufacturing processes and compare them. [BTL-04]
CO7	Students will be able to operate lathe machine and perform turning, facing, taper turning operations.[BTL-03]

6. **Mapping of Course Outcomes and Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2		02	2	3	1	3	3	3	2	3	03
CO2	3	3	2	2				2	1	1		1		3	03
CO3	2							1		1		1	2	3	02
CO4	2					02	2	3	2	3	3	3		3	03
CO5	3	3	3	2				1		1		1		3	02

CO6	2				2	02	2	3	2	3	3	3	2	3	02

7. **Contents of the Syllabus**

List of Practical's:

Sr. No.	Title	CO	PO	PSO
1	Turning	CO7	1,6,7,8,9,10,11,12	02
2	Welding (Arc welding)	CO4	1,2,6,7,9,10,11,12	02,03
3	Sand moulding	CO1	1,2,6,7,8,9,10,11,12	02,03
4	3D printing	CO6	1,2,5,6,7,8,9,10,11,12	02,03

Term work – 25 marks

Assessment tools –

1. Practical Journal

2. Oral after every practical on job.

3. Assignments on every practical.

Oral Examination – 25 marks

9. Reference Books

Text Books:

1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. I &II , Asian Publishing House.
2. D. K. Singh – Fundamentals of Manufacturing Engineering – Ane's Books. Pvt. Ltd.
3. P.N.Rao – Manufacturing technology – The Mc Graw hill companies.

Reference Books:

1. B. Ravi – Metal Casting – Computer Aided design and analysis- Prentice Hall of India
2. Reikher – Casting: An analytical approach – Springer
3. Wang – Rapid tooling guidelines for sand casting – Springer
4 J. T. Black – Degormos Materials and process in manufacturing – John Willey and sons
5 M.P Grover – Fundamentals of modern manufacturing: Materials and systems
6 Material and Processes in Manufacturing by DeGarmo E P and J T Kohser R A
7 Injection Mold Design by David O Kazmer.
8 Serope Kalpakjian Stevn- Maufactucring processes for Engineering materials.
9 John O. Milewski, Additive manufacturing Processes,Springer publications.

STRENGTH OF MATERIALS Lab. [ME209]

S.Y. Tech. Mechanical

Teaching Scheme
Practical: 2 Hrs./ Week
Credits: 1

Examination Scheme
Term Work: 25 Marks
Oral: 50 Marks
Total Marks: 75 Marks

Pre-requisite Course: Applied Mechanics, Mathematics
Post-requisite Course: Machine Design -I & II, Material Science, Project

Course Overview:

The subject strength of material encompasses the fundamentals of all material properties starting from simple stresses, principle stresses to buckling and torsion, material behaviour under different loading conditions like shear, temperature and bending, and also the knowledge of material failures. The concepts of stress, strain, stress-strain diagram is very much useful in selection of material in machine design process. It also includes concepts like principal stresses and strains which is important tool for understanding material failure. The concepts of shear force and bending moment diagrams are helpful in designing machine elements like shafts, frames.

Course Objectives :

- To conduct tension test on the given mild steel rod for determining mechanical properties
- To determine the ultimate stress to which the specimen can withstand
- To conduct shear test on given specimen under single and double shear.
- To determine the Young's modulus of the given specimen by conducting bending test.
- To use software to verify theoretical values

Course Outcomes (COs): Students will be able

Course Outcome	Statements	Blooms Taxonomy Level
CO1	To conduct a test on universal testing machine to determine mechanical properties of the given specimen	4
CO2	To demonstrate single and double shear test on the specimen	4
CO3	to verify the flexural formula for a simply supported beam	3
CO4	To plot shear force and bending moment diagrams using software	3
CO5	To compare the experimental values of deflection of a simply supported beam with theoretical values	4
CO6	To determine the Principal stresses by graphical method and verification through analytical method.	3

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			2	1	2		1	1	1		1	2		
CO2	1			1		2		1	2	2		2	2		
CO3	1			1		2		2	2	1		1	2		
CO4	1			2	2			1	1	2		2	2		
CO5	1			1	1			1	1	1		1	2		
CO6	1			2	2			1	2	2		2	2		

List of Practical:(All practical should be conducted)

Sr. No.	Title	CO	PO	PSO
1	Tension test on a ductile material to determine its mechanical properties. http://sm-nitk.vlabs.ac.in/exp13/index.html	1	1, 4,5, 6,9, 10,12	1
2	Tension test on a brittle material to draw stress-strain diagram and to evaluate its ultimate stress http://sm-nitk.vlabs.ac.in/exp14/index.html	1		1
3	To determine Compressive strength of materials (Virtual Lab) http://sm-nitk.vlabs.ac.in/exp16/index.html	1		1
4	To determine Shear strength of mild steel material under single and double shear http://sm-nitk.vlabs.ac.in/exp7/index.html	2		1
5	To find the values of bending stresses and young's modulus of the material of a simply supported beam http://sm-nitk.vlabs.ac.in/exp2/index.html	3		1
6	Plotting of shear force and bending moment diagrams for different boundary conditions and loading conditions of beam (using software)	4		1
7	Comparison of numerical and analytical analysis on Slope and deflection (by using software)	5		1
8	Determination of Principal stresses by graphical method and verification through analytical method	6		1

References:

- William Smith, Javad Hashemi, ***Foundations of materials science and engineering***, 2019, 6th edition, McGraw-Hill, ISBN 007-125690-3.
- Dieter, G.E., ***Mechanical metallurgy***, 1988, SI metric edition, McGraw-Hill, ISBN 0-07-100406-8.
- Norman E. Dowling, ***Mechanical Behavior of Materials***, Prentice-Hall International, 4th edition, 2013.
- W.D. Callister, ***Fundamental of materials science and engineering/an interactive e. text***,2001, John Willey & Sons, Inc., New York, ISBN 0-471-39551-x

Internal assessment Tools with Rubrics

1) Practical assessment (25 Marks)

WEIGHTAGE	CRITERIA	EXCEEDS EXPECTATION (LEVEL 3)	MEETS EXPECTATION (LEVEL 2)	NEEDS IMPROVEMENT (LEVEL 1)
30%	A. REMEMBERING & UNDERSTANDING (Experiment Procedure)	Able to remember and understand ALL the Concepts explained	Able to remember and understand MOST of the Concepts explained	Able to remember and understand FEW Concepts explained
30%	B. PERFORMANCE (Performance During Practicals)	Can apply ALL the Concepts effectively to complete Experiment	Can apply MOST of the Concepts to complete Experiment	Can apply FEW Concepts to complete Experiment
30%	C. REPORT PREPARATION OR WRITEUP (contents like Principle, diagram, observation table, calculations, conclusion etc.)	Excellent Presentation of writeup with all contents.	Good Presentation of writeup with all contents	Moderate Presentation of writeup with all contents.
10%	D. SUBMISSION Of WRITEUP	Checking of writeup ON Given Time	Checking of writeup one week Late	Checking of writeup two or more week late

SYLLABUS

SUBJECT: CONSTITUTION OF INDIA (MC210)

Course Code = [Branch Specific] L: T: P: C = 2:0:0:0

(L=Lecture, T=Tutorial, P = Practical, C = Credits)

Course Objectives

1. To study the historical background, salient features and preamble of Indian constitution
2. To study the provision of fundamental right in the Indian constitution.
3. To study the directive principle of state policy and fundamental duties.
4. To study the system of government through parliamentary and federal system,
5. To understand the formation, structure and legislative framework of central government.
6. To understand the formation, structure and legislative framework of state government.

Course Outcomes

Sr. No.	CO	Course Outcome	Bloom's Taxonomy Level	Level
1	CO1	The students can describe background, salient features of constitution of India	Remembering	1
2	CO2	The students can explain the system of government, it's structure and legislative framework also can interpret the fundamental rights and duties	Understanding	2
3	CO3	The student can use the fundamental rights and duties in their life	Applying	3

Unit-1: Introduction to Constitution of India

a. Historical background
b. Salient features
c. Preamble of constitution

Unit-2: Fundamental rights

a. Features of fundamental rights
b. Basic rights 1. Right to equality; 2. Right to freedom; 3. Right against exploitation; 4. Right to freedom of religion; 5. Cultural and educational rights; 6.Right to property; 7. Right to constitutional remedies

Unit-3: (A) Directive principle of state policy:

a. Features of directive principle
b. Classification of directive principle
c. Criticism of directive principle
d. Utility of directive principle
e. Conflict between Fundamental rights and directive principle

(B) Fundamental duties:

a. List of fundamental duties
b. Features of fundamental duties
c. Criticism of fundamental duties
d. Significance of fundamental duties
e. Swaran Singh Committee Recommendations

Unit-4: System of Government

a. Parliamentary system: Features of parliamentary government, Features of presidential government, merits and demerit of Parliamentary system
b. Federal system: Federal features of constitution, unitary features of constitution
c. Centre and state relation: Legislative relation, administrative relations and financial relation.
d. Emergency provision: National emergency, Financial emergency and criticism of emergency provision

Unit-5: Central government

a. President: Election of president, powers and functions of president, and Veto power of president
b. Vice-president: Election of vice-president, powers and functions of vice-president
c. Prime minister: Appointment of PM, powers and functions of PM, relationship with president
d. Central council of ministers: Appointment of ministers, responsibility of ministers, features of cabinet committees, functions of cabinet committees
e. Parliament: Organization of parliament, composition of the two houses , duration two houses, membership of parliament, session of parliament, joint sitting of two houses, budget in parliament.
f. Supreme court (SC): Organization of supreme court, independence of supreme court, jurisdiction and powers of supreme court

Unit-6: State government

a. Governor: Appointment of governor, powers and functions of governor, constitutional position
b. Chief minister: Appointment of CM, powers and functions of CM, relationship with governor

c. State council of ministers: Appointment of ministers, responsibility of ministers, cabinet.
d. High court (HC): Organization of HC, independence of HC, jurisdiction and powers of HC
e. Sub-ordinate court: Structure and jurisdiction, Lok Adalats, Family court, Gram Nyayalayas

Reference Book:

1. Indian Polity for Civil Service Examination, M Laxmikanth, Mc GrawHill Education, Fifth Edition.
2. Introduction to the Constitution of India, Durga Das Basu, LexisNexis, 22 nd Edition

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE - 2019 PATTERN

SECOND YEAR B. TECH.

LIST OF ABBREVIATIONS			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
ES	Engineering Science	HSMC	Humanity Science
PC	Professional Core	CA	Continuous Assessment
PE	Professional Elective	OR	End Semester Oral Examination
OE	Open Elective	PR	End Semester Practical Examination
ISE	In-Semester Evaluation	TW	Continuous Term work Evaluation
ESE	End-Semester Evaluation	BSC	Basic Science Course
PRJ	Project	MC	Mandatory Course

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING

KOPARGAON-423603

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

Sanjivani College of Engineering was established in the year 1983. The Mechanical Engineering Department is a part of the institute since its inception. The Department has grown over the years with qualified teaching faculty members who are passionate to impart quality education. The department laboratories are fully equipped with latest equipment's, software's and all necessary teaching aids. It is now recognized as one of the prominent departments and known for academic excellence under the Pune University. The department is having valid Accreditation by 'NBA' from 31 July 2015 to 31 June 2021. Besides high quality teaching and instruction at UG, PG and Ph. D., the department is actively involved in basic and applied research and consultancy services. The department is providing quality technical and advisory support through consultancy to various private construction agencies, State Government, Central Government projects. Apart from academic knowledge, we also, train our students to face the challenges in their profession by providing value added courses like Communication and Presentation skills, building of Team Sprit through field study, expert talk etc. The department also, provides an opportunity to learn software's like MATLAB, AUTOCAD, UGNX, ANSYS, PTC Creo etc. to make our students more digitalized.

We arrange regular interaction of our stake holders like students, parents and faculty along with a Training and Placement cell which works full time for bright future of our students. The results are consistently above 90% and considerable number of student ranks in SPPU merit list. Students from Mechanical department have made incredible mark national and international levels and we are sure will continue in times to come. The Infrastructure development in India is growing at a faster rate and there are many career paths for Mechanical engineers. Mechanical engineers are essential in government sector, public and private sector and Multinational companies, to build various mega projects like highways, Industrial structures, smart cities, and reservoirs etc. The next decade will be most demanding and rewarding for Mechanical engineers.

Vision of Department

Our vision is to develop world class, multidimensional, competent, disciplined and ethical Mechanical engineers for the society.

Mission of Department

Our mission is,

To impart the quality education to the students through class-room teaching, innovative projects, and industry-institution interaction.

To provide a better environment to encourage and support participation in co-curricular and extra-curricular activities.

To use technology of Mechanical Engineering as a prime tool for the multifaceted development of our students in the emerging fields of Engineering.

Program Outcomes (POs)

Mechanical Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

PEO1: To develop graduates with a sound technical knowledge for a successful career in industries, higher studies and as an entrepreneur.

PEO2: To prepare graduates with expertise in use of modeling, analysis and programming software.

PEO3: To inculcate interpersonal skills with ethical approach and contribute towards social, personal, economic and environmental issues.

Program Specific Outcomes (PSOs)

At the end of the program graduates will demonstrate ability to

PSO1. Design and manufacture mechanical components and systems

PSO2. Model and analyze machine components using modeling and analysis software's.

PSO3. Specify, analyze and determine the performance of thermal systems including IC engines, refrigeration and air conditioning systems, air compressors, hydraulic turbines and pumps.

COURSE STRUCTURE- 2019 PATTERN
SECOND YEAR B. TECH : MECHANICAL ENGINEERING

SEMESTER-III

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks						
			L (hrs)	T (hrs)	P (hrs)		Theory			OR	PR	TW	Total
							ISE	ESE	CA				
PRJ	ME201	General Prof. Skills	-	-	2	1	-	-	-	-	-	50	50
BSC	BS202	Vector Calculus and Differential Equations	3	1	-	4	30	50	20	-	-	-	100
PC	ME203	Basic Thermodynamics	3	-	-	3	30	50	20	-	-	-	100
PC	ME204	Manufacturing Processes	3	-	-	3	30	50	20	-	-	-	100
PC	ME205	Strength of Materials	3	-	-	3	30	50	20	-	-	-	100
HSMC	HS206	Universal Human Values & Ethics	3	-	-	3	30	50	20	-	-	-	100
PC	ME207	Basic Thermodynamics Lab	-	-	2	1	-	-	-	50	-	-	50
PC	ME208	Machine Shop - I	-	-	2	1	-	-	-	-	50	-	50
PC	ME209	Strength of Materials Lab	-	-	2	1	-	-	-	50	-	-	50
MC	MC210	Mandatory Course-III	2	-	-	No	-	-	-	-	-	-	-
		Total	17	1	8	**20**	**150**	**250**	**100**	**100**	**50**	**50**	**700**

SEMESTER-IV

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks						
			L (hrs)	T (hrs)	P (hrs)		Theory			OR	PR	TW	Total
							ISE	ESE	CA				
PC	ME211	Numerical Methods	3	-	-	3	30	50	20	-	-	-	100
PC	ME212	Fluid Mechanics	4	-	-	4	30	50	20	-	-	-	100
PC	ME213	Materials Science & Metallurgy	3	-	-	3	30	50	20	-	-	-	100
PC	ME214	Kinematics of Machines	4	-	-	4	30	50	20	-	-	-	100
PRJ	ME215	Seminar	-	-	2	1	-	-	-	50	-	-	50
PC	ME216	Machine Drawing & Geometrical Modeling	1	-	4	3	-	-	-	-	-	50	50
PC	ME217	Numerical Methods Lab	-	-	2	1	-	-	-	-	50		50
PC	ME218	Fluid Mechanics Lab	-	-	2	1	-	-	-	-	50	-	50
PC	ME219	Materials Science & Metallurgy Lab	-	-	2	1	-	-	-	50	-	-	50
PC	ME220	Kinematics of Machines Lab	-	-	2	1	-	-	-	50	-	-	50
MC	**MC221**	**Mandatory Course-IV**	**2**	-	-	**No**	-	-	-	-	-	-	-
		Total	17	-	14	**22**	**120**	**200**	**80**	**150**	**100**	**50**	**700**

MC210	**Mandatory Course-III**	**Constitution of India – Basic features and fundamental principles**
MC221	**Mandatory Course-IV**	**Innovation - Project based – Sc., Tech, Social, Design & Innovation**

Note: *For evaluation of Oral/Practical/TW, students should submit the journal regularly. Non submission of journal will be treated as absentees in concern head.*

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	NM (ME 211)
Subject	Numerical Methods	**No. of Lectures /Week**	3
Faculty Incharge	Dr P M Patare	**No. of Practical /Week**	--
Examination Scheme	In Sem (30) End Sem (50)	CA (20)	--
Assignment (One Each Unit)	06	**Class Test** (One on one units)	06

1. Course Objectives:

1. To **understand** the difference between analytical and Numerical Methods.
2. To **apply** Numerical Techniques for solving complex Mechanical engineering Problems.
3. To prepare base for **understanding** engineering analysis software.
4. **Develop** logical sequencing for solution procedure and skills in soft computing.
5. **Optimize** the solution for different real life problems with available constraints.
6. **Build** the foundation for engineering research

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	To **understand** different analytical and numerical methods to find the roots of the equations	2	Understand
CO2	To **apply** different numerical and analytical techniques to solve various types of simultaneous equations.	3	Apply
CO3	To **learn** various traditional and advanced optimization technique.	4	Analyze
CO4	To **recognize** and **learn** different numerical techniques to handle the differential equations.	4	Analyze
CO5	To **Evaluate and interpret** the data using curve fitting and regression analysis tools.	5	Evaluate
CO6	To **formulate** numerical techniques to solve the engineering problems using integration techniques	5	Evaluate

COURSE CONTENTS

Unit	Topics	No. of Hours	COs
Unit-I	**Roots of Equation and Error Approximations**		
	Roots of Equation : Bisection Method, Newton Raphson method **Error Approximations :** Types of Errors: Absolute, Relative, Algorithmic, Truncation, Round off Error, Error Propagation, Concept of convergence-relevance to numerical methods.	06	CO1
Unit-II	**Simultaneous Equations**		
	Gauss Elimination Method with Partial pivoting, Gauss-Seidal method and Thomas algorithm for Tri-diagonal Matrix	06	CO2
Unit-III	**Optimization**		
	Traditional Optimization Technique : GRA (Grey Relational Analysis), TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), Modern Optimization Techniques: Artificial Neural Network (ANN)	06	CO3
Unit-IV	**Numerical Solutions of Differential Equation**		
	Ordinary Differential Equations [ODE] Taylor series method, Euler Method, Runge-Kutta fourth order, Simultaneous equations using Runge Kutta 2nd order method. **Partial Differential Equations [PDE]:** Finite Difference methods Introduction to finite difference method, Simple Laplace method	06	CO4
Unit-V	**Curve Fitting and Regression Analysis**		
	Curve Fitting Least square technique- Straight line, Power equation, Exponential equation and Quadratic equation. Regression Analysis **Introduction to multi regression analysis,** Lagrange's Interpolation, Newton's Forward interpolation, Inverse interpolation (Lagrange's method only)	06	CO5
Unit-VI	**Numerical Integration**		
	Numerical Integration (1D only). Trapezoidal rule, Simpson's 1/3rdRule, Simpson's 3/8thRule. Double Integration, Trapezoidal rule.	06	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Numerical Methods for Engineers	Steven C. Chapra, Raymond P. Canale	Tata McGraw Hill	511.7 CHA-04 28520
2	Numerical Methods in Engineering and Science	Dr. B. S. Garewal	Khanna Publishers	511.7 GRE-10 70477
3	Applied Numerical Methods with MATLAB for Engineers and Scientist	Steven C. Chapra	Tata McGraw Hill	511.7 CHA-15 59147
4	Applied Numerical Methods using Matlab	Rao V. Dukkipati	New Age International Publishers	511.7 RAO-15 59301

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Applied Numerical Analysis	Gerald and Wheatley	Pearson Education	510 GER-16 59566
2	Numerical Methods	E. Balagurusamy	Tata McGraw Hill	511.7 E B-07 43889
3	Computer Oriented Numerical Methods	P. Thangaraj	PHI	001 THA-13 59256
4	Introductory Methods of Numerical Analysis	S. S. Sastry	PHI	511 SAS-91 13986

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	FM (ME 212)
Subject	Fluid Mechanics	**No. of Lectures /Week**	4
Faculty Incharge	Mr Y. H. Ahire	**No. of Practical /Week**	--
Examination Scheme	In Sem (30) End Sem (50)	CA (20)	--
Assignment (One Each Unit)	06	**Class Test** (One on each units)	06

1. Course Objectives:

1. To study the basic properties of fluids
2. To study fluid statics and fluid dynamics
3. To study basics of flow visualization
4. To study & apply the Bernoulli's theorem to solve various fluid flow problems
5. To compute the major & minor losses in pipe flow & forces of drag and lift
6. To analyse & establish relation between flow parameters

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	To **determine** various fluid properties encountered in fluid mechanics engineering applications	3	Apply
CO2	To **determine** total pressure force, center of pressure on submerged surfaces and metacentric height of floating body	3	Apply
CO3	To **differentiate** between the types of fluid flow and **calculate** the velocity, acceleration fields at any point in fluid flow	4	Analyze
CO4	To **apply** Bernoulli's, equation in flow measurements and **determine** the velocity, shear stress distribution for a laminar flow through pipes & parallel plates	3	Apply
CO5	To **differentiate** between major & minor losses in pipe flows and **compute** boundary layer thickness, forces of drag and lift for external flows	4	Analyze
CO6	To **formulate** the relationship among the fluid flow parameters and **predict** the performance of prototype by model studies	4	Analyze

COURSE CONTENTS

Unit	Topics	No. of Hours	COs
Unit-I	**Fundamental Concepts of Fluid and its Properties**		
	Introduction – fluids and its applications - distinction between solid and fluid-concept of continuum-properties of fluids and their measurement- rheology – no-slip condition, viscosity, viscosity relation with temperature and pressure, numerical on viscosity – Flow Characteristics - surface tension, capillarity, compressibility, vapor pressure.	06	CO1
Unit-II	**Pressure and Fluid Statics**		
	Forces acting on fluid element, pascal's law, hydrostatics law, **Manometry and barometry** - pressure scale, barometer, piezometer, manometer and its types. Numerical on manometer **Hydrostatic forces on submerged surfaces**: total pressure and center of pressure on vertical, inclined & curved surface submerged in liquid including numerical on dam gate. **Buoyancy and stability** – Metacenter, metacentric height, flotation, stability of submerged & floating bodies (No numerical).	08	CO2
Unit-III	**Fluid kinematics**		
	Lagrangian and Eulerian descriptions of flow, classification of fluid flows, velocity and acceleration fields, continuity equation (1D & 3D in cartesian system), visualization of flow (stream, path and streak line, stream tube), angularity, vorticity, stream function and velocity potential function.	06	CO3
Unit-IV	**Fluid Dynamics**		
	Equation of motion of incompressible fluid - Euler's and Navier Stokes equation. **Bernoulli's theorem and its applications** (Numerical included) - venturimeter, orifice meter, pitot tubes, introduction to orifices, notches & weirs. Introduction to coriolis flow meter. Stagnation pressure. **Laminar flow** - Entrance region theory, velocity and shear Stress distribution, fixed parallel plates and Couette flow - velocity profile of turbulent flow, hydro dynamically smooth and rough boundaries.	08	CO4
Unit-V	**Flow in pipes & External Flow**		
	Major losses - Darcy Weisbach equation, Moody chart, minor losses, Hydraulic and energy gradient, Pipes in series and parallel - concept of Equivalent Pipe, Siphons, power transmission in pipes. **External Flow:** Boundary layer concepts (flat plate) – types of boundary layer thickness, boundary layer separation and methods to control separation, drag and lift, friction and pressure drag, aerofoil, bluff body, streamline body.	08	CO5
Unit-VI	**Dimensional analysis and modelling**		
	Dimensions & units, Dimensional homogeneity, Dimensional Analysis, repeating variables, Buckingham-Pi Theorem, dimensionless parameters. Similitude & model testing: model & prototype, similarity, scaling parameters, model laws, objectives, importance and application of model studies.	06	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Fluid Mechanics & Hydraulic Machines	R. K. Bansal	Laxmi Publications	620.106 DR -15 61459
2	Introduction to Fluid Mechanics and Fluid Machines	S. K. Som, G. Biswas and S. Chakraborty	Tata McGraw Hill	620.106 SOM-12 70654
3	Fluid Mechanics: Fundamentals and Applications	Y. A. Cengel, J. M. Cimbala	McGraw Hill	620.106 CEN-TB 58663
4	Fluid Mechanics	F. M. White	Tata McGraw Hill	620.106 WHI-17 61989

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Introduction to Fluid Mechanics	R. W. Fox, P. J. Pritchard and A. T. McDonald	Wiley India	620.106 FOX-TB 56273
2	Fundamentals of Fluid Mechanics	B. R. Munson, D. F. Young, T. H. Okiishi and W. W. Huebsch	Wiley India	620.106 MUN-13 56734
3	Mechanics of Fluids	M. C. Potter, D. C. Wiggert	Cengage Learning (Indian Edition)	620.106 POT-13 59283
4	Fluid Mechanics	V. L. Streeter, E. B. Wylie and K. W. Bedford	Tata McGraw Hill	620.106 STR-98 27082

Sanjivani College of Engineering, Kopargaon Department of Mechanical Engineering			
Semester	IV	**Subject Code**	ME213(Theory)
Subject	Materials Science and Metallurgy	**No. of Lectures /Week**	3
Faculty Incharge	Mr.H.P.Varade	**No. of Practical /Week**	--
Examination Scheme	In Sem (30) End Sem (50) Continuous Assessment (20)	--	--
Assignment (One Each Unit)	06	**Class Test** (One on two units)	03

1. **Course Objectives:**
   1. To study the basic structure and mechanical behaviour of materials.
   2. To study the basic materials and metallography
   3. To understand theory of alloys & alloys diagrams
   4. To know the basic heat-treatment processes of steels
   5. To make aware of destructive & non-destructive testing of materials
   6. To develop futuristic insight into new advancements in engineering materials

2. **Course Outcomes(Theory): On completion of the course, learner will be able –**

Course Outcome	Statements	Blooms Taxonomy	
		Level	Descriptor
CO1	To Classify the defects in crystal, its effect on crystal properties and to differentiate between various types of defects in crystals [BT-4]	4	Analyze
CO2	To Understand the types of metals, non-metals, their properties and their characterisation techniques such as Macroscopy and Microscopy and to compare between them. [BT-4]	4	Analyze
CO3	To Explain how metals and alloys are formed and how the properties change due to microstructure by using phase diagrams [BT-3]	3	Apply
CO4	To Apply different heat treatment processes for modifying the properties of steels and to compare various heat treatment processes [BT-4]	4	Analyze
CO5	To Apply different tests such as destructive and non-destructive tests for Evaluating the properties of material. [BT-5]	5	Evaluate
CO6	To Understand the technological advancements in engineering materials. [BT-2]	2	Understand

3. Contents of the Course/Syllabus

Unit	Contents	No.of Hours	COs
1	**STRUCTURE AND MECHANICAL BEHAVIOUR OF MATERIALS**		
	Strusture of Materials: Basic concepts of Crystal structures, Types of crystal systems , Crystal structure of metals(BCC, FCC and HCP systems), ceramics & molecular arrangement of polymers , Miller indices , indexing of lattice planes & directions, Lattice parameters (coordination number, no. of atoms per unit cell, atomic packing factor, density-only theory no derivation and numericals) **Lattice Imperfections:** Definition, classification and significance of Imperfections Point defects: vacancy, interstitial and impurity atom defects, Their formation and effects, Dislocation - Edge and screw dislocations Burger's vector, Motion of dislocations and their significance, Surface defects -Grain boundary, sub-angle grain boundary and stacking faults, their significance, **Deformation:** Definition, elastic and plastic deformation, Mechanism of deformation and its significance in design and shaping, Critical Resolved shear stress, Deformation in single crystal and polycrystalline materials	8 Hrs.	CO1
2	**BASIC MATERIALS AND METALLOGRAPHY**		
	Basic Materials: Metallic materials, Polymeric Materials, Ceramics and Composites: Definition, composition, general properties, applications with examples **Metallography:** Classification of metal observations: their definition, difference & importance. Microscopy: specimen preparation, specimen mounting (hot & cold mounting) electrolytic polishing, etching procedure and reagents, electrolytic etching. Microscopic techniques : optical microscopy, electron microscopy techniques(Principles only) Study of Metallurgical microscope, Macroscopy: Sulphur printing, flow line observations	6 Hrs.	C02
3	**IRON-IRON CARBIDE EQUILIBRIUM DIAGARM**		
	Solidification of pure metal, Different types of phase diagrams (Isomorphous, Eutectic, Peritectic, Eutectoid, Peritectoid) and their analysis, Importance of Iron as engineering material, Allotropic forms of Iron, Significance of alloying, Influence of carbon in Iron- Carbon alloy diagram, Iron-Iron carbide diagram and its analysis, Graphitization of Iron- Grey Cast iron, white cast iron, Nodular and malleable cast irons, their microstructures, properties and applications, Introduction to designation of steels	8 Hrs.	C03
4	**HEAT-TREATMENT OF STEELS**		
	Transformation products of Austenite, Time Temperature Transformation diagrams, critical cooling rate, continuous cooling transformation diagrams. Heat treatment of steels: Annealing, Normalising, Hardening & Tempering, quenching media, other treatments such as Martempering, Austempering, Patenting, Ausforming. Retention of austenite, effects of retained austenite. Elimination of retained austenite (Subzero treatment). Secondary hardening,	8 Hrs.	C04

	temper embrittlement, quench cracks, Hardenability & hardenability testing, Defects due to heat treatment and remedial measures. Classification of surface hardening treatments, Carburising, heat treatment after Carburizing, Nitriding, Carbo-nitriding, Flame hardening, and Induction hardening.		
5	**DESTRUCTIVE & NON-DESTRUCTIVE TESTING**		
	Study of destructive testing, Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, Numerical based on Evaluation of properties, compression test, different hardness tests-Vickers, Rockwell, Brinell, Poldi, Micro Hardness Test, Durometers, Impact test, fatigue test, creep test, Erichson Cupping Test. Non Destructive testing: Principals & procedure, advantages, disadvantages and Industrial applications of NDT, such as Visual Inspection ,Liquid /dye penetrate test, Magnaflux test, Eddy current test, Sonic & Ultrasonic testing and Radiography testing.	8 Hrs.	C05
6	**ADVANCED MATERIALS**		
	Introduction to New materials: **6.1** Composites: Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications **6.2** Nano Materials: Introduction, Concepts, synthesis of nanomaterials, examples, applications and Nano composites **6.3** An overview to Smart materials (e.g.: Rheological fluids)	4 Hrs.	CO6

4. Books:

Text Books:

1. Kodgire V. D. “Material Science and Metallurgy” Everest Publishing House
2. “Material Science & Engg.” Raghvan V., Prentice Hall of India, New Delhi. 2003

Reference Books:

1. Materials Science and Engineering by William D. Callister, Jr.Adapted by R.Balasubramaniam,Wiley India(P) Ltd.
2. Mechanical Behaviour of Materials by Courtney, McGraw Hill International New Delhi
3. Introduction of Engineering Materials, by B.K. Agrawal, McGraw Hill Pub. Co. ltd
4. Mechanical Metallurgy by G.E. Dieter, McGraw Hill International New Delhi
5. The Structure and Properties of Engineering Alloys by W.F. Smith, McGraw hill Int.
6. Engineering Physical Metallurgy, by Y. Lakhtin, Mir Publishers, Moscow
7. Introduction to Physical Metallurgy by SydneyAvner, McGraw Hill
8. Metallurgy for Engineers by E.C. Rollason - ELBS SOC and Edward Arnold, London

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	KOM (ME 214)
Subject	**Kinematics of Machines**	**No. of Lectures /Week**	4
Faculty Incharge	Mr I I Sayyad	**No. of Practical /Week**	--
Examination Scheme	In Sem (30) End Sem (50)	CA (20)	--
Assignment (One Each Unit)	06	**Class Test** (One on one units)	06

Prerequisites: -

1. Systems in Mechanical Engineering
2. Engineering Mathematics
3. Engineering Physics
4. Engineering Mechanics
5. Computer aided drawing & drafting

Course Objectives:

1. To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications.
2. To develop the competency to analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
3. To develop the skill to propose and synthesize the mechanisms using graphical and analytical technique.
4. To develop the competency to understand & apply the principles of gear theory to design various applications.
5. To develop the competency to design a cam profile for various follower motions.

Course Outcomes:

On completion of the course, learner will be able to –

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	Identify mechanisms in real life applications.	2	Understand
CO2	Apply kinematic analysis to simple mechanisms.	3	Apply
CO3	Analyze velocity and acceleration in mechanisms by vector and graphical method.	4	Analyze
CO4	Synthesize a four bar mechanism with analytical and graphical methods.	4	Analyze
CO5	Apply fundamentals of gear theory as a prerequisite for gear design.	5	Evaluate
CO6	Design cam profile for given follower motions.	5	Evaluate

Course Content

Unit	Topics	No. of Hours	COs
Unit-I	**Fundamentals of Mechanism**		
	Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom , Kutzbach crieterion , Grubler's criterion. Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions.	07	CO1
Unit-II	**Kinematic Analysis of Mechanisms: Analytical Method**		
	Analytical method for displacement, velocity and acceleration analysis of slider crank Mechanism. Velocity and acceleration analysis of four bar and slider crank mechanisms using complex algebra methods. Computer aided Kinematic Analysis of Mechanism like Slider crank and four bar mechanism. Analysis of Single and Double Hooke's joint.	07	CO2
Unit-III	**Kinematic Analysis of Mechanisms: Graphical Method**		
	Displacement, velocity and acceleration analysis of mechanisms by relative velocity method (Mechanisms upto 6 Links), Instantaneous Centre of Velocity, Kennedy's Theorem, Angular velocity ratio theorem, Analysis of mechanism by ICR method (Mechanisms upto 6 Links), Coriolis component of acceleration, Kleins construction	08	CO3
Unit-IV	**Synthesis of Mechanisms**		
	Steps in Synthesis: Type synthesis, Number Synthesis, Dimensional synthesis, Tasks of Kinematic synthesis: Path, function and motion generation (Body guidance). Precision Positions, Chebychev spacing, Mechanical and structural errors. **Graphical Synthesis**: Inversion and relative pole method for three position synthesis of four bar and single slider crank mechanisms. **Analytical Synthesis:** Three position synthesis of four bar mechanism using Freudenstein's equation.	07	CO4
Unit-V	**Kinematics of Gears**		
	Gear: classification, Spur Gear: terminology, law of gearing, Involute and cycloidal tooth profile, path of contact, arc of contact, sliding velocity,	08	CO5

	Interference and under cutting, Minimum number of teeth to avoid interference, force analysis. Helical and Spiral Gears: terminology, geometrical relationships, virtual number of teeth for helical gears **Gear train:** types, Analysis of epicyclical gear trains, Holding torque – simple, compound and epicyclic gear trains, torque on sun and planetary gear train, compound epicyclic gear train, Gear boxes.		
Unit-VI	**Cams and Follower**		
	Cams & Followers : Introduction, Classification of followers and cams, Terminology of cam Displacement diagram for the Motion of follower as Uniform velocity, Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation Motion (UARM),Cycloid motion ,Cam profile construction for Knife edge follower and Roller follower, Cam jump phenomenon. Advanced cam curve.	06	CO6

Books & Other Resources

Text Books

1. S. S. Rattan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.
2. Bevan T, Theory of Machines, Third Edition, Longman Publication.
3. A. G. Ambekar, Mechanism and Machine Theory, PHI.
4. J. J. Uicker, G. R. Pennock, J. E. Shigley, Theory of Machines and Mechanisms, Third Edition, International Student Edition, OXFORD

Reference Books

1. Paul E. Sandin, Robot Mechanisms and Mechanical Devices Illustrated, Tata McGraw Hill Publication.
2. Stephen J. Derby, Design of Automatic Machinery (2005, Marcel Dekker, 270 Madison Avenue, New York.
3. Neil Sclater, Mechanisms and Mechanical Devices Sourcebook, Fifth Edition, Tata McGraw Hill Publication.
4. Ghosh Malik, Theory of Mechanism and Machines, East-West Pvt. Ltd.
5. Hannah and Stephans, Mechanics of Machines, Edward Arnolde Publication.
6. R. L. Norton, Kinematics and Dynamics of Machinery, First Edition, McGraw Hill Education (India) P Ltd. New Delhi
7. Sadhu Singh, Theory of Machines, Pearson
8. Dr. V. P. Singh, Theory of Machine, Dhanpatrai and sons.
9. C. S. Sharma & Kamlesh Purohit, Theory of Machine and Mechanism, PHI.
10. M.P. Groover, Automation, production systems and computer-integrated manufacturing, Prentice-Hall of India Pvt. Ltd, New Delhi.

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	ME 215
Subject	Seminar	**No. of Lectures /Week**	--
Faculty Incharge	Mr.P.N.Patil	**No. of Practical /Week**	2
Examination Scheme	--	**OR**	50
Assignment (One Each Unit)	--	**Class Test** (One on one units)	--

1. Course Objectives:

1. To make survey on selected topics related to issues of science in society.
2. To study scientific literatures.
3. To collect relevant information from collected literature.
4. To compile the information and present it effectively.

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Study various research papers to understand existing and recent technology.	2	Understand
CO2	Identify various promising and new cutting edge technologies	2	Understand
CO3	Prepare detailed technical report describing the results.	3	Apply
CO4	Make effective communication through an oral presentation.	4	Analyze

COURSE CONTENTS

Seminar should be based on technical literature in the form of peer reviewed journals, conference proceedings and identify a current research topic relevant to Mechanical Engineering. Comprehend the seminar topic and prepare a technical report on the topic of presentation in specified format. Prepare presentation aids and deliver technical presentation in front of examiners, one of them will be guide and other will be examiner appointed by Authority. The Performance of the students will be evaluated by both examiner and guide jointly based on communication, content of seminar, delivery of seminar and ability to handle question and answer session.

Sanjivani College of Engineering, Kopargaon Department of Mechanical Engineering			
Semester	III	**Subject Code**	
Subject	Machine Drawing & Geometrical Modeling	**No. of Lectures /Week**	1
Faculty Incharge	Mr. Y.A.Bhavsar	**No. of Practical /Week**	2
Examination Scheme	--	**TW**	50
Assignment (One Each Unit)	06	**Class Test** (One on two units)	03

1. Course Objectives:

a. To develop the ability to apply Limit, Fits and Dimensional Tolerances, as well as Geometric Tolerances to components and assemblies on Engineering Drawings.
b. To develop an ability to create standard components using any Drafting Tool.
c. To develop an ability to Create Solid Models of machine components. The student should be able to apply these skills to the solution of a variety of practical problems and be able to employ their knowledge to solve more complicated problems.
d. To develop an ability to create assembly models and Production Drawings of simple machine parts.
e. To develop an ability to analyze the simple mechanisms by the simulation tools.
f. To develop an ability to create the sheet metal models using modeling software tools.

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	Course Outcomes	Bloom's Taxonomy	
		Level	Descriptor
CO1	**Understand** the standards used in Machine Drawing	2	Understand
CO2	**Demonstrate** Geometrical Dimensions and Tolerances for machine parts	2	Understand
CO3	**Apply** modelling commands to develop 3D models of any machine parts	3	Apply
CO4	**Apply** Assembly command to machine parts and its production drawing	3	Apply
CO5	**Construct** sheet metal models in Modeling Software	3	Apply
CO6	**Analyse** the mechanisms with the help of Simulation Tool	4	Analyze

COURSE CONTENTS

Unit	Contents	No. of Hours	COs
1	**Conventions in Machine Drawing**		
	Introduction to machine drawing, Dimensioning technique for machine components, Conventional representation of machine components as per IS code: SP-46 such as screw threads, springs, gears, bearing, tapped holes, knurling, splined shafts, tapers, chamfers, countersunk and counter bores, keys, & welded joints, Surface Roughness Introduction, terminology, machining symbol with all parameters, roughness values (Ra) indicating surface roughness on drawing.	2 Hrs.	CO1
2	**Limit, Fits and Tolerances**		
	Definitions applied to tolerances, types of tolerance, types of fits, fit system. Geometrical tolerances – Nomenclature, tolerance frame, types of geometrical tolerances & their symbols, indicating geometric tolerances on drawing.	2 Hrs.	C02
3	**Sketching and Solid Modeling**		
	Introduction to Graphic User Interface of modeling software, Sketching of simple machine parts in 2D,Parametric solid modeling (3D) using any modeling software.	2 Hrs.	C03
4	**Assembly of M/C Parts and Production Drawing**		
	Dimensional and Geometrical Constraints, Assembly of Machine Components, examples- Wheel support assembly, Bench-vice, Universal coupling, Butterfly valve etc. Production drawing techniques in any modeling software.	2 Hrs.	C04
5	**Sheet metal modeling**		
	Introduction to Sheet Metal design process, Sheet Metal model fundamentals, Creating primary and secondary Sheet metal, Wall features, Modifying Sheet Metal models, Sheet Metal Bends, Setting the Sheet metal environment.	2 Hrs.	C05
6	**Simulation of Mechanisms**		
	Kinematic simulation to study displacement, velocity and acceleration of links in the mechanism like four bar mechanism, slider crank mechanism, cam and follower etc.	2 Hrs.	CO6

List of Practical's:

Sr No	Name of Practical	No of Hours	CO
1	One A2 size sheet based on various IS conventions mentioned in the above syllabus.	04	1
2	Two A2 size sheets: one on Assembly & other on Details of simple mechanical system such as vice, tool post, tailstock and valve. Sheet on Details must include dimensional as well as geometrical tolerances and surface finish requirements	06	2
3	Sketching of Machine Parts using Modeling Software. (Any 05 Models)	04	3
4	Solid Modeling of Machine Components using Modeling Software. (Any 15 Models)	06	3
5	Assembly and Production Drawing of Machine Parts using Modeling Software. (Any 05 Assemblies)	08	4
6	Sheet Metal Modeling using Modeling Software. (Any 05 Models)	06	5
7	Position, Velocity and Acceleration analysis of Mechanisms. (Any 03 Mechanisms)	04	6
8	3D modeling of any one real life engineering component and obtaining 2D Production Drawing for the same.	06	3
9	Creating 3D Model from an existing Industrial Machine Drawing of a component	04	3
10	Study of Generative Design using Artificial Intelligence.	02	4

Text Books:

1. Gill P. S., "A Text book of Machine Drawing", Revised Edition K. Kataria and Sons, New Delhi, 2008, ISBN: 81-85749-79-5.
2. FarazdakHaideri, "Machine Drawing and Computer Graphics", Nirali Prakashan, Pune, 1998.ISBN: 9380725272
3. Roger Toogood, "Creo Parametric 6.0 Tutorial", DC Publications,2019. ISBN 978-1630572853.

Reference Books:

1. Narayana K. L., Kannaiah P., Venkatata Readdy K., "Machine Drawing", 2nd Edition, New age international Publishers, Delhi, 2008, ISBN 81-224-1917-8.
2. Bhat N. D., Panchal, "Machine Drawing", Charotar Pub. House, 2000.ISBN: 9380358466.
3. Michael J Rider, "Designing with CREO PARAMETRIC 6.0", SDC Publication, USA, ISBN: 987-1-63057-300-3.

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	NM (ME 217)
Subject	Numerical Methods	**No. of Lectures /Week**	--
Faculty Incharge	Dr P M Patare	**No. of Practical /Week**	2
Examination Scheme	--	PR	50
Assignment (One Each Unit)	06	**Class Test** (One on one units)	06

1. Course Objectives:

1. To **understand** the difference between analytical and Numerical Methods.
2. To **apply** Numerical Techniques for solving complex Mechanical engineering Problems.
3. To prepare base for **understanding** engineering analysis software.
4. **Develop** logical sequencing for solution procedure and skills in soft computing.
5. **Optimize** the solution for different real life problems with available constraints.
6. **Build** the foundation for engineering research

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	To **understand** different analytical and numerical methods to find the roots of the equations	2	Understand
CO2	To **apply** different numerical and analytical techniques to solve various types of simultaneous equations.	3	Apply
CO3	To **learn** various traditional and advanced optimization technique.	4	Analyze
CO4	To **recognize** and **learn** different numerical techniques to handle the differential equations.	4	Analyze
CO5	To **Evaluate and interpret** the data using curve fitting and regression analysis tools.	5	Evaluate
CO6	To **formulate** numerical techniques to solve the engineering problems using integration techniques	5	Evaluate

Term Work (PR)

Term work shall consist of-

SN	Title of Term Work	CO	PO	PSO	BTL
1.	Program on Roots of Equation (Validation by suitable solver, all three compulsory) a) Bisection Method, b) Newton Raphson method	CO1	1,2,5,10, 12	1,2	2
2.	Program on Simultaneous Equations (Validation by suitable solver, all three compulsory) a) Gauss Elimination Method, b) Thomas algorithm , c) Gauss-Seidal method.	CO2	1,2,5,10, 12	1,2	3
3.	Optimization technique Grey Regression Analysis	CO3	1,2,3,4,5, 10,12	1,2	4
4.	Program on ODE(Validation by suitable solver, all three compulsory) a) Euler Method, b) Runge-Kutta Methods- fourth order,	CO4	1,2,5,10, 12	1,2	4
5.	Program on PDE(Validation by suitable solver): Laplace equation	CO4	1,2,5,10, 12	1,2	4
6.	Program on Curve Fitting using Least square technique (Validation by suitable solver, all four compulsory) a) Straight line, b) Power equation, c) Exponential equation, d) Quadratic equation	CO5	1,2,4,5,1 0,12	1,2	3
7.	Program on Interpolation(Validation by suitable solver, all three compulsory) a) Lagrange's Interpolation, b) Newton's Forward interpolation,	CO5	1,2,4,5,1 0,12	1,2	3
8.	Program on Numerical Integration(Validation by suitable solver, all four compulsory) a) Trapezoidal rule, b) Simpson's Rules (1/3rd, 3/8th) [In one program only], c) Double integration: Trapezoidal rule	CO6	1,2,5,10, 12	1,2	5

5. Problem Based Learning Topics

1. Program for the Modified newton Raphson Method
2. Program for Gauss Jordon Method
3. Program for Newton Backward Difference Interpolation Method.

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Numerical Methods for Engineers	Steven C. Chapra, Raymond P. Canale	Tata McGraw Hill	511.7 CHA-04 28520
2	Numerical Methods in Engineering and Science	Dr. B. S. Garewal	Khanna Publishers	511.7 GRE-10 70477
3	Applied Numerical Methods with MATLAB for Engineers and Scientist	Steven C. Chapra	Tata McGraw Hill	511.7 CHA-15 59147
4	Applied Numerical Methods using Matlab	Rao V. Dukkipati	New Age International Publishers	511.7 RAO-15 59301

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Applied Numerical Analysis	Gerald and Wheatley	Pearson Education	510 GER-16 59566
2	Numerical Methods	E. Balagurusamy	Tata McGraw Hill	511.7 E B-07 43889
3	Computer Oriented Numerical Methods	P. Thangaraj	PHI	001 THA-13 59256
4	Introductory Methods of Numerical Analysis	S. S. Sastry	PHI	511 SAS-91 13986

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	FM (ME 218)
Subject	Fluid Mechanics	**No. of Lectures /Week**	--
Faculty Incharge	Mr Y. H. Ahire	**No. of Practical /Week**	2 Hrs
Examination Scheme	--	**PR**	50
Assignment (One Each Unit)	06	**Class Test** (One on each units)	06

1. Course Objectives:

1. To learn the skill of finding experimentally, the kinematic viscosity & pressure properties of fluid
2. To acquire the skill of performing the experiment, to find metacentric height of floating body
3. To learn to determine the Reynolds no. to differentiate between flow regimes
4. To learn Bernoulli's theorem and its verification using experimental apparatus
5. To learn the experimental skill of calibrating the flow-meters like venturimeter and notch
6. To learn the procedure of writing computer program for analyzing experimental data (friction loss)

2. Course Outcomes (COs) :

After learning the course the students will be able to-

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	To **conduct experiments** to determine fluid properties kinematic viscosity and pressure using measuring instruments	4	Analyze
CO2	To **determine** Metacentric height of the floating object	3	Apply
CO3	To **differentiate** laminar & turbulent flows using Reynolds experiment	4	Analyze
CO4	To **verify/demonstrate** Bernoulli's theorem using experimental apparatus	3	Apply
CO5	To **determine** coefficient of discharge for given Venturimeter & Notch devices	3	Apply
CO6	To **write and execute** computer code to calculate friction losses in pipe	3	Apply

LIST OF PRACTICALS

Sr. No.	Title	CO	PO	PSO
1	To determine kinematic viscosity of given fluid at different temperatures using Redwood viscometer.	1	1, 4, 8,9, 10,12	3
2	Determination of pressure using manometers (any two).	1		3
3	Determination of Metacentric height of floating object.	2		3
4	To perform the Reynolds experiment for determination of different regimes of flow.	3		3
5	Verification of Bernoulli's theorem using Bernoulli's apparatus.	4		3
6	To determine coefficient of discharge for given Venturimeter. (also by Virtual Lab)	5		3
7	To determine Coefficient of Discharge of V-notch. (by Virtual Lab)	5		3
8	Determination of Friction (major) losses in pipe flow, by developing computer code. (by using software)	6		3

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Fluid Mechanics & Hydraulic Machines	R. K. Bansal	Laxmi Publications	620.106 DR -15 61459
2	Introduction to Fluid Mechanics and Fluid Machines	S. K. Som, G. Biswas and S. Chakraborty	Tata McGraw Hill	620.106 SOM-12 70654
3	Fluid Mechanics: Fundamentals and Applications	Y. A. Cengel, J. M. Cimbala	McGraw Hill	620.106 CEN-TB 58663
4	Fluid Mechanics	F. M. White	Tata McGraw Hill	620.106 WHI-17 61989

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Introduction to Fluid Mechanics	R. W. Fox, P. J. Pritchard and A. T. McDonald	Wiley India	620.106 FOX-TB 56273
2	Fundamentals of Fluid Mechanics	B. R. Munson, D. F. Young, T. H. Okiishi and W. W. Huebsch	Wiley India	620.106 MUN-13 56734
3	Mechanics of Fluids	M. C. Potter, D. C. Wiggert	Cengage Learning (Indian Edition)	620.106 POT-13 59283
4	Fluid Mechanics	V. L. Streeter, E. B. Wylie and K. W. Bedford	Tata McGraw Hill	620.106 STR-98 27082

Sanjivani College of Engineering, Kopargaon Department of Mechanical Engineering			
Semester	IV	**Subject Code**	ME219
Subject	Materials Science and Metallurgy	**No. of Lectures /Week**	--
Faculty Incharge	Mr.H.P.Varade	**No. of Practical /Week**	2 Hrs/Week
Examination Scheme	In Sem (30) End Sem (50) Continuous Assessment (20)	OR	50
Assignment (One Each Unit)	06	**Class Test** (One on two units)	03

1. **Course Objectives:**
   1. To study the basic structure and mechanical behaviour of materials.
   2. To study the basic materials and metallography
   3. To understand theory of alloys & alloys diagrams
   4. To know the basic heat-treatment processes of steels
   5. To make aware of destructive & non-destructive testing of materials
   6. To develop futuristic insight into new advancements in engineering materials

2. **Course Outcomes(Theory): On completion of the course, learner will be able –**

Course Outcome	Statements	Blooms Taxonomy	
		Level	Descriptor
CO1	To Classify the defects in crystal, its effect on crystal properties and to differentiate between various types of defects in crystals [BT-4]	4	Analyze
CO2	To Understand the types of metals, non-metals, their properties and their characterisation techniques such as Macroscopy and Microscopy and to compare between them. [BT-4]	4	Analyze
CO3	To Explain how metals and alloys are formed and how the properties change due to microstructure by using phase diagrams [BT-3]	3	Apply
CO4	To Apply different heat treatment processes for modifying the properties of steels and to compare various heat treatment processes [BT-4]	4	Analyze
CO5	To Apply different tests such as destructive and non-destructive tests for Evaluating the properties of material. [BT-5]	5	Evaluate
CO6	To Understand the technological advancements in engineering materials. [BT-2]	2	Understand

List of Practicals:

Sr. No.	Title	CO
1	Study and trial of optical metallurgical microscope	1
2	Study & Demonstration of Specimen Preparation for microscopic examination	1
3	Study, Drawing and analysis of Microstructure of Steels of various compositions using suitable image analysis software.	1
4	Heat treatment of plain carbon steels and determination of relative hardness	2
5	Determination of hardenability of steel using Jominy end Quench Test.	2
6 7	Study and Trial of Rockwell Hardness Test OR Brinell Hardness Test and Poldi Hardness Test	3
8 9	Magnetic Particle Test. OR Dye Penetrant Test.	3
10	Impact Tests	3

3. **Books:**

Text Books:

1. Kodgire V. D. “Material Science and Metallurgy” Everest Publishing House
2. “Material Science & Engg.” Raghvan V., Prentice Hall of India, New Delhi. 2003

Reference Books:

1. Materials Science and Engineering by William D. Callister, Jr.Adapted by R.Balasubramaniam,Wiley India(P) Ltd.
2. Mechanical Behaviour of Materials by Courtney, McGraw Hill International New Delhi
3. Introduction of Engineering Materials, by B.K. Agrawal, McGraw Hill Pub. Co. ltd
4. Mechanical Metallurgy by G.E. Dieter, McGraw Hill International New Delhi
5. The Structure and Properties of Engineering Alloys by W.F. Smith, McGraw hill Int.
6. Engineering Physical Metallurgy, by Y. Lakhtin, Mir Publishers, Moscow
7. Introduction to Physical Metallurgy by SydneyAvner, McGraw Hill
8. Metallurgy for Engineers by E.C. Rollason - ELBS SOC and Edward Arnold, London

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	KOM (ME 220)
Subject	**Kinematics of Machines**	**No. of Lectures /Week**	--
Faculty Incharge	Mr I I Sayyad	**No. of Practical /Week**	02Hrs/Week
Examination Scheme	In Sem (30) End Sem (50)	OR	50
Assignment (One Each Unit)	06	**Class Test** (One on one units)	06

Prerequisites: -

1. Systems in Mechanical Engineering
2. Engineering Mathematics
3. Engineering Physics
4. Engineering Mechanics
5. Computer aided drawing & drafting

Course Objectives:

1. To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications.
2. To develop the competency to analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
3. To develop the skill to propose and synthesize the mechanisms using graphical and analytical technique.
4. To develop the competency to understand & apply the principles of gear theory to design various applications.
5. To develop the competency to design a cam profile for various follower motions.

Course Outcomes:

On completion of the course, learner will be able to –

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	Identify mechanisms in real life applications.	2	Understand
CO2	Apply kinematic analysis to simple mechanisms.	3	Apply
CO3	Analyze velocity and acceleration in mechanisms by vector and graphical method.	4	Analyze
CO4	Synthesize a four bar mechanism with analytical and graphical methods.	4	Analyze
CO5	Apply fundamentals of gear theory as a prerequisite for gear design.	5	Evaluate
CO6	Design cam profile for given follower motions.	5	Evaluate

Guidelines for TW Assessment

- There should be continues assessment for term work.
- Assessment must be based on assessment of theory, attentiveness during practical and understanding of the course.
- Timely submission of journals.

The student shall complete following activities as a part of TW

Sr. No.	Activity
1.	**Group A : Assignments:** i. To study of various mechanisms and to determine types of pairs, links, and degrees of freedom. ii. To solve two problems on velocity and acceleration analysis using relative velocity and acceleration method. iii. To solve two problems on velocity analysis using ICR method. iv. To draw conjugate profile for any general type of gear tooth. **v.** To draw a cam profile any two problems with combination of various follower motion with radial and off-set cam.
2.	**Group B : Experiments:** i. Speed and torque analysis of epicyclic gear train to determine holding torque.. ii. To study and verify cam jump phenomenon iii. To study manufacturing of gear using gear generation with rack as a cutter and to generate involute profile.
3.	**Group C: Software based assignments: (Any Two)** i. To design a simple planer mechanism by using any software.(Any Software) ii. To do computer programming on kinematic analysis of slider crank mechanism using Analytical Method. (Any Software) iii. To do computer programming on kinematic analysis of Hooke's joint mechanism using Analytical Method. (Any Software) iv. To generate a cam profile using any modelling software (Any Software) v. To synthesize the four bar and slider crank mechanism using relative pole and inversion method with three accuracy points. (Any Software) vi. To do computer programming on synthesis of mechanism using Chebychevs spacing, Freudensteins equation and function generation. (Any Software)
4.	**Group D : Virtual Lab:** i. Mechanics-of-Machines Lab (All Experiments)

	ii. Mechanisms and Robotics > Oldham Coupling Mechanism iii. Mechanisms and Robotics > Quick Return Mechanism **iv.** Mechanisms and Robotics > CAM Follower Mechanism
5.	**Group E: Industry/Workshop visit:** The Visit to the industries consisting automation like Assembly line, Sugar factory, Bottle feeling plants etc is mandatory to provide awareness and understanding of the course.
6.	**Self-Learning:** i. To study various types of gearboxes. ii. To make a model of any mechanism by using waste material by the group of 4 to 6 students and to give presentation using PPTs.
7.	**NPTEL REFERENCES** **i.** **NPTEL1.** Kinematics of Machines, Prof. Ashok K Mallik, IIT Kanpur **ii.** **NPTEL2.**Theory Of Mechanism by Prof. Sujatha Srinivasan IIT Madras **iii.** **NPTEL3.** Kinematics of Mechanisms And Machines by Prof.Anirvan Das Gupta, IIT Kharagpur **iv.** **NPTEL4.** Mechanism and Robot Kinematics by Prof.Anirvan Das Gupta Institute: IIT Kharagpur **v.** **Introduction to Robotics and Automation**

Books & Other Resources

Text Books

1. S. S. Rattan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd.New Delhi.
2. Bevan T, Theory of Machines, Third Edition, Longman Publication.
3. A. G. Ambekar, Mechanism and Machine Theory, PHI.
4. J. J. Uicker, G. R. Pennock, J. E. Shigley, Theory of Machines and Mechanisms, Third Edition, International Student Edition, OXFORD

Reference Books

1. Paul E. Sandin, Robot Mechanisms and Mechanical Devices Illustrated, Tata McGraw Hill Publication.

2. Stephen J. Derby, Design of Automatic Machinery (2005, Marcel Dekker, 270 Madison Avenue, New York.
3. Neil Sclater, Mechanisms and Mechanical Devices Sourcebook, Fifth Edition, Tata McGraw Hill Publication.
4. Ghosh Malik, Theory of Mechanism and Machines, East-West Pvt. Ltd.
5. Hannah and Stephans, Mechanics of Machines, Edward Arnolde Publication.
6. R. L. Norton, Kinematics and Dynamics of Machinery, First Edition, McGraw Hill Education (India) P Ltd. New Delhi
7. Sadhu Singh, Theory of Machines, Pearson
8. Dr. V. P. Singh, Theory of Machine, Dhanpatrai and sons.
9. C. S. Sharma & Kamlesh Purohit, Theory of Machine and Mechanism, PHI.
10. M.P. Groover, Automation, production systems and computer-integrated manufacturing, Prentice-Hall of India Pvt. Ltd, New Delhi.

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	ME 221
Subject	**Mandatory Course-IV** Innovative Project Base	**No. of Lectures /Week**	2
Faculty Incharge	Ms S M Gujrathi	**No. of Practical /Week**	--
Examination Scheme	--	CA (20)	--
Assignment (One Each Unit)	--	**Class Test** (One on one units)	--

1. Course Objectives:

1. Carry out a substantial innovative - based project
2. Demonstrate capacity to lead and manage change through collaboration with others
3. Analyze data and synthesize research findings
4. Report research findings in written and verbal forms

2. Course Outcomes (COs) :

On completion of this subject, participants will have the knowledge, skills and understanding to enable them to:

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	Apply critical thinking skills	3	Apply
CO2	Apply foundational research skills to address a research question	2	Understand
CO3	Demonstrate planning, time and leadership skills	4	Analyse
CO4	Demonstrate a capacity to communicate research results clearly, comprehensively and persuasively.	5	Evaluate

COURSE CONTENTS

Projects should be based on society based problems, innovative ideas, product development, application development etc. It is expected to add substantial innovative based projects by doing review of existing systems, peer reviewed journals, live survey by preparing questionnaire etc. in order to formulate the problem faced by society. Accordingly students should submit project report consists of detailed design with working model if any. The Performance of the students will be evaluated by both examiner and guide jointly based on communication, problem identified, whether model/design/application is in working condition or not, presentation delivery and facing to question and answer round.

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE - 2019 PATTERN

SECOND YEAR B. TECH.

LIST OF ABBREVIATIONS			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
ES	Engineering Science	HSMC	Humanity Science
PC	Professional Core	CA	Continuous Assessment
PE	Professional Elective	OR	End Semester Oral Examination
OE	Open Elective	PR	End Semester Practical Examination
ISE	In-Semester Evaluation	TW	Continuous Term work Evaluation
ESE	End-Semester Evaluation	BSC	Basic Science Course
PRJ	Project	MC	Mandatory Course

COURSE STRUCTURE- 2019 PATTERN

SECOND YEAR B. TECH : MECHANICAL ENGINEERING

SEMESTER-I

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks						
			L (hrs)	T (hrs)	P (hrs)		Theory			OR	PR	TW	Total
							ISE	ESE	CA				
PRJ	ME201	First Year Internship	-	-	-	2	-	-	-	50	-	-	50
BSC	BS202	Vector Calculus and Differential Equations	3	1	-	4	30	50	20	-	-	-	100
PC	ME203	Basic Thermodynamics	3	-		3	30	50	20	-	-	-	100
PC	ME204	Manufacturing Processes	3	-		3	30	50	20	-	-	-	100
PC	ME205	Strength of Materials	3	-		3	30	50	20	-	-	-	100
HSMC	HS206	Universal Human Values & Ethics	3	-	-	3	30	50	20	-	-	-	100
PC	ME207	Basic Thermodynamics Lab			2	1	-	-	-	50		25	75
PC	ME208	Machine Shop - I			2	1	-	-	-	25		25	50
PC	ME209	Strength of Materials Lab			2	1	-	-	-	50		25	75
MC	MC210	Mandatory Course-III	2	-	-	No	-	-	-	-	-	-	-
		Total	17	1	6	**21**							**750**

SEMESTER-II

Cat.	Code	Course Title	Teaching Scheme			Credits	Evaluation Scheme-Marks						
			L (hrs)	T (hrs)	P (hrs)		Theory			OR	PR	TW	Total
							ISE	ESE	CA				
PC	ME211	Numerical Methods	3	-		3	30	50	20	-	-	-	100
PC	ME212	Fluid Mechanics	4	-		4	30	50	20	-	-	-	100
PC	ME213	Materials Science & Metallurgy	3	-		3	30	50	20	-	-	-	100
PC	ME214	Kinematics of Machines	4	-		4	30	50	20	-	-	-	100
PRJ	ME215	Seminar	-	-	4	2	-	-	-	25	-	25	50
PC	ME216	Machine Drawing & Geometrical modeling	1	-	4	3	-	-	-	-	-	50	50
PC	ME217	Numerical Methods Lab			2	1	-	-	-	-	25		25
PC	ME218	Fluid Mechanics Lab			2	1	-	-	-	-	50	25	75
PC	ME219	Materials Science & Metallurgy Lab			2	1	-	-	-	50	-	25	75
PC	ME220	Kinematics of Machines Lab			2	1	-	-	-	50	-	25	75
MC	**MC221**	**Mandatory Course-IV**	**2**	-	-	**No**	-	-	-	-	-	-	-
		Total	17	-	16	**23**							**750**

MC210	**Mandatory Course-III**	**Constitution of India – Basic features and fundamental principles**
MC221	**Mandatory Course-IV**	**Innovation - Project based – Sc., Tech, Social, Design & Innovation**

T.Y.B. Tech SEM V

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
			L	T	P		Theory			OR	PR	TW	Total
							ISE	ESE	CIA				
PRJ	ME301	Professional Internship-II	-	-	-	2	-	-	-	50	-	-	50
PCC	ME302	Production Technology	3	-	-	3	30	50	20	-	-	-	100
PCC	ME303	Machine Design –I	3	-	2	4	30	50	20	-	-	25	125
PCC	ME304	Metrology and QC	3	-	2	4	30	50	20	25	-	-	125
PCC	ME305	Heat Transfer	3	-	2	4	30	50	20	-	50	-	150
PEC	ME306	Professional Elective-I	3	-	-	3	30	50	20	-	-	-	100
PRJ	ME307	Skill based Credit Course/PBL	1	-	-	1	-	-	50	-	-	-	50
MLC	ME308	Mandatory Learning Course (Design Thinking)	1	-	-	Non Credit	-	-	-	-	-	-	-
		Total	**17**		**06**	**21**	**150**	**250**	**150**	**75**	**50**	**25**	**700**

T.Y.B. Tech SEM VI

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
			L	T	P		Theory			OR	PR	TW	Total
							ISE	ESE	CIA				
PCC	ME309	Applied Thermodynamics	3	-	2	4	30	50	20	-	50	-	150
PCC	ME310	Machine Design –II	3	-	2	4	30	50	20	50	-	-	150
PEC	ME311	Professional Elective-II	3	-	-	3	30	50	20	-	-	-	100
OE	ME312	Open Elective-I	4	-	-	4	30	50	20	-	-	-	100
HSMC	ME313	Employability Skill Development	1	-	2	2	-	-	-	-	-	50	50
PRJ	ME314	IPR & EDP	2	-	2	3	15	25	10	-	-	50	100
MLC	ME315	Mandatory Learning Course (Programming Skills)	1	-	-	Non Credit	-	-	-	-	-	-	-
PCC	ME316	Machine Shop-II Lab	-	-	2	1	-	-	-	-	-	50	50
		Total	**17**	**-**	**10**	**21**	**135**	**225**	**90**	**50**	**50**	**150**	**700**

Professional Elective – I		Professional Elective – II	
1	Refrigeration System-T	1	Turbo Machinery –T
2	Reliability Engineering -P	2	Operation Research-P
3	Industrial Tribology-D	3	Process Equipment Design-D

Open Electives-I	
1	IoT (Internet of Things)
2	Artificial Intelligence
3	Digital Marketing
4	Enterprise Resource Planning

Final. B.Tech SEM VII

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
							Theory			OR	PR	TW	Total
			L	T	P		ISE	ESE	CIA				
PRJ	ME401	Professional Internship-III	-	-	-	2	-	-	-	50	-	-	50
PCC	ME402	Finite Element Analysis	3	-	2	4	30	50	20	-	25	25	150
PCC	ME403	Mechatronics	3	-	2	4	30	50	20	25	-	25	150
PEC	ME404	Professional Elective-III	3	-	-	3	30	50	20	-	-	-	100
OE	ME405	Open Elective-II	3	-	-	3	30	50	20	-	-	-	100
PRJ	ME406	Project Stage-I	-	-	4	2	-	-	-	50	-	-	50
OE	ME407	Open ELECTIVE-III [Online through MOOCs]	-	-	-	2	-	-	100*	-	-	-	100 *
MLC	ME408	Mandatory Learning Course	(1)	-	-	Non-Credit	-	-	-	-	-	-	-
		Total	**13**	**-**	**8**	**20**	**120**	**200**	**180**	**125**	**25**	**50**	**700**

Final. B.Tech SEM VIII

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
							Theory			OR	PR	TW	Total
			L	T	P		ISE	ESE	CIA				
PCC	ME409	HVAC Heating Ventilation and Air Conditioning	3	-	2	4	30	50	20	-	50		175
PCC	ME410	Hydraulic and Pneumatics	3	-	2	4	30	50	20	50	-	25	175
PCC	ME411	Dynamics of Machines	3	-	-	3	30	50	20	-	-	25	100
PEC	ME412	Professional Elective-IV	3	-	-	3	30	50	20	-	-	-	100
PRJ	ME413	Project Stage-II	-	-	8	4				50	-	100	150
MLC	ME414	Mandatory Learning Course	(1)	-		Non-Credit	-	-	-	-	-	-	-
		Total	**13**	**-**	**12**	**18**	**120**	**200**	**80**	**100**	**50**	**150**	**700**

Professional Elective – III		**Professional Elective – IV**	
1	Additive Manufacturing-D	**1**	Advanced Finite Element Analysis-D
2	Computational Fluid Dynamics-T	**2**	Power Plant Engineering-T
3	Robotics and Automation	**3**	Automobile Engg

Open Electives-II		**Open Electives-III**	
1	Optimization Techniques	**1**	**Industrial Safety**
2	Artificial Neural Networks and Fuzzy Systems	**2**	Logistics & ware-housing-Pz
3	Cyber Law and Ethics	**3**	
4	Speech and Image Processing	**4**	
5	Fire Safety (Health Safety and Environment)	**5**	
6	Quality Management System	**6**	

SANJIVANI
GROUP OF INSTITUTES

Production Technology (ME302)

Production Technology (ME 302)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: (if Any)

==========

Course Objectives: (Please specify Six Objectives)

1. The students should understand machine tools and various machining operations, and economy of machining processes
2. To select process parameter and tools for obtaining desired machining characteristic
3. To provide the students the knowledge of modern manufacturing processes.
4. To analyse and understand the metal cutting phenomena
5. The students should understand selection of jigs and fixtures.

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Make the students aware about drilling machines, milling machines & various cutting tools	1	Remember
CO2	Explain the students' knowledge of various Grinding machines	2	Understand
CO3	Understand the different advance manufacturing processes and applications	2	Understand
CO4	Discuss the mechanism of metal cutting and different forces acting on the tools and determine the tool wear and tool life	2	Understand
CO5	Develop the ability among the students to learn and analyse technical concepts of CNC programming and various parts of CNC machine.	3	Apply
CO6	Understand the concept of jigs and fixtures and there application.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2					2						
CO2	3	3	3	2			2	2	2						
CO3	3	2							2						
CO4	3	2													
CO5	3	3	3	2	3	2	2	2	3	2	2	2			
CO6	3	3	3	3	3				3						

Course Contents

Unit	Contents	No.of Hours	COs
1	**Drilling and Milling Machines**		
	Drilling: Fundamentals of drilling process, twist drill geometry, tool holders. Types of drilling machines, operations performed on drilling machines. Types of drills. Reaming process, **Milling Machines**: Fundamentals of milling process, cutters - types and geometry. Operations performed on milling machines. Dividing head, methods of indexing. (mc time calculation) Introduction to Shaper and Planer Machines: Construction, working of quick return mechanism, operations performed Advanced cutting tools used in drilling and milling.	Hrs. 6	CO1
2	**Finishing Processes**:		
	Grinding machines Introduction: Types and Operations of grinding machines. Grinding wheel – Shapes, Designation and selection, Mounting, Balancing and Dressing of grinding wheels, Machining time calculation for cylindrical and plunge grinding. **Super-finishing processes** – Introduction to Honing, Lapping, Buffing and Burnishing.	Hrs. 6	C02
3	**Advanced Machining Processes**		
	Introduction, classification of advanced machining processes. Principles, Working, Process Parameters, Advantages, Limitations and Application for following processes: Abrasive Jet Machining (AJM), Ultra Sonic Machining (USM), Electric Discharge Machining (EDM), Laser Beam Machining (LBM), Plasma arc machining (PAM), Electron Beam machining (EBM) and Electro Chemical Machining (ECM)	Hrs. 4	C03
4	**Theory of Metal cutting**		
	Single point cutting tool: Tool geometry, Mechanics of shearing (orthogonal and oblique), Shear plane angle, Shear stress, strain and Shear strain rate. Process parameters and their effect on machining. Merchant's circle of forces (analytical) Estimation of shear force, Normal shear force, Friction force, Normal friction force, Material Removal Rate (MRR), Cutting power estimation. **Introduction to advanced tools**-Carbides tips and poly crystalline diamond tools (PCD) Tool life, Tool wear, Effect of process parameters on tool life, Taylor's tool life equation.	Hrs. 10	C04
5	**CNC Technology**		
	Smart Manufacturing Introduction, Classification, Construction and working of NC, CNC, DNC and machining centre. CNC axes and drives. Automatic Tool	Hrs.	C05

	Changer (ATC) and Automatic pallet changer (APC) CNC Programming: Word address format (WAF) –ISO Standards, G & M codes, Type of CNC Control systems, Manual part programming (plain milling and Turning), Subroutine, Canned cycles.	6	
6	**Jigs and Fixtures**		
	Concept of Degree Of Freedom, 3-2-1 Principle of location, General guidelines to design Jigs and Fixtures, significance of jigs and fixture **Jigs :** Definition. Elements of Jig with the types, Location guidelines, Principles of clamping, Principles of guiding element, Channel Jig, Template Jig, Plate Jig, Angle plate Jig, Turn over Jig, Box Jig, and Latch type Jig. **Fixtures :** Definition. Elements of Fixtures, Location guidelines, Principles of clamping, Principles of setting element, Turning Fixture, Welding Fixture, Milling Fixture, Introduction to Assembly and Inspection Fixtures. Indexing Fixtures. Advanced materials used in jigs and fixtures (Teflon, aluminium).Introduction to Templates fixtures	Hrs. 6	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Elements of Workshop Technology	S. K. Hajra Choudhary, A. K. Hajra Choudhary	Media promoters	
2.	A Course in Workshop Technology Vol. II	B. S. Raghuwanshi	Dhanpat Rai & CO	
3.	Workshop Technology Part 1, 2 and 3	W. A. J. Chapman	Taylor & Francis	
4.	Manufacturing Process – 2,	Anul Goel	Technical Publication	
5.	Production Technology Manufacturing Processes)	P C Sharma,	S Chand Publication	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	HMT Handbook for Production Technology		Tata McGraw-Hill,	
2.	Materials and processes in Manufacturing	Degarmo, Black and Kohser	Prentice Hall of India. 2nd Edition	
3.	Workshop Technology	B.S. Raghuwanshi	Dhanpatrai Publication, 9th Edition, 1999.	
4.	Production Technology	O.P. Khanna and M. Lal,	Dhanpatrai Publication, 5th Edition, 1999.	
5.	Workshop Technology	Chapman W.A.J,	CBS Publishers and distributors, 5th Edition,2002.	

SANJIVANI
GROUP OF INSTITUTES

Machine Design –I (ME303)

Machine Design-I (ME 303)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	2 Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**4**	**Total:**	100 Marks

==========

Prerequisite Course: (Strength of Machine Elements, Basics of Mechanical Engineering)

==========

Course Objectives:

1. Student shall gain appreciation and understanding of the design function in Mechanical Engineering, different steps involved in designing and the relation of design activity with manufacturing activity.
2. The student shall learn to choose proper materials for different machine elements depending on their physical and mechanical properties. They will learn to apply the knowledge of material science in real life situations.
3. Student shall gain a thorough understanding of the different types of failure modes and criteria. They will be conversant with various failure theories and be able to judge which criterion is to be applied for a particular situation.
4. Student shall gain design knowledge of the different types of elements used in the machine design process, for e.g. shafts, couplings etc. and will be able to design these elements for each application.
5. Students shall gain a thorough understanding about the design of the various types of springs.
6. Students shall gain thorough knowledge about the design of clutch and brake.

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Ability to identify and understand failure modes for mechanical elements and design of machine elements based on strength.	2	Understand
CO2	Ability to design Shafts, Keys and Coupling for industrial applications.	3	Apply
CO3	Ability to design machine elements subjected to fluctuating loads.	3	Apply
CO4	Ability to design Power Screws for various applications.	3	Apply
CO5	Ability to design various Springs for strength and stiffness.	2	Understand
CO6	Ability to design various Clutch and brake	3	Apply

Course Contents

Unit	Contents	No.of Hours	COs
1	**Design of Simple Machine Elements**		
	Introduction to Machine Design, product life cycle, types of stress, strains, Design considerations - Strength, Rigidity, Manufacture, Assembly and Cost, Standards and codes, Use of preferred series, Factor of safety, Service factor. Design of Cotter joint, Knuckle joint, Levers - hand / foot lever, components subjected to eccentric loading. Use of Design data books.	6 Hrs.	CO1
2	**Design of Shafts, Keys and Couplings**		
	Shaft design on the basis of strength, torsional rigidity and lateral rigidity, A.S.M.E. code for shaft design. Hollow shaft, Design of keys (square and rectangular key) and splines. Design of Flange Coupling and Flexible Bushed Pin Coupling.	6 Hrs	C02
3	**Design for Fluctuating Load**		
	Stress concentration - causes & remedies, fluctuating stresses, fatigue failures, S-N curve, endurance limit, notch sensitivity, endurance strength modifying factors, design for finite and infinite life, cumulative damage in fatigue failure, Soderberg, Gerber, Goodman, Modified Goodman diagrams, Fatigue design of components under combined stresses:- Theoretical treatment only.	6 Hrs	C03
4	**Power Screws**		
	Forms of threads, multiple start screws, Torque analysis and Design of power screws with square and trapezoidal threads, Self-locking screw, Collar friction torque, Stresses in power screws, design of a C-Clamp. Design of screw jack.	6 Hrs	C04
5	**Mechanical Springs**		
	Types, applications and materials for springs, Stress and deflection equations for helical compression Springs, Style of ends, Design of helical compression and tension springs, Springs in series and parallel, Concentric helical springs, Surge in springs, Helical torsion Spring, Design of Multi-leaf springs. (Theoretical treatment only).	6 Hrs	
6	**Friction Clutches and brakes**		
	Clutch: Introduction, Torque transmission capacity, multidisc clutches, friction materials, cone clutches, centrifugal clutches Brakes - Introduction, Energy to be dissipated, Heating of brakes, Shoe or Block brakes (Single & Double), internal and external shoe brakes, self-locking brakes, Differential band brakes, Internal expanding brakes.	6 Hrs.	C05

Self-Learning: Differential/compound screw without mathematical treatment. Disk Brakes,

List of Practical:

Pr No	Description	CO	PO
1.	**Two design projects on Assemblies covering above syllabus**. The design project shall consist of half imperial sheets (A2 size) involving assembly-drawing with a bill of material and overall dimensions and drawings of individual components. The Project should be assigned to a group of three to five students. **Project 1 shall be based on any one of the following topics-** i) Cotter joint/ knuckle joint/turn buckle for a specified application. ii) Transmission Shaft/Machine tool spindles/coupling for specified application. iii) Hand or foot operated levers/lever for safety valve. **Project 2 shall be based on any one of the following topics-** i) Bench vice/Machine vice for specified applications. ii) Bottle type/toggle jack for vehicles. iii) Lead screw for machine tool/other applications. iv) Design of Clutches and brakes Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary for selection of standard components. Drawings of design project should be done manually.	**CO1, CO2, CO3, CO4, CO5, CO6**	**PO1, PO3, PO6**
2.	Preparation of program using programing languages/modern tools for design of following elements: (any one) 1. Knuckle joint 2. Cotter joint 3. Spring 4. Power screw 5. Lever	**CO1, CO3, CO6**	**PO1 PO6**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	2	-	-	-	-	-	-	-	3	-
CO2	3	-	3	-	-	2	-	-	-	-	-	-	-	3	-
CO3	3	-	3	-	-	2	-	-	-	-	-	-	-	3	-
CO4	3	-	3	-	-	2	-	-	-	-	-	-	-	2	-
CO5	3	-	3	-	-	2	-	-	-	-	-	-	-	3	-
CO6	3	-	3	-	-	2	-	-	-	-	-	-	-	3	-

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Mechanical Engineering Design	Shigley J.E. and Mischke C.R.	McGraw Hill Publication Co. Ltd.	621.815
2.	Design of Machine Elements	Spotts M.F. and Shoup T.E	Prentice Hall International	621.815
3.	Design of Machine Elements	Bhandari V.B	Tata McGraw Hill Publication Co. Ltd.	621.815
4.	Fundamentals of Machine Components Design	Juvinal R.C	John Wiley and Sons	621.815

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Machine Design	Black P.H. and O. Eugene Adams	McGraw Hill Book Co. Inc.	621.815
2.	Machine Components Design	Willium C. Orthwein	West Publishing Co. and Jaico Publications House.	--
3.	Theory and Problems of Machine Design,	Hall A.S., Holowenko A.R. and Laughlin H.G	Schaum's Outline Series	--
4.	Design of Machine Elements,	C.S.Sharma and Kamlesh Purohit	PHI Learing Pvt. Ltd	621.815
5.	Machine Design	D.K.Aggarwal & P.C.Sharma	S.K Kataria and Sons	621.815
6.	Machine Design: Fundamentals and Applications	P. C. Gope	PHI Learing Pvt. Ltd	621.815
7.	Design Data	P.S.G	P.S.G. College of Technology, Coimbatore.	621.815
8.	Machine Design data book	Bhandari, V. B.	Tata McGraw Hill Publication Co. Ltd.	621.815

SANJIVANI
GROUP OF INSTITUTES

Metrology and QC (ME304)

Metrology and Quality Control (ME 304)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	2 Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**4**	**Oral:**	25 Marks
		Total:	125 Marks

==========

Prerequisite Course: (if Any)-Nil

==========

Course Objectives: (Please specify Six Objectives) Students are expected to

1. Understand the knowledge of basics of Measurements, Metrology and Measuring devices.
2. Understand thread, gear and surface roughness metrology.
3. Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System.
4. Select and apply appropriate Quality Control Technique for given application.
5. Select and Apply appropriate Quality Management Tool
6. Understand and apply statistical quality control (SQC) for given application

Course Outcomes (COs): On completion of the course, learner will be able –

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	To Understand and Identify methods and devices for measurement of length, angle etc. and to design the gauges.	2	Understand
CO2	To Identify and apply methods and devices for measurement of gear, thread parameters, surface roughness and geometric features of parts.	3	Apply
CO3	To Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System.	2	Understand
CO4	To Select and apply appropriate Quality Control Technique such as check sheets, Pareto charts, flowchart, cause and effect diagrams, histogram, scatter diagram and control charts for given application	3	Apply
CO5	To Select and Apply appropriate Quality Management Tool	3	Apply
CO6	To apply statistical quality control (SQC) technique for given application to improve quality of processes / products and to analyze whether a process is under statistical control.	4	Analyse

Course Contents

Unit	Contents	No.of Hours	COs
1	**Unit-I Fundamentals of Metrology, Comparators and Design of Gauges**		
	Introduction: Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision, Calibration: Concept and procedure, traceability, Linear And Angular Measurements(Conventional and Digital) **Comparators:** Mechanical, Pneumatic, Optical, Electrical (LVDT). **Design of Gauges**: Tolerances, Limits and Fits [IS 919-1993], Region of uncertainty,Taylor's principle, Types of gauges, Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials, Considerations of gauge design (numerical).Gauge R & R.	8 Hrs.	CO1
2	**Unit-II Thread and Gear Metrology, Surface Roughness Metrology**		
	Geometric Form Measurement: Straightness, Flatness, Roundness - Straight edge, use of level beam comparator, autocollimator testing of flatness of surface plate. **Measurement of Thread form:** Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method),Best wire size(Derivation and Numerical) Flank angle and Pitch, Floating Carriage Micrometer (Numerical). **Gear Metrology**: Errors in Spur Gear form, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Gear Rolling Tester. Profile Projector, Tool maker's microscope and their applications **Surface Roughness Measurement**: Introduction to Surface texture, Parameters for measuring surface roughness, Surface roughness measuring instrument: TalySurf, Surface roughness tester.	8 Hrs.	CO2
3	**Unit – III Advances in Metrology**		
	Coordinate Measuring Machine (CMM): Fundamental features of CMM – development of CMMs – role of CMMs – types of CMM and Applications, types of probes **Machine Vision Systems:** vision system measurement – Multisensory systems. **Interferometry:** Principle, Concept of Optical Flat and its types, NPL Interferometer **Laser Metrology:** Basic concepts of lasers, advantages of lasers, laser interferometers, types, applications	6 Hrs.	CO3
4	**Unit – IV Introduction to Quality and Quality Tools**		
	Concept of Quality: Various Definitions and Quality Statements, Cost of quality & value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Old and New Seven Quality Tools, 5-Why technique, 8 Disciplines (8-D) technique, Quality Circles, Areas and criteria for National and International Quality Awards.	6 Hrs.	CO4

Unit	Contents	No.of Hours	COs
5	**Unit –VI Total Quality Management**		
	TQM: Introduction, Quality Function Deployment, 5S, Kaizen, Poka yoke, Kanban, JIT,FMECA, Zero defects, TPM. Six Sigma: DMAIC - Concept and Applications. **Quality Management System** Need for quality management system – design of quality management system – quality management system requirements – ISO 9001, TS-16949, ISO-14000, Introduction to IATF-16949, Quality Audit-terminology, types of QA, Quality conformance and Quality Assurance.	6 Hrs.	CO5
6	**Unit –V Statistical Quality Control (SQC)**		
	Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (**X & R** Chart) & Attribute (**P & C** Chart), Process capability, Statistical Process Control (Numerical). Production Part Approval Method (PPAP). **Acceptance Sampling:** Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical)	8 Hrs.	CO6

List of Practical's: Any eight experiments of following to be performed

Part(A)

Pr No	Description	CO	PO
1.	Demonstration of linear measuring instruments and their applications for linear measurements	**1**	
2.	Demonstration of linear measuring instruments and Angular measurements by using sine bar/sine centre/Autocollimator	**1**	
3.	Error determination of linear / angular measuring instruments and determination of linear and angular dimensions of given part.	**1**	
4.	Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one) (Refer ISO 17025).	**1**	
5.	Verification of dimensions and geometry of given components using Mechanical /Pneumatic comparator. [An assignment with this experiment write-up as, Introduction to use of Standard CODE viz. ASME-Y14.5, ISO-1101].	**1**	
6.	Demonstration of surfaces inspection using optical flat/interferometers / Demonstration of surface roughness measurement using surface roughness tester.	**2**	
7.	Determination of geometry and dimensions of given composite object using profile projector and tool maker's microscope.	**2**	
8.	Measurement of thread parameters using floating carriage diameter measuring machine.	**2**	
9.	Measurement of spur gear parameters using Gear Tooth Vernier / Span Micrometer / Gear Rolling Tester.	**2**	
10.	Determination of given geometry using coordinate measuring machine (CMM).	**3**	

Part: B] Statistical Quality Control (SQC) (Any Two) Note - Use of computational tools [such as Minitab / Matlab / MS Excel] are recommended

1. Analyze the fault in given batch of specimens by using seven quality control tools for engineering application/ Case study on any of seven quality control tools.
2. Determination of process capability from given components and plot variable control chart/ attribute chart.
3. Case study on various tools in Total Quality Management (TQM)

Part: C] Industrial visit to: Calibration lab / CMM Lab / Gear Inspection Unit

ORs

Automotive Industry / Engineering Industry.

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Engineering Metrology	Jain R.K.	Khanna Publication	
2.	Engineering Metrology	I. C. Gupta	Dhanpath Rai Publication	
3.	Metrology and Measurements	Bewoor A. K. and Kulkarni V. A	Tata McGraw hill Publication.	
4.	Quality Handbook	Juran J. M.	McGraw Hill Publications.	
5.	Statistical Quality Control	Grant S.P.	Tata McGraw hill Publication	
6.	A text book of Metrology	M. Mahajan	Dhanpatrai and Co.	
7.	Statistical Quality Control	M. Mahajan	Dhanpatrai and Co.	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Metrology for engineers	Galyer J.F & Shotbolt C.R.	Cengage Learning	
2.	Handbook of Industrial Metrology	ASTME	Prentice Hall of India Ltd	
3.	Fundamentals of Dimensional Metrology	Connie Dotson	Thomson Publn., 4th Edition	
4.	Quality control	Basterfield D. H.	Pearson Education India, 2004	
5.	Modern Methods for Quality control and Improvement	Harrison M. Wordsworth, Stefeen Godfrey	Willy Publication	

SANJIVANI
GROUP OF INSTITUTES

Heat Transfer (ME305)

Heat Transfer (ME305)

Teaching Scheme	Examination Scheme
Lectures: 3 Hrs. / Week	**In-Sem Exam : 30 Marks**
Practical: 2 Hrs./ Week	**End Sem Exam : 50 Marks**
Credits: 4	**CIA : 20 Marks**
	Practical : 50 Marks

==========

Prerequisite Course: Applied Thermodynamics, Basic Mechanical Engineering

==========

Course Objectives:

1. Identify the important modes of heat transfer and their applications.
2. Formulate and apply the general three dimensional heat conduction equations.
3. Analyse the thermal systems with internal heat generation and lumped heat capacitance.
4. Understand the mechanism of convective heat transfer
5. Describe the various two phase heat transfer phenomenon. Execute the effectiveness and rating of heat exchangers
6. Determine the radioactive heat transfer between surfaces.

Course Outcomes (COs): (Strictly Six Outcomes need to be specified here)

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Analyze the various modes of heat transfer and implement the basic heat conduction equations for steady one dimensional thermal system.	3	Apply
CO2	Implement the general heat conduction equation to thermal systems with and without internal heat generation and transient heat conduction.	5	Evaluate
CO3	Analyze transient heat conduction	4	Analyze
CO4	Analyze the heat transfer rate in natural and forced convection and evaluate through experimentation investigation.	4	Analyze
CO5	Calculate heat transfer by radiation between objects with simple geometries.	3	Apply
CO6	Analyze the heat transfer equipment and investigate the performance.	4	Analyze

Course Contents

Unit	Contents	No.of Hours	COs
Unit-I	**Introduction and Basic concept** Unit-I: - Introduction-Modes and mechanisms of heat transfer: Basic laws of heat transfer for all three modes (Numerical treatment), concept of Thermal conductivity, Thermal diffusivity, heat transfer coefficient, General discussion about applications of heat transfer. Conduction Heat Transfer: General heat conduction equation in Cartesian (derivation), Cylindrical and Spherical coordinates. Simplification and forms of the field equation: steady, unsteady and periodic heat transfer, Initial and boundary conditions (Numerical treatment), Thermal insulation, types of insulation Thermal resistance Thermal contact Resistance. Electrical analogy 1-D steady state conduction in plane wall, cylinder and sphere (Numerical treatment)	8 Hrs.	CO 1
Unit-II	**Conductive Heat Transfer**		
	A] **1-D steady state heat conduction with heat generation:** Application of 1-D Poisson's heat conduction equation for plane wall and cylinder with various boundary conditions B] **Heat transfer through fins:** Types, applications, Governing Equation for constant cross sectional area fins, solution for infinitely long & insulated fin tip, fin efficiency & fin effectiveness C] **Transient Conduction and thermal Insulation** Concept of ITG, limped capacity analysis, dimensionless numbers in unsteady state, time constant of thermocouple,	8 Hrs.	CO 2
Unit-III	**Convective Heat Transfer**		
	Convective Heat Transfer: classification of convection, Local and overall heat transfer coefficient., dimensionless numbers in forced convection, velocity and thermal boundary layer **External Forced Convective Heat Transfer** Flow over a flat horizontal plate (Laminar and turbulent), numerical based on empirical correlation **Internal Forced Convective Heat Transfer** concept of hydraulic diameter, Flow through a pipe or tube (Turbulent flow, Laminar flow), Flow over cylinders and spheres, Flow across a cylinder, sphere, numerical based on empirical correlation	8 Hrs.	CO3

Unit	Contents	No.of Hours	COs
Unit-IV	**Heat Transfer by Natural Convection** **Heat Transfer by Natural Convection**: Introduction, dimensionless numbers in natural convection, Natural convection around a flat horizontal/vertical plate, Natural convection around a horizontal cylinder, numerical based on empirical correlation introduction to mixed convection, **Condensation and Boiling:** Boiling heat transfer, types of boiling, pool boiling curve and forced boiling phenomenon, condensation heat transfer, film wise and drop wise condensation	6 hrs.	CO 4
Unit-V	**Radiation**		
	Laws of black-body radiation, Irradiation, radiosity, concept of black body, grey body, laws of radiation: Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann, heat exchange between two black bodies, concepts of shape factor. Laws of shape factor, Calculation of radiation heat transfer between surfaces using radiative properties, radiation shields electrical analogy for radiation networks.	6 Hrs.	CO 5
Unit-VI	**Applications of Heat Transfer**		
	Heat exchangers: Classification and applications, heat exchanger analysis – LMTD, effectiveness– NTU method for parallel and counter flow heat exchanger, LMTD correction factor, cross flow heat exchanger, design criteria for heat exchanger, Introduction to TEMA, ASME standards. **Application of heat transfer:** heat pipe, thermo well, cooling of electronic equipment, phase change materials, heat transfer improvement methods	6 Hrs.	CO 6

List of Practical:

Pr No	Description	CO	PO
1.	Determination of Thermal Conductivity of insulating powder	1	1,2, 9,10,11,12
2.	Determination of Thermal Conductivity of Composite wall	1	1,2, 9,10,11,12
3.	Determination of Emissivity of a Test surface	6	1,2, 9,10,11,12
4.	Determination of Stefan Boltzmann Constant	6	1,2, 9,10,11,12
5.	Determination of heat transfer coefficient in Natural Convection	4	1,2, 9,10,11,12
6.	Determination of heat transfer coefficient in Forced Convection	4	1,2, 9,10,11,12
7.	Determination of temperature distribution, fin efficiency in Natural / Forced Convection	2, 4	1,2, 9,10,11,12
8.	Determination of effectiveness of heat exchanger	5	1,2, 9,10,11,12

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4 PO5 PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1			1	1		1			2
CO2	3	2	1	2			1	1		1			2
CO3	3		2							1			2
CO4	3	2	2	2			2	1		1			2
CO5	3	2	1	1			2	1		1			2
CO6	3	2	2	2			2	1		1			2

(Specify values as : 3: High Level, 2: Medium Level, 1: Low Level for mapping of Cos to POs)

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Fundamentals of Heat and Mass Transfer	F.P. Incropera, D.P. Dewit	John Wiley	
2.	Heat and Mass Transfer – Fundamentals and Applications	Y. A. Cengel and A.J. Ghajar	Tata McGraw Hill Education Private Limited.	
3.	A Textbook on Heat Transfer	S.P. Sukhatme	Universities Press	
4.	Fundamentals of Engineering Heat and Mass Transfer	R.C. Sachdeva	New Age Science.	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Basic Heat and Mass Transfer	A.F. Mills	Pearson	
2.	Heat Transfer	S. P. Venkatesan	AneBooks Pvt. Ltd	
3.	Fundamentals of Heat and Mass Transfer	Holman	McGraw–Hillpublicatio	
4.	Fundamentals of Heat and Mass Transfer	M. Thirumaleshwar	Pearson EducationIndia	
5.	Process Heat Transfer	Kern D. Q	Tata Mc Graw-Hill Edition	

SANJIVANI
GROUP OF INSTITUTES

Professional Elective-I

Refrigeration System (ME306_1)

Professional Elective-I - Refrigeration System-T (ME 306)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: Basic Knowledge of Basic Thermodynamics and Heat Transfer.

==========

Course Objectives: (Please specify Six Objectives)

1. Student should able to understand the fundamental principles and explain applications of refrigeration
2. Understand, conceptualize and determine cooling capacity and coefficient of performance of vapour compression refrigeration system.
3. Understand, conceptualize and find coefficient of performance of compound vapour compression refrigeration system and vapour absorption refrigeration system.
4. Explain properties and environmental issues of refrigerants
5. Understand functions and working of various components of refrigeration system.
6. Explain refrigeration system control and understand cryogenics system.

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Discuss the fundamental principles, applications of refrigeration and explain air cycle refrigeration systems.	3	Apply level
CO2	Understand, conceptualize and determine cooling capacity and coefficient of performance of vapour compression refrigeration system.	4	Analyse Level
CO3	Understand, conceptualize and find coefficient of performance of compound vapour compression refrigeration system and vapour absorption refrigeration system.	3	Apply level
CO4	Explain properties, environmental issues of different refrigerants and compare different refrigerants.	3	Apply level
CO5	Understand functions, working and analyse the performance of various components of refrigeration system.	4	Analyse Level
CO6	Explain refrigeration system control and understand cryogenics system.	5	Evaluate Level

Course Contents

Unit	Contents	No.of Hours	COs
1	**Introduction, Applications of Refrigeration and Air Cycle Refrigeration**		
	Introduction: Review of basics thermodynamics and heat transfer, Definition of Refrigeration and Air Conditioning, History of refrigeration, Ice production by nocturnal cooling in ancient India and application of evaporative cooling in India, Use of natural ice, Ice houses. Applications of Refrigeration: Household refrigerator with types, Freezers, Ice plant, Industrial Refrigeration, Cold chain for vaccination, Chemical and process industries, Dairy plant, Petroleum refineries, Cold storage, Food processing and food chain, Preservation of fruits, vegetables and beverages, Water cooler, Refrigerated trucks, Miscellanous. Air cycle refrigeration systems: Bell Coleman cycle or Reverse Brayton cycle (Numericals), Aircraft refrigeration cycles.	8 Hrs.	CO 1
2	**Vapour Compression Refrigeration System**		
	Vapour Compression Refrigeration system (VCRS) Basic block diagram of VCRS, Tons of refrigeration (TR), Coefficient of performance (COP), Energy efficiency Ratio (EER), Ideal refrigeration cycle – Reversed Carnot cycle and maximum COP (Numericals), Deviations of practical cycles from carnot cycle, Standard vapour compression refrigeration cycle, Numericals based on standard vapour compression refrigeration cycle, Actual vapour compression refrigeration cycle, Effect of suction and discharge pressure, sub cooling and superheating on performance. Case Study on determination of COP of vapour compression refrigeration system	8 Hrs.	C0 2
3	**Compound Vapour Compression Refrigeration System and Vapour Absorption Refrigeration System**		
	Introduction to multistage compression refrigeration system, Compound vapour compression refrigeration system with intercooling for single and multiple evaporator, Numericals. Vapour absorption Refrigeration System (VARS) : Basic principle of VARS, Aqua-ammonia absorption refrigeration system, Properties of Mixtures, Lithium bromide-water absorption Systems, Three fluid Electrolux system. Numericals based on VARS, Solar energy based adsorption refrigeration systems, Numericals.	8 Hrs.	C0 3
4	**Refrigerants and Steam jet Refrigeration System**		
	Types of Refrigerants, designation of refrigerant, Properties of refrigerants, Ozone layer depletion, environment and performance issues, Primary and secondary	8 Hrs.	C0 4

Unit	Contents	No.of Hours	COs
	refrigerants, Synthetic and natural refrigerants, Introduction of CFCs and HCFCs, Refrigerant mixtures – zeotropic and azeotropic mixtures, Applications of various refrigerants, Case study - Comparison between different refrigerants. Leak detection in refrigeration equipment. Steam Jet Refrigeration system. Case Study on determination of COP of ice plant		
5	**Refrigeration System Components**		
	Compressors - Reciprocating compresses - Constructional details – open, hermetic and semi-sealed compressors, Performance and power requirements of the ideal and actual compressor, Centrifugal compressors - Basic principle, Construction details, applications and performance characteristics, Screw compressors - Basic principles- single screw and double screw compressors, working principle, work requirement and performance characteristics, Rotary- single vane and multi-vane compressor, Wise motion compressor (optional). Condensers - Classification based on type of construction, flow direction etc., Condensing capacity and Heat Rejection Ratio, Correlations for condensing heat transfer coefficients, Effects of fouling and noncondensible gases on performance. Evaporators - Classification based on type of construction, flow direction etc., Correlations for boiling heat transfer coefficients for various configurations, Design and performance aspects, Effects of pressure drops and frost formation. Expansion devices - Capillary tubes - Applications, operating characteristics, Thermostatic expansion valves, Automatic expansion valves, Float valves, Electronic expansion valves. Case study on failure of stainless steel cooling coils.	8 Hrs.	C0 5
6	**Refrigeration System Control and Cryogenics**		
	Part- I Refrigeration System Control Capacity Controls of compressors, Measurement and Instruments - Temperature and Pressure measurement of refrigeration system, uncertainty analysis, Controls in Refrigerator. Control of moisture and other contaminants in refrigerant systems, Refrigerant containment, recovery, recycling, and reclamation, Insulation systems for refrigerant piping, Lubricants in refrigerant systems. Troubleshooting of refrigeration system – symptom, possible cause and action.	8 Hrs.	CO 6

Unit	Contents	No.of Hours	COs
	Part – II Cryogenics Low temperature refrigeration - Cryogenics – Introduction and Applications, Cascade refrigeration system, Numericals, Liquification of gases, methods of air liquefaction, Linde‟s and Claude‟s cycle, Numericals, Adiabatic demagnetisation. Case Study - Energy consumption calculations, Cooling load calculations for Household Refrigerator or Ice Plant or Cold Storage (any one).		

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2														
CO2	3	2													3
CO3	3	2													3
CO4	2	2	2			2	2	2							
CO5	3	2	2												3
CO6	3	2								2		2			3

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Refrigeration and Air conditioning	Arora, C.P	Tata-McGraw Hill	ISBN 0-07-463010-5
2.	Refrigeration and Air conditioning	R.S. Khurmi J.K. Gupta	Eurasia Publishing House (P) Ltd.	ISBN 978-81-219-2781-9
3.	Refrigeration and Air conditioning	Manohar Prasad	New Age International	
4.	Basic Refrigeration and Air Conditioning	P .N. Ananthanarayanan	McGraw Hill	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	2018 ASHRAE Handbook - Refrigeration	ASHRAE Technical Committees, Task Groups, and Technical Resource Groups	ASHRAE	ISBN 978-1-939200-98-3 ISSN 1930-7217
2.	2013 ASHRAE Handbook - Fundamentals	ASHRAE Technical Committees, Task Groups, and Technical Resource Groups	ASHRAE	ISBN 978-1-936504-46-6 ISSN 1523-7230
3.	NPTEL – Refrigeration and air conditioning	Ravi Kumar	NPTEL	
4.	Principles of Refrigeration	Roy J Dossat	Pearson	

			Education	
5.	Air Conditioning and Refrigeration Journals – Cold chain for covid – 19 Vaccine	ISHRAE Members	ISHRAE	Volume 11 Number 4 November – December 2020
6.	Air Conditioning and Refrigeration Journals – Integration of HVAC and Fire Safety	ISHRAE Members	ISHRAE	Volume 20 Number 6 November – December 2020

SANJIVANI
GROUP OF INSTITUTES

Professional Elective-I

Reliability Engineering (ME306_2)

Reliability Engineering (ME306)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	2 Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: (if Any)- NIL

==========

Course Objectives: (Please specify Six Objectives)

1. To introduce the basic concepts of reliability, various models of reliability
2. To analyse reliability of various systems
3. To introduce techniques of reliability improvement
4. To introduce the concepts of availability and maintainability.
5. To introduce the concept of system failure analysis
6. To understand the reliability testing of the systems.

Course Outcomes (COs): After the learning this course, the learners will be able to;

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Calculate the system failure rate	2	Understand
CO2	Determine the reliability of the complex systems	2	Understand
CO3	Model the systems for reliability improvement	3	Apply
CO4	Determine availability and maintainability of systems	5	Evaluate
CO5	Analyse the system failures	4	Analyse
CO6	Conduct the test for reliability testing	5	Evaluate

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1												
CO2	2	3	1												
CO3	2	3	1												
CO4	2	3	1												
CO5	2	3	1												
CO6	2	3	1												

Course Contents

Unit	Contents	No.of Hours	COs
1	**Fundamental concepts of Reliability**		
	Reliability terminologies, Role of the reliability function in the organization, Interrelationship of safety, quality and reliability, life characteristic phases, Product liability-Significance, importance of reliability, Introduction to maintainability, availability. Concepts of Failure, failure density, failure Rate, hazard rate, pdf, cdf. Modes of failure, Mean Time To Failure (MTTF), Mean Time Between Failure (MTBF), Numericals based on calculation of failure rate, hazard rate. Warranty Management and Life cycle cost	6 Hrs.	1
2	**Network Modelling and Reliability Evaluation**	6 Hrs	CO
	Basic concepts – Evaluation of network Reliability / Unreliability – Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability / Unreliability using conditional probability method – Paths based and Cutest based approach – complete event tree and reduced event tree methods.		2
3	**System reliability Analysis**	6Hrs.	C0
	Reliability Improvement- Redundancy, element redundancy, unit redundancy, standby redundancy-types of stand by redundancy, parallel components single redundancy, multiple redundancies (Numerical). Introduction to Reliability allocation or apportionment, reliability apportionment techniques – equal apportionment, AGREE, ARINC, Minimum effort method (Numerical).		3
4	**Availability and maintainability**	6Hrs.	C0
	Objectives of maintenance, types of maintenance, Maintainability, factors affecting maintainability, system down time, availability - inherent, achieved and operational availability (Numerical treatment). Introduction to Reliability Centered Maintenance.		4
5	**Reliability in Design & Development**	6Hrs.	C0
	Reliability techniques- Failure mode, effects analysis (FMEA), RPN , Failure mode, effects and criticality analysis (FMECA)-Case Studies, Basic symbols, Fault Tree construction and analysis	6Hrs.	5
6	**Reliability Testing**		CO
	Reliability Life Testing - Test time calculations, Burn-in testing, Acceptance testing, accelerated life testing and Experimental Design - Reliability Growth Testing - Growth process, Idealized growth curve and other growth modals Introduction to reliability testing, Stress strength interaction, Introduction to Markov model Testing for Reliability and Durability- Accelerated Life Testing and Highly Accelerated Life Testing (HALT), highly accelerated stress Screening (HASS).	8Hrs.	6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Reliability Engineering	Srinath L S	East-West Press Limited, New Delhi.	
2.	Concepts of Reliability Engg	Srinath L S	East-West Press Limited, New Delhi.	
3.	Reliability Engineering	A.K. Govil	Tata McGraw-Hill Publishing Co. Ltd	
4.	Reliability Engineering	E. Balagurusmy	Tata McGraw-Hill Publishing Co. Ltd	
5.	Engineering Maintainability	Dhillon B S	Prentice Hall of India, New Delhi	
6.	Quality Control and Reliability in Engineering Design	Dhillon B S	Marcel Dekker Inc	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	An introduction to Reliability and Maintainability Engineering	Ebling CE	Tata McGraw-Hill Publishing Co. Ltd	
2.	Reliability in Engineering Design	K.C. Kapur, L.R. Lamberson	John Wiley & Sons	
3.	Introduction to Reliability in Design	C.O. Smith	Tata McGraw-Hill Publishing Co. Ltd	
4.	Reliability Engineering, Theory and Practice	Alessandro Birolini	Springer-Verlag Berlin Heidelberg	
5.	Reliability and Availability Engineerin	Kishor S. Trivedi and Andrea Bobbio	Cambridge University Press	
6.	Analysis with Minitab	Kishore K. Pochampall and Surendra M. Gupta	CRC Press	

SANJIVANI
GROUP OF INSTITUTES

Professional Elective-I

Industrial Tribology-(ME306_3)

Industrial Tribology (ME306)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	-- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: Engineering Mathematics, Engineering Mechanics, Material Science, Strength of Materials, Fluid Mechanics, Dynamics of Machines, Machine Design**.**

==========

Course Objectives: (Please specify Six Objectives)

1. To know about properties of lubricants, modes of lubrication, additives etc.
2. To Select suitable/proper grade lubricant for specific application.
3. To select suitable material combination for tribological contact.
4. To Apply the basic theories of friction, wear and lubrications about frictional behavior Commonly encountered sliding surfaces.
5. To suggest an explanation to the cause of tribological failures.
6. To design bearing, friction, wear test rig for laboratory purposes.

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Understand the properties of lubricant and select proper lubricant for a given application	2	Understand
CO2	Use basic fundamentals of friction and wear for the understanding behavior of the mechanical systems.	3	Apply
CO3	Determine tribological performance parameters of sliding contact in different lubrication regimes.	4	Analyze
CO4	Develop the systems with proper hydrostatic lubrication.	4	Analyze
CO5	Design and select appropriate bearings for a given application.	4	Apply
CO6	Know the working and use of surface measuring instruments	3	Apply

Course Contents

Unit	Contents	No.of Hours	COs
1	**Introduction to Tribology**		
	Tribology definition, **History and significance of Tribology and economical considerations of tribology in industry,** Tribology in design- bearing material its properties and construction Tribological design of oil seals and gasket, Tribology in industry (Maintenance), Lubrication-Definition, basic modes of lubrication, properties of lubricants, additives, EP lubricants, Recycling of used oil, oil conservation, oil emulsion, Bearing Terminology-Types of Sliding contact, rolling contact bearings, Comparison between sliding and rolling contact bearing. (Theoretical treatment only)	8 Hrs.	CO1
2	**Friction and Wear**		
	Friction- Introduction, laws of friction, Friction classification, causes of friction, Theories of dry friction, Friction measurement, Stick-slip motion and friction instabilities, Wear-classification, wear between solids, wear between solid and liquids, factors affecting wear,Theories of wear, Wear measurement, Approaches to friction control and wear prevention. (Numerical)	8 Hrs.	C02
3	**Hydrodynamic Lubrication**		
	Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, Two dimensional Reynold‘s equation and its limitations, Petroff`s equation , **Stribeck's curve**. Infinitely long journal bearing, infinitely short journal bearing and finite bearing, designing journal bearing using Raimondi and Boyd approach, Hydrodynamic thrust bearing-Introduction, types , Flat plate thrust bearing-Pressure equation, load, centre of pressure, frictional force equation , Tilting pad thrust bearing- bearing-Pressure equation, load, centre of pressure, frictional force equation. (Numericals on Raimondi and Boyd approach and thrust bearing only)	8 Hrs.	C03
4	**Hydrostatic Lubrication**		
	Hydrostatic lubrication-Basic concept, advantages, limitations, viscous flow through rectangular slot, load carrying capacity, flow requirement of hydrostatic step bearing, energy losses, optimum design of stepped bearing, compensators and their actions. **Applications of hydrostatic bearings**	8 Hrs.	C04

Unit	Contents	No.of Hours	COs
	Squeeze film lubrication- Basic concept, circular and rectangular plate approaching a plane (Numericals on hydrostatic bearing, Squeeze film lubrication). .		
5	**Elasto-hydrodynamic Lubrication and Gas Lubrication**		
	Elasto-hydrodynamic lubrication- Principle and applications, pressure viscosity term in Reynold's equation, Hertz theory, Ertel-Grubin equation, lubrication of spheres. Applications of EHD and gas bearings. Gas(air) lubricated bearings-Introduction, advantages, disadvantages, applications of tilting pad bearing, hydrostatic and hydrodynamic bearing with air lubrication, Active and passive magnetic bearings(working principle, types and advantages over conventional bearing). (Theoretical treatment only) . Applications of gas bearings.	8 Hrs.	C05
6	**Surface topography measurements**		
	Electron microscope and friction and wear measurements - Laser method. Sliding friction and wear abrasion test, rolling contact and fatigue test, solid particle and erosion test, Use of transducers and instruments in Tribology. **Introduction to basic surface texture of metals and application of different techniques to measure surface texture.**	8 Hrs.	CO 6

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	0	0	0	2	2	0	0	0	0	2	2	--	--
CO2	3	2	0	0	0	2	2	0	0	0	0	2	2	--	--
CO3	3	2	0	0	2	2	2	0	0	0	0	2	2	--	--
CO4	3	3	2	2	0	2	2	0	0	0	0	2	2	--	--
CO5	2	2	2	2	0	2	2	0	0	0	0	2	2	--	--
CO6	3	2	3	0	0	3	0	0	0	0	0	0	2	--	--

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Design of Machine Elements	V.B. Bhandari.	McGraw-Hill, 199	
2.	Theory and Practice of Lubrication for Engineers	Fuller D. D.	John Wiley and Sons	
3.	Introduction to Tribology and Bearings	B. C. Majumdar	S.CHAND and Company Ltd. New Delhi	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Handbook of tribology: materials, coatings and surface treatments	B. Bhushan, B.K. Gupta	McGraw-Hill, 199	
2.	Basic Lubrication Theory	Cameron A	Wiley Eastern Ltd	
3.	Principles of Tribology	Halling J	McMillan Press Ltd.	

SANJIVANI
GROUP OF INSTITUTES

Mandatory Learning Course

(Design Thinking) (ME308)

Design Thinking (ME 308)

Teaching Scheme		Examination Scheme	
Lectures:	1 Hrs. / Week	**In-Sem Exam :**	-
Practical:	- Hrs./ Week	**End Sem Exam:**	-
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments: Oral:**	-
Credits:	-	**Total:**	-

==========

Prerequisite Course: (if Any) The subject Machine Design-II has a prerequisite as Strength of Materials, and Applied Mechanics as major subjects

==========

Course Objectives: (Please specify Six Objectives)

1. To bring awareness on innovative design and new product development.
2. To explain the basics of design thinking.
3. To familiarize the role of reverse engineering in product development.
4. To train how to identify the needs of society and convert into demand.
5. To introduce product planning and product development process.

Course Outcomes (COs): At the end of the course the student will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Explain the principles of science to engineering, simple mechanics motion and force transmission and Identify the laws of physics applied to engineering products	3	Apply
CO2	Identify innovation in early mechanical designs and list out the developments in computing machines	4	Analysis
CO3	Apply systematic approach in design and develop strategies for new product development	3	Apply
CO4	Understand reverse engineering methods in product development and Apply electronic controls to improve the product acceptability	3	Apply
CO5	Identify the needs for new product development in agriculture and explain the principles in design electrical vehicles and drones	3	Apply

Course Contents

Unit	Contents	No.of Hours	COs
1	**Design Thinking Introduction**		
	Science to Engineering: Job of engineers, engineering units and measurement, elements of engineering analysis, forces and motion, energy, kinematics and motion, conversion of linear motion to rotary and vice versa, motion transmission. Physics to Engineering: Application of Newton laws, Pascal's law, Bouncy, Bernoulli's theorem, Ohm's law, and electrical induction in engineering products. Introduction, Need of Design Thinking, Traditional Problem Solving versus Design Thinking, phases of Design Thinking, Tools for Design Thinking, Relevance of Design and Design Thinking in Engineering	3 Hrs.	CO1
2	**Historical Development and Electronics**		
	Historical Development: Invention wheel, early mechanics in design, mechanical advantages, industrial revolution, steam and petrol for mobility. Innovations in Electrical and Electronics: Electrical energy generation, electrical bulb, electrical equipment, electronics and automation, computing for early days to present, innovations in communications	2 Hrs.	C02
3	**Product development**		
	Systematic approach to product development: Design Thinking, Innovation, Empathize Design Thinking as a systematic approach to Innovation, brainstorming, visual thinking, design challenges, innovation, art of Innovation, strategies for idea generation, creativity, teams for innovation. Solution finding methods: conventional, intuitive, discursive, methods for combining solution, decision making for new design	3 Hrs.	C03
4	**Reverse engineering in product development**		
	Reverse engineering in product development: Reversing engineering methods, identifying the bad features in a product, reduction in size and weight, usage of new materials, 3D printing, study of introducing electrical and electronic controls to the old products, importance of ergonomics in product development, environmental considerations in design, safety considerations in design.	3 Hrs.	C04
5	**Study of Product Development**		
	Study of Product Development- Agriculture, development of machines for separation of corn seeds, peeling of groundnut shells, husk removing from paddy. Electrical: Design of burglar alarm, speedometer, water level indicator, smart gates, smart lights. Design of electrical vehicles, unmanned vehicles, design principles in drones.	2 Hrs.	C05

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															
CO6															

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Exploring Engineering: An Introduction to Engineering and Design",	Philip Kosky, Robert T. Balmer, William D. Keat, George Wise,	4th edition, Elsevier, 2016.	
2.	History of Modern Design	David Ralzman	2nd edition, Laurence King Publishing Ltd., 2010	
3.	Design Thinking	AVA Publishing, 2010.	AVA Publishing, 2010.	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Engineering Design: A Systematic Approach	G. Pahl, W.Beitz, J. Feldhusen, KH Grote	3rd edition, Springer, 2007.	
2.	Ten Faces in Innovation	Tom Kelley, Jonathan Littman	Currency Books, 2006.	
3.	Designing for Growth: A Design Thinking Tool Kit for Managers	Jeanne Liedtka and Tim Ogilvie	New York: Columbia University Press, 2011	

SANJIVANI
GROUP OF INSTITUTES

Thank You

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING KOPARGAON

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE - 2019 PATTERN

THIRD YEAR B. TECH. (Semester-VI)

LIST OF ABBREVIATIONS			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
ES	Engineering Science	HSMC	Humanity Science
PC	Professional Core	CA	Continuous Assessment
PE	Professional Elective	OR	End Semester Oral Examination
OE	Open Elective	PR	End Semester Practical Examination
ISE	In-Semester Evaluation	TW	Continuous Term work Evaluation
ESE	End-Semester Evaluation	BSC	Basic Science Course
PRJ	Project	MC	Mandatory Course

SANJIVANI RURAL EDUCATION SOCIETY'S

SANJIVANI COLLEGE OF ENGINEERING

KOPARGAON-423603

(An Autonomous Institute Affiliated to SPPU Pune)

DEPARTMENT OF MECHANICAL ENGINEERING

Sanjivani College of Engineering was established in the year 1983. The Mechanical Engineering Department is a part of the institute since its inception. The Department has grown over the years with qualified teaching faculty members who are passionate to impart quality education. The department laboratories are fully equipped with latest equipment's, software's and all necessary teaching aids. It is now recognized as one of the prominent departments and known for academic excellence under the Pune University. The department is having valid Accreditation by 'NBA' from 31 July 2015 to 31 June 2021. Besides high quality teaching and instruction at UG, PG and Ph. D., the department is actively involved in basic and applied research and consultancy services. The department is providing quality technical and advisory support through consultancy to various private construction agencies, State Government, Central Government projects. Apart from academic knowledge, we also, train our students to face the challenges in their profession by providing value added courses like Communication and Presentation skills, building of Team Sprit through field study, expert talk etc. The department also, provides an opportunity to learn software's like MATLAB, AUTOCAD, UGNX, ANSYS, PTC Creo etc. to make our students more digitalized.

We arrange regular interaction of our stake holders like students, parents and faculty along with a Training and Placement cell which works full time for bright future of our students. The results are consistently above 90% and considerable number of student ranks in SPPU merit list. Students from Mechanical department have made incredible mark national and international levels and we are sure will continue in times to come. The Infrastructure development in India is growing at a faster rate and there are many career paths for Mechanical engineers. Mechanical engineers are essential in government sector, public and private sector and Multinational companies, to build various mega projects like highways, Industrial structures, smart cities, and reservoirs etc. The next decade will be most demanding and rewarding for Mechanical engineers.

Vision of Department

Our vision is to develop world class, multidimensional, competent, disciplined and ethical Mechanical engineers for the society.

Mission of Department

Our mission is,

To impart the quality education to the students through class-room teaching, innovative projects, and industry-institution interaction.

To provide a better environment to encourage and support participation in co-curricular and extra-curricular activities.

To use technology of Mechanical Engineering as a prime tool for the multifaceted development of our students in the emerging fields of Engineering.

Program Outcomes (POs)

Mechanical Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

PEO1: To develop graduates with a sound technical knowledge for a successful career in industries, higher studies and as an entrepreneur.

PEO2: To prepare graduates with expertise in use of modeling, analysis and programming software.

PEO3: To inculcate interpersonal skills with ethical approach and contribute towards social, personal, economic and environmental issues.

Program Specific Outcomes (PSOs)

At the end of the program graduates will demonstrate ability to

PSO1. Design and manufacture mechanical components and systems

PSO2. Model and analyze machine components using modeling and analysis software's.

PSO3. Specify, analyze and determine the performance of thermal systems including IC engines, refrigeration and air conditioning systems, air compressors, hydraulic turbines and pumps.

T.Y.B. Tech SEM V

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
			L	T	P		Theory			OR	PR	TW	Total
							ISE	ESE	CIA				
PRJ	ME301	Professional Internship-I	-	-	-	2	-	-	-	50	-	-	50
PCC	ME302	Production Technology	3	-	-	3	30	50	20	-	-	-	100
PCC	ME303	Machine Design –I	3	-	-	3	30	50	20	-	-	-	100
PCC	ME304	Metrology and QC	3	-	-	3	30	50	20	-	-	-	100
PCC	ME305	Heat Transfer	3	-	-	3	30	50	20	-	-	-	100
PEC	ME306	Professional Elective-I	3	-	-	3	30	50	20	-	-	-	100
PCC	ME307	Machine Design –I Lab	-	-	2	1	-	-	-	-	-	25	25
PCC	ME308	Metrology and QC Lab	-	-	2	1	-	-	-	25	-	-	25
PCC	ME309	Heat Transfer Lab	-	-	2	1	-	-	-	-	50	-	50
PRJ	ME310	Skill based Credit Course/PBL	1	-	-	1	-	-	50	-	-	-	50
MLC	ME311	Mandatory Learning Course	1	-	-	NC	-	-	-	-	-	-	-
		Total	**17**		**06**	**21**	**150**	**250**	**150**	**75**	**50**	**25**	**700**

T.Y.B. Tech SEM VI

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
			L	T	P		Theory			OR	PR	TW	Total
							ISE	ESE	CIA				
PCC	ME312	Applied Thermodynamics	3	-	-	3	30	50	20	-	-	-	100
PCC	ME313	Machine Design –II	3	-	-	3	30	50	20	-	-	-	100
PEC	ME314	Professional Elective-II	3	-	-	3	30	50	20	-	-	-	100
OE	ME315	Open Elective-I	4	-	-	4	30	50	20	-	-	-	100
PRJ	PR316	IPR & EDP	2	-	-	2	15	25	10	-	-	-	50
PRJ	PR317	IPR & EDP Lab	-	-	2	1	-	-	-	-	-	50	50
HSMC	HS318	Corporate Readiness	1	-	2	2	-	-	-	-	-	50	50
PCC	ME319	Applied Thermodynamics Lab	-	-	2	1	-	-	-	-	50	-	50
PCC	ME320	Machine Design –II Lab	-	-	2	1	-	-	-	50	-	-	50
PCC	ME321	Machine Shop-II Lab	-	-	2	1	-	-	-	-	-	50	50
MLC	ME322	Mandatory Learning Course	1	-	-	NC	-	-	-	-	-	-	-
		Total	**17**	**-**	**10**	**21**	**135**	**225**	**90**	**50**	**50**	**150**	**700**

Professional Elective – I		Professional Elective – II	
ME306A	Refrigeration System	ME314A	Turbo Machinery
ME306B	Reliability Engineering	ME314B	Operation Research
ME306C	Industrial Tribology	ME314C	Process Equipment Design

Open Electives-I			
ME315A	IoT (Internet of Things)	ME315C	Digital Marketing
ME315B	Artificial Intelligence	ME315D	Enterprise Resource Planning
ME315E	Renewable Energy Sources	ME315F	OOP-C++/JAVA/Python

ME311	**Mandatory Learning Course**	**Proficiency Skills (Design Thinking)**
322	**Mandatory Learning Course**	**Proficiency Skills (Programing Skills)**

Applied Thermodynamics (ME 312)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	Not applicable	**End Sem Exam:**	50 Marks
Tutorials :	Not applicable	**Home Assignments:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: Basic Thermodynamics

==========

Course Objectives :(Please specify Six Objectives)

1. To study working of engine, Actual, Fuel-Air and Air standard cycle and its Performance
2. To understand Combustion in SI and CI engines and factors affecting performance parameters
3. To estimate performance parameters by conducting a test on I. C. Engines and study emissions with its controlling methods.
4. To learn about steam generator and analyse its performance.
5. To understand about reciprocating air compressor and evaluate the performance
6. To learn about vapour compression & vapour absorption refrigeration systems

Course Outcomes (COs): On completion of the course of Applied Thermodynamics, learner will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	**Explain** basic engine terminology, air standard, fuel air and actual cycles.	2	Understanding
CO2	**Identify** factors affecting the combustion performance of SI and CI engines.	2	Understanding
CO3	**Determine** performance parameters of IC Engines and **Understand** emission control Systems	3	Applying
CO4	**Describe** construction, working, classification, mounting and accessories of boiler and **calculate** equivalent evaporation, boiler efficiency, energy balance of boiler.	3	Applying
CO5	**Explain** construction, working of reciprocating compressor and **determine** the volumetric efficiency, isothermal efficiency of reciprocating compressor	3	Applying
CO6	**Describe** vapour compression and vapour absorption refrigeration system and **calculate** coefficient of performance of (COP) of refrigeration system	3	Applying

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	-	2
CO2	2	1	-	-	-	-	-	-	-	-	-	1	-	-	2
CO3	3	2	-	2	-	-	2	-	2	1	-	1	-	-	2
CO4	3	2	-	2	-	-	-	-	1	1	-	1	-	-	2
CO5	3	2	-	2	-	-	-	-	1	1	-	1	-	-	2
CO6	3	2	-	2	-	-	-	-	1	1	-	1	-	-	2

High-3: Medium-2: Low-1

Course Contents

Unit no.	Unit title and contents	No. of Hours	COs
1	**Unit 01: Introduction to Internal Combustion (IC) Engine**		
	IC Engine: Terminology of I.C. engines , Classification, parts and materials of I.C Engine Working of four stroke/two stroke - petrol/diesel engine , Cycle of operation in Four stroke and Two-stroke IC engines and their comparative study , Comparison between Petrol and Diesel Engines, Applications, Intake and exhaust system, Valves actuating mechanisms, Valve timing diagram.	8 Hrs.	CO1
2	**Unit 02: SI and CI Engines**		
	SI Engines:- Spark ignition Engine mixture requirements, Fuel-Air ratio, Simple, Electronic Fuel Injection System, Qualities and Properties of fuels in S.I. Engine, Combustion stages in SI engines, Abnormal Combustion, Theory of Detonation and Parameters affecting detonations, Combustion Chambers used in SI Engine. **CI Engines**: Fuel Injection system, Construction and Working of Fuel Pump, Fuel Injector and Various types of Nozzle, Electronically controlled unit fuel injection system, CRDI, Combustion stages in CI engines, Theory of knocking and Parameters affecting knocking, Combustion Chambers used in CI Engines, Rating of fuels in SI and CI engines, Dopes and Additives.	8 Hrs.	C02
3	**Unit 03: IC Engine Testing and Emission**		
	Engine Testing: Introduction to Indian Standards for testing of I.C. Engine, Basic Performance Parameters of I.C. Engine, Methods and Tests to determine power and efficiencies of I.C. Engine, characteristic curves, heat balance sheet,	10 Hrs.	C03

Unit no.	Unit title and contents	No. of Hours	COs
	Determination of IP, BP, FP, Mean effective pressure, Fuel consumption, Air Consumption, Engine efficiencies **Emission & Control**: Introduction to Indian Driving Cycle (IDC), European Driving Cycle (EDC), Methods to measure emission such as (Non Dispersive Infrared Red (NDIR), Bharat stage norms. Emission control methods and systems for SI and CI engines, catalytic convertors.		
4	**Unit 04: Steam Generators**		
	Steam Generators: Classification, Constructional details of low pressure boilers, Primary Features of high pressure (Power) boilers, Location, Construction and working principle of boiler, Boiler mountings and accessories, Instrumentations required for safe and efficient operation, Introduction to IBR Act, Boiler performance Calculations-Equivalent Evaporation, Boiler efficiency, Heat balance Sheet.	8 Hrs.	C04
5	**Unit 05: Air Compressor**		
	Reciprocating Compressor: Applications of compressed air, single stage compressor (without clearance and with clearance volume), volumetric efficiency, isothermal efficiency, effect of clearance volume, free air delivery (FAD), actual indicator diagram for air compressor, Multi staging of compressor, optimum intermediate pressure, intercooler, after cooler, Capacity control of compressors.	8 Hrs.	C05
6	**Unit 06: Refrigeration Systems**		
	Refrigeration: Reversed Carnot Cycle, unit of refrigeration, Simple Vapour Compression Cycle (VCC), Refrigerating Effect, Compressor Power & COP. Simple Vapor Absorption Cycle (VAC), Comparison between VCC & VAC	6 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Internal Combustion Engines	V. Ganesan	Tata McGraw-Hill	
2.	Fundamentals of Internal Combustion Engines	H.N. Gupta,	PHI Learning Pvt. Ltd.	
3.	Applied Thermodynamics	Onkar Singh	New Age International Publishers	
4.	Thermal Engineering - I	Mahesh M Rathore	McGraw Hill Education (India) Private Ltd	
5.	Thermal Engineering	Sadhu Singh	Pearson India Education Services Pvt. Ltd	
6.	Applied Thermodynamics	Onkar Singh	New age international publishers	
7.	Basics and Applied Thermodynamics	P.K. Nag	Tata McGraw Hill publications	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Internal Combustion Engine Fundamentals	Heywood	Tata McGraw-Hill	
2.	Internal Combustion Engine	Domkundwar & Domkundwar	Dhanpat Rai & Co.	
3.	Thermal Engineering	S.Domkundwar,C.P. Kothandaraman, A. Domkundwar	Dhanpat Rai & Co	
4.	Applied Thermodynamics	T.D. Eastop and A.McConkey	Pearson	

Machine Design-II (ME 313)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	-	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA**	20 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: (if Any) The subject Machine Design-II has a prerequisite as Machine Design-I, Strength of Materials, and Applied Mechanics as major subjects

==========

Course Objectives: (Please specify Six Objectives)

1. Enable students to attain the basic knowledge required understanding, analyzing, designing and select machine elements required in transmission systems.
2. Reinforce the philosophy that real engineering design problems are open-ended and challenging
3. Impart design skills to the students to apply these skills for the problems in real life industrial applications
4. Inculcate an attitude of team work, critical thinking, communication, planning and scheduling through design projects
5. Create awareness amongst students about safety, ethical, legal, and other societal constraints in execution of their design projects
6. Develop an holistic design approach to find out pragmatic solutions to realistic domestic and industrial problems

Course Outcomes (COs): At the end of the course students will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Determine the dimensions of spur gear, helical and bevel gear for given power transmitting capacity and design industrial gear box without failure.	3	Apply
CO2	Calculate dimensions of worm and worm gear considering strength rating and design industrial gear box without failure.	3	Apply
CO3	Calculate required capacity of Rolling contact bearing and its selection from manufacturer's Catalogue	3	Apply
CO4	Estimate sizes of belt drives and selection of belt, rope and chain from manufacturer catalogue for given power transmitting capacity	3	Apply
CO5	Determine the dimensions of crane components	3	Apply
CO6	Determine the dimensions of IC Engine components	3	Apply

Course Contents

Unit	**Contents**	No.of Hours	COs
1	**Design of Spur, Helical and Bevel Gears**		
	Introduction to gears: Gear Selection, material selection, Basic modes of tooth failure, Gear Lubrication Methods. Spur Gears: Number of teeth and face width, Force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation. Types of helical and Bevel gears, Terminology, Virtual number of teeth, and force analysis of Helical and Straight Bevel Gear. Design of Helical and Straight Bevel Gear based on Beam Strength, Wear strength and estimation of effective load based on Velocity factor (Barth factor) and Buckingham's equation. Mountings of Bevel Gear. (No numerical on force analysis of helical & Bevel Gear)	8 Hrs.	CO1
2	**Design of Worm and worm wheel**		
	Worm and worm gear terminology and proportions of worm and worm gears, Single and double enveloping, Force analysis of worm gear drives, Friction in Worm gears, efficiency of worm gears, Self-locking properties of worm and worm wheel drive, Worm and worm gear material, Strength and wear ratings of worm gears (Bending stress factor, speed factor, surface stress factor, zone factor) IS 1443-1974, Thermal consideration in worm gear drive, Types of failures in worm gear drives, Methods of lubrication (grade of lubricant) and mounting. Feasibility of worm and worm wheel replacement, Life span for reliable operation, Effect of dry running on life.	6 Hrs.	C02
3	**Rolling Contact Bearings**		
	Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent bearing load, Load- life relationship, Selection of bearing life, Selection of rolling contact bearings from standard and commercially available manufacturer's catalogue, e.g. SKF, NTN. Design for cyclic loads and speed, bearing with probability of survival other than 90% Taper roller bearing: Force analysis and selection criteria. (Theoretical Treatment only)	6 Hrs.	C03
4	**Design of Belt and Chain drive**		
	Belt drive: Materials and construction of flat and V belts, geometric relationships for length of belt, power rating of belts, concept of slip & creep, initial tension, effect of centrifugal force, maximum power condition, Selection of Flat and V-belts from standard and commercially available manufacturer's	6 Hrs.	C04

	catalogue, belt tensioning methods, relative advantages and limitations of Flat and V- belts, construction and applications of timing belts, V-Belt drive with variable speed ratio, its effect on belt design and applications. **Chain Drives** Types of chains and its Geometry, selection criteria for chain drive, Polygon effect of chain, Modes of failure for chain, Lubrication of chains		
5	**Design of Cranes**		
	Basic objectives of material handling system, Types of load, Classification and application of various Material handling equipment, Basic principles in selection of material handling system, Classification of cranes, Stress analysis and selection of Hooke (IS 15560, 2005), Pulley System (hoisting tackle analysis), Steel Wire ropes: Classification and coding, stress analysis and selection, Design of Sheave and drums.	6 Hrs.	C05
6	**Design of IC Engine Components**		
	Selection of type of IC engine, General design considerations, Design of cylinder and cylinder head; Design of piston and its parts like piston ring and gudgeon pin etc.; Design of connecting rod; and Design of crankshaft.	4 Hrs.	CO6

Assignments on

1. Design of Spur Gears.
2. Design of Helical Gears and force analysis.
3. Design of Bevel Gear and force analysis.
4. Design of Worm gear.
5. Selection of Rolling Contact bearing including taper roller bearings
6. Design of IC engine components.

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	2	-	1	2	2	2	2	3	-	-
CO2	3	3	3	2	2	2	-	2	2	2	2	2	2	-	-
CO3	3	2	2	2	-	2	-	2	2	2	2	1	2	-	-
CO4	3	3	3	2	3	2	-	1	2	2	1	1	2	-	-
CO5	2	3	3	-	-	2	-	2	-	1	-	2	3	-	-
CO6	3	3	2	2	-	2	-	1	-	1	-	-	2	-	-

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Design of machine elements	Bhandari V.B.	Tata Mc Graw Hill Public Co. Ltd.	(621.815/bha-tb) 17324 to 332
2.	Mechanical Engineering Design	Shigley J.E. and Mischke C.R.	Mc Graw Hill Pub. Co. Ltd.	(621.815/shi-tb) 005910,11
3.	Design of Machine elements	Spotts M.F. and Shoup T.E.	Prentice Hall International.	(621.815/spo-tb) 9332, 7359, 60,61
4.	Machine Design	Black P.H. and O. Eugene Adams	Mc Graw Hill Book Co. Ltd.	(621.815/bla-tb) 7663,64

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Design Data	P. S. G. College of Technology, Coimbatore.	P. S. G. College of Technology, Coimbatore.	(621.815/psg-tb) 12385, 6665- 69
2.	Fundamentals of Machine Components Design	Juvinal R. C.	John Wiely and Sons.	(621.815/juv-tb) 14375

Turbo Machinery-I (ME 314 A)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course:

==========

Course Objectives:

1. **Apply thermodynamics and kinematics principles to turbo machines**
2. **Analyse the performance of turbo machines.**
3. **Ability to select turbo machine for given application.**
4. **Predict performance of turbo machine using model analysis.**
5. **Analyse the velocity triangles and apply the derivation to different flow conditions in turbomachines**
6. **To understand and analyse comparative working behaviour of different turbomachines**

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	To understand and apply the basic principles, governing equations of turbo machine.	3	Apply
CO2	Analyse and develop a derivation of the velocity triangles and its application on Pelton Wheel.	4	Analyse
CO3	To apply the general derivations of impulse and momentum equations to Francis Turbine, Kaplan and Propeller Turbine and comparative analysis	3	Apply
CO4	To apply the general derivations of impulse and momentum equations to steam turbine.	3	Apply
CO5	To apply the derivation of general derivations of impulse and momentum equations to Centrifugal Pump	3	Apply
CO6	To analyse the performance in air compressors.	4	Analyse

Course Contents

Unit	Contents	No.of Hours	COs
1	**Introduction to Turbo Machinery and Impact of Jet**		
	Introduction to Turbo Machinery Turbo machines (Hydraulic & Thermal), Classification of Turbo machines, Fundamental equation governing turbo machines, Different losses associated with turbo-machinery, Applications of Turbo machines. **Impact of Jet** Impulse momentum principle and its applications, Force exerted on fixed and moving flat plate, curved vanes, series of flat plates and radial vanes, velocity triangles and their analysis, work done equations, vane efficiency.	6 Hrs.	CO1
2	**Impulse Water Turbines**		
	Introduction to Hydro power plant, classification of hydraulic turbines construction, principle of working, velocity diagrams and analysis, design aspects, performance parameters, performance characteristics, specific speed, selection of turbines, multi-jet Pelton wheel.	6 Hrs	C02
3	**Reaction Water Turbines**		
	Classifications, Francis, Propeller, Kaplan Turbines, construction features, velocity diagrams and analysis with numerical, degree of reaction, performance characteristics. Draft tubes: types and analysis, causes and remedies for cavitation phenomenon (no numerical on Draft tube), Governing of turbines	6 Hrs	C03
4	**Steam Turbines**		
	Steam nozzles: types and applications, Equation for velocity and mass flow rate [No numerical treatment]. **Steam Turbines:** Classifications, construction details, compounding of steam turbines (No numerical), velocity diagrams and analysis of Impulse and reaction turbines (single stage) with numerical, governing of steam turbine, performance characteristics. Losses in steam turbines, selection of turbines.	6 Hrs	C04
5	**Centrifugal Pumps**	6 Hrs	C05
	Classification of rotodynamic pumps, components of centrifugal pump, types of heads, velocity triangles and their analysis, effect of outlet blade angle, cavitation, NPSH, Thomas's cavitation factor, priming of pumps, installation, specific speed, performance characteristics of centrifugal pump, series and parallel operation of		

Unit	Contents	No.of Hours	COs
	pumps, selection of pumps.		
6	**Centrifugal & Axial Compressor**		
	Centrifugal compressor: Classification of compressors, Construction, velocity diagram, flow process on T-S Diagram, Euler's work, actual work input, performance characteristics, various losses in centrifugal compressor. **Axial Compressor:** Construction, stage velocity triangles and its analysis, enthalpy entropy diagram, stage losses and efficiencies, performance characteristics. [No numerical treatment]	6 Hrs.	C06

Case studies: (CIA 10 Marks)

1. **Verification of impulse momentum principle.**
2. **Study and Trial on Pelton turbine.**
3. **Study and Trial on Francis turbine.**
4. **Study and Trial on centrifugal pump.**
5. **Study and trial on Centrifugal compressor.**
6. **Visit to sugar factory to observe and prepare a report on steam turbine.**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3							1	1				2
CO2	3	3													3
CO3	3	3	3	1						1	1				3
CO4	3	3	3	3					1	1	1	1			3
CO5	3	3		3						1	1				3
CO6	3	3								1	1				2

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Steam and Gas Turbines and Power Plant Engineering	R. Yadav	Central Publ. house Allahabad	43936
2.	Hydraulics, Fluid Mechanics and Machinery	Modi P N & Seth S N	Standard Book House New Delhi	61852
3.	Fluid mechanics and hydraulic machines	Dr. R.K. Bansal	Laxmi Publication	61258
4.	Thermal Engineering	R.K.Rajput	Laxmi Publication, New Delhi	621402
5.	Turbo Machines	B.U.Pai	John Wiley	62005
6.	Thermal Engineering	Sadhu Singh & Sukumar Pati	Pearson Publication	621402

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Fundamentals of Turbomachinery	William W. Peng	John Wiley & Sons.	69313
2.	Thermal Turbomachines	Dr. Onkar Singh	Wiley India	62224
3.	Theory of Hydraulic Machinery	V. P. Vasandani	Khanna Publishers, Delhi	17726
4.	Fluid Mechanics, Thermodynamics of Turbomachinery	S.L. Dixon	IV edition, Butterworth-Heinemann Publ., 1966.	
5.	Hydraulic machines	Dr.Jagdish Lal	Metropolitan Books Co.Pvt.Ltd.,Delhi	8674

Operation Research (ME 314 B)

Teaching Scheme	Examination Scheme
Lectures: 3 Hrs. / Week	**In-Sem Exam : 30 Marks**
Practical: 00 Hrs./ Week	**End Sem Exam: 50 Marks**
Tutorials : Hrs./Week (if applicable)	**CIA: 20 Marks**
Credits : 3	**Total: 100 Marks**

==========

Prerequisite Course: Mathematics I, II and III

==========

Course Objectives:

1. To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
2. To familiarize the students with various tools of optimization
3. To make aware students the techniques of process time minimization
4. To make students aware about various techniques for project management
5. To familiarize the students with sequencing techniques
6. To familiarize the students with multistage decision making techniques

Course Outcomes (COs) : After learning this subject, the students will be able to,

1. Apply LPP and Decision Theory to solve the problems.
2. Apply the concept of transportation models to optimize available resources.
3. Decide optimal strategies in conflicting situations.
4. Implement the project management techniques.
5. Minimize the process time
6. Optimize multi stage decision making problems

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3									1		2	
CO2	2	3									1		2	
CO3	2	3									1		2	
CO4	2	3									1		2	
CO5	2	3									1		2	
CO6	2	3									1		2	

Course Contents

Unit-I	**Introduction: Operation Research**	No.of Hours	COs
	Introduction: Definition, Evolution and Classification of Quantitative Methods and Operations Research Techniques, Methodology, Advantages and Limitations. Linear Programming Problem Introduction, Formulation of LPP, Solution of LPP by Two Phase Method only. Decision Theory Meaning and Steps in Decision Making, Types of Management Decisions, Decision under Certainty, under Risk, under Uncertainty.	Hrs.6	01
Unit-II	**Transportation & Assignment Model**	No.of Hours	COs
	Introduction, Formulation, Basic Method of Solving Transportation Problem. Optimization Methods like UV and Stepping Stone Method. Assignment Problem- Hungarian Method to solve Assignment Problem.	5 Hrs.	2
Unit-III	**Theory of Games and Linear Programming**	No.of Hours	COs
	Theory of Games: Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance, Solution by Graphical Method. m x n size Game Problem, Iterative method, Introduction to formulation of games using Linear Programming. Replacement Analysis: Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly.	6 Hrs.	3
Unit-IV	**Project Management**	No.of Hours	COs
	Network Models: Fulkerson ‘s rule, concept and types of floats, CPM and PERT, Crashing Analysis and Resource Scheduling. Simulation: Introduction, Monte-Carlo Simulation method, Simulation of Inventory and Queuing Problems.	6 Hrs.	4
Unit-V	**Queuing Theory and Sequencing Models**	No. of Hours	COs
	Queuing Theory: Introduction, Basis Structure, Terminology (Kendal‘s Notations) and Applications. Queuing Model M/M/1: /FIFO, M/M/c. Sequencing models : Solution of sequencing Problem - Processing of n jobs through two machines, Processing of n jobs through three machines, Processing of two jobs through m Machines, Processing of n jobs through m Machines.	5 Hrs.	5
Unit-VI	**Integer and Dynamic Programming**	No. of Hours	COs
	Integer Programming Introduction to Integer Programming,		

	Cutting plane method and Branch and Bound Method. Dynamic Programming: Introduction, DP Model, Applications of DP Model to shortest route problems. Solution of LPP by Dynamic Programming	5 Hrs.	6

Books:

Text Books:

1. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991
2. J. K. Sharma, Operations Research: Theory and Application, Laxmi pub. India.
3. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut.
4. Manohar Mahajan, Operation Research, Dhanpatrai Publication.

Reference Books:

1. Hillier F.S., and Lieberman G.J., Operations Research, Eight Edition, Mc. Tata McGraw Hill, India.
2. Ravindran, —Engineering optimization Methods and Applications ‖ , 2nd edition, Wiley, India.
3. Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Second Edition, Mc. WSE Willey,
4. Operations Research - An introduction, Hamdy A Taha, Pearson Education.

CIA Activities:

1. Case study based on simulation and analysis of formulation of LPP model for real life industrial problem.
2. Case study-based assignment of Transpiration
3. Case study on Mechanical Project network analysis using software
4. Case Study of queuing model at Bank/Toll Plaza
5. Sequencing of machines for new product development using software
6. Case study-based Assignment on simulation of Assignment Technique.
7. Case study-based Assignment on simulation of inter programming
8. Assignment on multistage decision making in dynamic situation

Process Equipment Design Name of Subject (ME 314C)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: (Strength of Materials)

==========

Course Objectives: (Please specify Six Objectives)

1.Use various standards used for design of pressure vessel
2.Design process equipment and modify the design of existing equipment to new process conditions or new required capacity.
3. Build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
4. Create understanding of equipment design with mechanical concept.
5. Review the importance of design concepts in process industry.
6. Learn safety measures in the process industry.

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Learn about various codes and standard for the design of pressure vessel	2	Understand
CO2	Design of the pressure vessel	3	Apply
CO3	Design the supports of vessel	3	Apply
CO4	Design of storage vessel	3	Apply
CO5	Design of heat exchangers	3	Apply
CO6	Learn safety measures in pressure equipment design	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						2	2	2						2	
CO2	2	2	2	2				2						2	
CO3	2	2	2					2						2	
CO4	2	2	2					2						2	
CO5	2	2	2					2						2	
CO6						2	2	2						2	

Course Contents

Unit	Contents	No.of Hours	COs
1	**INTRODUCTION**		
	Introduction to Chemical Engineering Design, Process design, Mechanical aspects of process equipment design, General design procedure, Equipment classifications, Design codes and standards (IS, ASTM and BS) Properties of materials, Material of construction for various equipments and services, Material specifications, Fabrication techniques	Hrs.	CO
2	**DESIGN OF PRESSURE VESSELS**		
	Design of pressure vessels under internal pressure, Construction features, Pressure vessel code, Design of shell, various types of heads, nozzles, flanges for pressure vessel, Design and construction features of thick-walled pressure vessels, Various types of jackets and coils for reactors, Auxiliary process vessels	Hrs.	C0
3	**SUPPORTS FOR VESSELS**		
	Design consideration for supports for process equipment, Design of brackets support, leg support skirt, support, saddle support.	Hrs.	C0
4	**DESIGN OF STORAGE VESSEL**		
	Storage of non-volatile and volatile liquids and gases, Codes for storage vessel design, Bottom, Roof and Shell designs. Design criteria for external design pressure, vessels operated under vacuum, Use of stiffeners, Design of covers, pipes and tubes	Hrs.	C0
5	**DESIGN OF HEAT EXCHANGERS**		
	Types of heat exchangers, Selection criteria, Design of heat exchangers- shell, tube, baffles, closures, channels, tube sheets etc	Hrs.	C0
6	**PROCESS HAZARDS & SAFETY, MEASURES IN EQUIPMENT DESIGN**		
	Equipment testing, Analysis of hazards, Pressure relief devices. Safety measures in process equipment design	Hrs.	CO

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Process Equipment Design	Joshi M.V., Mahajani V.V	MacMillan, Delhi	
2.	IS Code: 2825 (1969).			
3.	Introduction to Chemical Equipment Design: Mechanical Aspects	Bhattacharyya B.C	CBS Publishers, New Delhi	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Process Engineering Equipment Handbook	Soares C	McGraw-Hill, New York,	
2.	Handbook of Chemical Processing Equipment	Cheremisinoff N.P.,	Butterworth Heinemann, Oxford	

ENTERPRISE RESOURCE PLANNING (ME 315D)

Teaching Scheme		Examination Scheme	
Lectures:	4 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**4**	**Total:**	100 Marks

==========

Course Objectives:

1. Basic concepts of ERP systems for manufacturing or service companies, and the differences among MRP, MRP II, and ERP systems;
1. Apply the principles of ERP systems, their major components, and the relationships among these components.
2. The knowledge of typical ERP systems, and the advantages and limitations of implementing ERP systems.
3. To comprehend the technical aspects of ERP systems
4. To be able to map business processes using ERP concepts and techniques

Course Outcomes (COs): (Strictly Six Outcomes need to be specified here)

CO1. Classify different processes of the organization and relationship among all processes.
CO2. Examine systematically the planning mechanisms in an enterprise, and identify all components in an ERP system and the relationships among the components
CO3. To describe the Generic Model of ERP and General ERP Implementation Methodology
CO4. To apply the concepts of BPR, SCM
CO5. To demonstrate knowledge of SAP
CO6. To apply the concepts of CRM

Mapping of Course Outcomes to Program Outcomes(POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		01			03				02	01	02				
CO2		01			03				02	01	02				
CO3		01			03				02	01	02				
CO4		01			03				02	01	02				
CO5		01			03				02	01	02				
CO6		01			03				02	01	02				

Course Contents

Unit-I	**Introduction to Enterprise Resource Planning**	No.of Hours	COs
	Introduction of the term Business Process Reengineering(BPR) ,BPR Methodology, Current BPR Tools ,Introduction to material requirement planning (MRP), Definition of Enterprise Resource Planning (ERP); Evolution of ERP; Characteristics, Features, Components and needs of ERP; ERP Vendors; Benefits & Limitations of ERP Packages	03	CO1
Unit-II	**Enterprise Modeling and Integration of ERP**	No.of Hours	COs
	Need to focus on Enterprise Integration/ERP; Information mapping; Role of common shared Enterprise database; System Integration, Logical vs. Physical System Integration, Benefits & limitations of System Integration, ERP's Role in Logical and Physical Integration	03	CO2
Unit-III	**ERP Architecture and Implementation Methodology of ERP**	No.of Hours	COs
	Generic Model of ERP system; Core Modules functionality; Types of ERP architecture, Client Server Architecture, Web-based Architecture, Service Oriented Architecture (SOA) ; Difficulty in selecting ERP, Approach to ERP selection,General Implementation Methodology of ERP, Vanilla Implementation; Evaluation Criteria of ERP packages;	03	CO 3
Unit-IV	**Introduction to SAP**	No.of Hours	COs
	SAP, Integrated SAP Model, SAP Architecture, SAP R/3 System & mySAP, SAP Modules;	03	CO 4
Unit-V	**ERP for Supply Chain Managemen**t	No.of Hours	COs
	.Definition of Supply Chain Management (SCM); Supply Chain Council's SCOR Model; Stevens Model of Supply Chain Management; Aims of SCM; SCM Key,Benefits of SCM; ERP Vs SCM; Key SCM Vendors	03	CO 5
Unit-VI	**Customer Relationship Management**	No.of Hours	COs

	Definition of Customer Relationship Management (CRM); CRM Evolution; CRM Delivery Processes, CRM support Processes; CRM Analysis Processes; CRM components	03	CO6

Books:

Text Books:

1. Enterprise Systems For Management, Luvai F. Motiwalla, Jeff Thompson, Pearson Education., 2nd Ed., 2011. ISBN-10: 0132145766 | ISBN-13: 978- 0132145763
2. Enterprise Resource Planning, Ravi Shankar, S.Jaiswal, Galgotia Publication Pvt. Ltd., 1st Ed., 1999. ISBN 81-203-0417-9

3. Enterprise Resource Planning, second edition, Alexis Leon, Tata McGraw-Hill, 2008. ISBN 9780070656802

4. Concepts in Enterprise Resource Planning, Third Edition,Bret Wagner & Ellen Monk©2009 | Course Technology
ISBN 10: 1-4239-0179-7 | ISBN 13: 978-1-4239-0179-2

Reference Books:

1. CRM at the speed of Light : Social CRM strategies, tools and techniques for engaging your customers : 4th edition by Paul Greenberg , McGraw Hill ,2009

2. Supply Chain Management Casebook : The Comprehensive Coverage and Best Practices in SCM , by Chuck Munson , Pearson FT Press 2013, **ISBN**-13: 978-0- 13-336723-**2**

3. Definitive Guide to Supply Chain Best Practices, The Comprehensive Lessons and Cases in Effective SCM , by Robert Frankel , Pearson FT Press , 2014

4. Enterprise Resource Planning by Mary Sumner , Prentice Hall , 2005

Intellectual Property Rights and Entrepreneurship Development (PR 316)

Teaching Scheme	Examination Scheme
Lectures: 2Hrs. / Week	In-Sem Exam : 10 Marks
Practical: -- Hrs./ Week	End Sem Exam: 25 Marks
Tutorials: -- Hrs./Week	CIA: 10 Marks
Credits: 02	Total: 50 Marks

==========

Prerequisite Course: NIL

==========

Course Objectives:

1.To introduce student with IPR

2. To explain IPR procedure in India such as Patents, Designs and Trademarks

3. To make aware economic importance of IPRs.

4. To develop ability to search and analyse the IPRs.

5. To Instill a spirit of entrepreneurship among the student participants.

6. To give insights into the Management of Small Family Business.

Course Outcomes (COs): After learning the course the leaners will be able to,

Course Outcome(s)	Blooms Technology	
	Level	Descriptor
CO1. Understand patenting system	2	Create
CO2. Understand the procedure to file patent in India	2	Apply
CO3.Understading of financial importance of IPR	2	Understand
CO4. Search and analyse the patents, designs and Trademarks	4	Analyse
CO5. Identify the Skill sets required to be an Entrepreneur.	4	Analyse
CO6. Understand the Role of supporting agencies and Governmental initiatives to promote Entrepreneurship.	4	Analyse

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			2			3		
CO2						2			2			3		
CO3						2			2			3		
CO4						2			2			3		
CO5						2	2	2			3			
CO6						2	2	2			3			

(Specify values as: 3: High Level, 2: Medium Level, 1: Low Level for mapping of Cos to POs)

Course Contents

Unit-I	**Introduction to IPR**	No.of Hours	COs
	• Concepts of IPR • The history behind development of IPR • Necessity of IPR and steps to create awareness of IPR • Concept of IP Management • Intellectual Property and Marketing • IP asset valuation • Introduction to the leading International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, TRIPS, The World Intellectual Property Organization (WIPO) and the UNESCO	4	1
Unit-II	**Patents**	No.of Hours	COs
	• Introduction to Patents • Procedure for obtaining a Patent • Licensing and Assignment of Patents i. Software Licensing ii. General public Licensing iii. Compulsory Licensing • Infringement of Patents • Software patent and Indian scenario	4 Hrs.	2
Unit-III	**Designs**	No. of Hours	COs
	• Registrable and non-Registrable Designs • Novelty & Originality • Procedure for Registration of Design • Copyright under Design • Assignment, Transmission, License • Procedure for Cancellation of Design • Infringement • Remedies	4 Hrs.	3
Unit-IV	**Trademarks and Copy Rights**	No.of Hours	COs
	A) **Trademarks** • Concept of trademarks • Importance of brands and the generation of “goodwill” • Trademark registration procedure • Infringement of trademarks and Remedies available • Assignment and Licensing of Trademarks	4 Hrs.	4

	B) Copyright Right • Concept of Copyright Right • Assignment of Copyrights • Registration procedure of Copyrights • Infringement (piracy) of Copyrights and Remedies • Copyrights over software and hardware		
Unit-V	**Entrepreneurship: Introduction**	No.of Hours	COs
	5.1 Concept and Definitions: Entrepreneur & Entrepreneurship, Entrepreneurship and Economic Development, A Typology of Entrepreneurs. **5.2 Entrepreneurial Competencies:** The Entrepreneur's Role, Entrepreneurial Skills: creativity, problem solving, decision making, communication, leadership quality; Self-Analysis, Culture & values, Risk-taking ability, Technology knowhow. **5.3 Factor Affecting Entrepreneurial Growth:** Economic & Non-Economic Factors, EDP Programmes. **5.4 Steps in Entrepreneurial Process:** Deciding Developing Moving Managing Recognizing.	4	5
Unit-VI	**Resources for Entrepreneurship**	No.of Hours	COs
	6.1 Project Report Preparation: Specimen Format of Project Report; Project Planning and Scheduling using PERT / CPM; Methods of Project Appraisal – Feasibility Study both Economic and Market Preparation projected financial statement. **6.2 Role of Support Institutions and Management of Small Business:** Director of Industries, DIC, SIDO, SIDBI, Small Industries Development Corporation (SIDC), SISI, NSIC, NISBUED, State Financial Corporation (SFC) EPC,	4	

	ECGC. **6.3 Various Governmental Initiatives:** Make in India Start Up India Stand Up India Digital India Skill India **6.4 Case Studies of Successful Entrepreneurs**		

Text Books:

1. Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, PHI, New Delhi
2. The Indian Patent act 1970.
3. The copy right act 1957
4. Manual of patent office practice and procedure of Govt. of India.
5. Manual of Designs Practice and Procedure of Govt. India
6. Manual of Trademarks Practice and Procedure of Govt. India
7. Semiconductor Integrated Circuits Layout Design (SICLD) Act 2000 of Govt. India
8. Intellectual Property Rights- A Primer, R. Anita Rao & Bhanoji, Rao, Eastern BookCo.
9. The Dynamics of Entrepreneurial Development & Management by Desai, Vasant, Himalaya Publishing House, Delhi.
10. Managing Small Business by Longenecker, Moore, Petty and Palich, Cengage Learning, India Edition.
11. Cases in Entrepreneurship by Morse and Mitchell, Sage South Asia Edition.
12. Entrepreneurship – Indian Cases on Change Agents by K Ramchandran, TMGH.

Reference Books:

1. Handbook of Indian Patent Law and Practice,
2. Entrepreneurship: New Venture Creation by David H. Holt
3. Entrepreneurship Development New Venture Creation by Satish Taneja, S.L.Gupta
4. Project management by K. Nagarajan.

Intellectual Property Rights and Entrepreneurship Development (PR 317)

Teaching Scheme	**Examination Scheme**
Lectures: -- Hrs. / Week	**In-Sem Exam : -- Marks**
Practical: 02 Hrs./ Week	**End Sem Exam: -- Marks**
Tutorials: -- Hrs./Week	**Term Work: 50 marks**
Credits: 01	**Total: 50 Marks**

==========

Prerequisite Course: NIL

==========

Course Objectives:

1.To introduce student with IPR

2. To explain IPR procedure in India such as Patents, Designs and Trademarks

3. To make aware economic importance of IPRs.

4. To develop ability to search and analyse the IPRs.

5. To Instill a spirit of entrepreneurship among the student participants.

6. To give insights into the Management of Small Family Business.

Course Outcomes (COs): After learning the course the leaners will be able to,

Course Outcome(s)	Blooms Technology	
	Level	Descriptor
CO1. Understand patenting system	2	Create
CO2. Understand the procedure to file patent in India	2	Apply
CO3.Understading of financial importance of IPR	2	Understand
CO4. Search and analyse the patents, designs and Trademarks	4	Analyse
CO5. Identify the Skill sets required to be an Entrepreneur.	4	Analyse
CO6. Understand the Role of supporting agencies and Governmental initiatives to promote Entrepreneurship.	4	Analyse

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			2			3		
CO2						2			2			3		
CO3						2			2			3		
CO4						2			2			3		
CO5						2	2	2			3			
CO6						2	2	2			3			

(Specify values as: 3: High Level, 2: Medium Level, 1: Low Level for mapping of Cos to POs)

List of experiments: The term work shall consist following experiments/reports to be completed within the semester.

1. Searching of patent, design, trademarks, and copy rights at various databases and its report preparation.
2. Patent draft preparation for a sample invention
3. Design draft preparation for a sample design
4. Trademark draft preparation for a sample Trademark/Device
5. Copy right draft preparation for a sample documents/audio/video
6. Report preparation of patent Infringement
7. Preparation of Detailed project report for new business/industry/startup
8. Visit to industry to understand entrepreneurship and its report preparation

Text Books:

1. Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, PHI, New Delhi
2. The Indian Patent act 1970.
3. The copy right act 1957
4. Manual of patent office practice and procedure of Govt. of India.
5. Manual of Designs Practice and Procedure of Govt. India
6. Manual of Trademarks Practice and Procedure of Govt. India
7. Semiconductor Integrated Circuits Layout Design (SICLD) Act 2000 of Govt. India
8. Intellectual Property Rights- A Primer, R. Anita Rao & Bhanoji, Rao, Eastern BookCo.
9. The Dynamics of Entrepreneurial Development & Management by Desai, Vasant, Himalaya Publishing House, Delhi.
10. Managing Small Business by Longenecker, Moore, Petty and Palich, Cengage Learning, India Edition.
11. Cases in Entrepreneurship by Morse and Mitchell, Sage South Asia Edition.
12. Entrepreneurship – Indian Cases on Change Agents by K Ramchandran, TMGH.

Reference Books:

1. Handbook of Indian Patent Law and Practice,
2. Entrepreneurship: New Venture Creation by David H. Holt
3. Entrepreneurship Development New Venture Creation by Satish Taneja, S.L.Gupta
4. Project management by K. Nagarajan.

Corporate Readiness (HS 318)

Teaching Scheme		Examination Scheme	
Lectures:	1 Hrs. / Week	**In-Sem Exam :**	-- Marks
Practical:	2 Hrs./ Week	**End Sem Exam:**	-- Marks
Tutorials :	- Hrs./Week (if applicable)	**TW :**	50 Marks
Credits:	**2**	**Total:**	50 Marks

==========

Prerequisite Course: (Quantitative aptitude, Verbal and non verbal communication)

==========

Course Objectives: (Please specify Six Objectives)

1. To develop clarity in the exploration process of student career and to match his skills and interests with a chosen career path.
2. To develop required aptitude skills.
3. To design the functional and chronological resume.
4. To demonstrate the importance of critical thinking ability and expression in group discussions
5. To prepare students for the various professional interviews.
6. To develop different soft skills necessary to get success in their profession.

Course Outcomes (COs): After successful completion of this course students should be able to

CO1. Remember placement processes of various organizations and modern job search approach.
CO2. Understand Industry Specific skill set with a view to design an Ideal Resume.
CO3. Apply the knowledge of GD & Presentation Skill during Industry Assessments for Placement/Internship/Industry Training/Higher Studies/Competitive Exams etc.
CO4. Analyse and apply the critical thinking ability as required during Aptitude/Technical Tests.
CO5. Evaluate Technical/General Dataset to interpret insights in it.
CO6. Create an ideal personality that fits Industry requirement.

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2														
CO3														
CO4														
CO5														
CO6														

(Specify values as: 3: High Level, 2: Medium Level, 1: Low Level for mapping of Cos to POs)

Course Contents

Unit-I	Placement Awareness	No.of Hours	COs
	Discussion over Different Companies for recruitment, their eligibility criteria and placement procedures. Revision and Assessment of Quantitative Aptitude.	06 Hrs.	CO 1
Unit-II	Resume Writing	No.of Hours	COs
	Keywords, resume examples for industry, professional font, active language, important achievements, Proofread and edit. Innovative resume building- video resume.	05 Hrs.	CO2
Unit-III	Group Discussion and Presentation skills	No.of Hours	COs
	Why GDs are implemented commonly, Aspects which make up a Group Discussion, Tips on group discussion, do's and don'ts of GD and Presentation skills.	05 Hrs.	CO3
Unit-IV	Logical Reasoning, I	No.of Hours	COs
	Coding and Decoding (Visual Reasoning and series), Statement & Conclusions (Syllogisms), Relationships (Analogy), Data arrangements, Crypt arithmetic.	05 Hrs.	CO4
Unit-V	Logical Reasoning II	No.of Hours	COs
	Data Interpretation, Data Sufficiency	04 Hrs.	CO5
Unit-VI	Logical Reasoning III	No.of Hours	COs
	Blood relation and dices, Clocks and Calendar, Direction sense and cubes, Logical connectives, Puzzle.	05 Hrs.	CO6

Learning Resources :
Text Books:
1. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Agarwal 2. Reasoning verbal and non verbal by B. S. Sijwali.
Reference Books:
1 Shortcuts in Reasoning (Verbal, Non-Verbal, Analytical) 2 Analytical Reasoning by M. K. Panday 3 Logical and analytical reasoning by K. Gupta 4 Multi dimensional reasoning by Mishra & Kumar Dr. Lal
E- Books : https://themech.in/quantitative-aptitude-and-logical-reasoning-books/ https://www.thelocalhub.in/2021/01/reasoning-competitive-exams-pdf.html
E-learning Resources/MOOCs/ NPTEL Course Links:
1. https://www.practiceaptitudetests.com/non-verbal-reasoning-tests/ 2. https://www.educationquizzes.com/11-plus/non-verbal-reasoning/ 3. https://www.livecareer.com/resume/examples/web-development/e-learning-developer

Applied Thermodynamics (ME 319)

Teaching Scheme		Examination Scheme	
Lectures:	- Hrs. / Week	**OR Exam :**	-- Marks
Practical:	2 Hrs./ Week	**PR Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**TW :**	-- Marks
Credits:	**1**	**Total:**	50 Marks

==========

Prerequisite Course: Thermodynamics, Basic Mechanical Engineering

==========

Course Objectives:

1. To estimate performance parameters by conducting a test on I. C. Engines and study emissions with its controlling methods.
2. To study automobile service station.
3. To learn about steam generator, air compressor, refrigeration system and analyse its performance
4. To write computer code for analysing refrigeration system

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Conduct experiment to determine performance factors of SI and CI engines and study constituents of exhaust gases	5	Evaluate
CO2	Prepare and present report of visit of automobile service station.	3	Apply
CO3	Conduct trial on boiler, air compressor, vapor compression test rig to determine performance parameters.	5	Evaluate
CO4	Write and execute computer code to analyse vapor compression cycle.	3	Apply

List of Practical's

Pr No	Description	CO	PO
1.	Morse Test on Multi cylinder Petrol/ Diesel engine for determination of Friction power.	**3**	**1,2,9,10**
2.	Variable load test on diesel engine to determine various efficiencies, SFC	**3**	**1,2,9,10**
3.	Trial on diesel engine to prepare heat balance sheet.	**3**	**1,2,9,10**
4.	Demonstration & study of commercial exhaust gas analyzers.	**3**	**1,7**
5.	Visit to Automobile service station	**1,2**	**1, 9, 10,12**
6.	Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance.	**4**	**1,2,9,10**
7.	Trial on Positive Displacement Air Compressor.	**5**	**1,2,9,10**
8.	Thermal Analysis of refrigeration cycle using suitable software/computer code	**6**	**1,2,5,9**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3				1	1		1	1					3
CO2	2					1	1		1	1		1			3
CO3	3	3				1	1		1	1					3
CO4	2	2			3							1		1	3

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Internal Combustion Engines	V. Ganesan	Tata McGraw-Hill	
2.	Fundamentals of Internal Combustion Engines	H.N. Gupta,	PHI Learning Pvt. Ltd.	
3.	Applied Thermodynamics	Onkar Singh	New Age International Publishers	
4.	Thermal Engineering - I	Mahesh M Rathore	McGraw Hill Education (India) Private Ltd	
5.	Thermal Engineering	Sadhu Singh	Pearson India Education Services Pvt. Ltd	

6.	Applied Thermodynamics	Onkar Singh	New age international publishers	
7.	Basics and Applied Thermodynamics	P.K. Nag	Tata McGraw Hill publications	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Internal Combustion Engine Fundamentals	Heywood	Tata McGraw-Hill	
2.	Internal Combustion Engine	Domkundwar & Domkundwar	Dhanpat Rai & Co.	
3.	Thermal Engineering	S. Domkundwar,C.P. Kothandaraman, A. Domkundwar	Dhanpat Rai & Co	
4.	Applied Thermodynamics	T.D. Eastop and A.McConkey	Pearson	

Machine Design-II Lab (ME 320)

Teaching Scheme		Examination Scheme	
Lectures:	- Hrs. / Week	**OR Exam :**	50 Marks
Practical:	2 Hrs./ Week	**PR Exam:**	-- Marks
Tutorials :	- Hrs./Week (if applicable)	**TW :**	-- Marks
Credits:	**1**	**Total:**	50 Marks

==========

Prerequisite Course: (if Any) The subject Machine Design-II has a prerequisite as Machine Design-I, Strength of Materials, and Applied Mechanics as major subjects

==========

Course Objectives: (Please specify Six Objectives)

1. Enable students to attain the basic knowledge required understanding, analyzing, designing and select machine elements required in transmission systems.
2. Impart design skills to the students to apply these skills for the problems in real life industrial applications
3. Develop an holistic design approach to find out pragmatic solutions to realistic domestic and industrial problems

Course Outcome (CO's) : At the end of the course students will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Design two stage gear box for elevator system, machine tool gear box, two and four wheeler gear box.	6	Create
CO2	Draw assembly of transmission system and detailed drawing of machine components	3	Apply
CO3	Prepare design report and make effective presentation	3	Apply

List of Practical:

Pr No	Description	CO	PO
1.	The design project shall consist of two imperial size sheets (Preferably Assembly drawn with 3D/2D CAD software) - one involving assembly drawing with a part list and overall dimensions and the other sheet involving drawings of individual components, manufacturing tolerances (Defining the fits between the mating components and selection of tolerances accordingly), surface finish symbols and geometric tolerances must be specified so as to make it working drawing. A design report giving all necessary calculations of the design of components and assembly should be submitted. Projects shall be in the form of design of mechanical systems including two stage gear box for	**CO1. CO2, CO3, CO4. CO6**	**PO3, PO10 PO11**

	lifting applications such as lift, hoist, Elevator or conveyor system or multi speed gear box for machine tool applications like Lathe, Drilling, Milling machines, gear box used for two and four wheelers. (Open ended problems)		
2.	Each Student shall complete any two of the following assignments in the form of presentation and report 1. Design of Flywheel. 2. Design considerations for Manufacturing, Assembly and safety. 3. Case study of one patent/ copyright/trademark from the product design point of view. (Patent of product which is used in day to day applications) 4. Application of belt drive and its selection method for Industrial application. (By using Manufacturer's Catalog). 5. Application of chain drive and its selection method for Automobile application. (By using Manufacturer's Catalog). 6. Mounting of machine elements on transmission shaft (like Bearings, gears, Pulley, Sprocket, etc). 7. Selection of Bearing from Manufacturer's Catalog. 8. Construction and details of Gears.	**CO1, CO3, CO5**	**PO3, PO10**

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	2	-	1	2	2	2	2	3	-	-
CO2	3	3	3	2	2	2	-	2	2	2	2	2	2	-	-
CO3	3	2	2	2	-	2	-	2	2	2	2	1	2	-	-

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Design of machine elements	Bhandari V.B.	Tata Mc Graw Hill Public Co. Ltd.	(621.815/bha-tb) 17324 to 332
2.	Mechanical Engineering Design	Shigley J.E. and Mischke C.R.	Mc Graw Hill Pub. Co. Ltd.	(621.815/shi-tb) 005910,11
3.	Design of Machine elements	Spotts M.F. and Shoup T.E.	Prentice Hall International.	(621.815/spo-tb) 9332, 7359, 60,61
4.	Machine Design	Black P.H. and O. Eugene Adams	Mc Graw Hill Book Co. Ltd.	(621.815/bla-tb) 7663,64

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Design Data	P. S. G. College of Technology, Coimbatore.	P. S. G. College of Technology, Coimbatore.	(621.815/psg-tb) 12385, 6665- 69
2.	Fundamentals of Machine Components Design	Juvinal R. C.	John Wiely and Sons.	(621.815/juv-tb) 14375

Machine Shop II (ME 321)

Teaching Scheme		Examination Scheme	
Lectures:	- Hrs. / Week	**OR Exam :**	-- Marks
Practical:	2 Hrs./ Week	**PR Exam:**	-- Marks
Tutorials :	- Hrs./Week (if applicable)	**TW :**	50 Marks
Credits:	**1**	**Total:**	50 Marks

==========

Prerequisite Course: (0)

==========

Course Objectives:

1. **To set the manufacturing set-up appropriately and study corresponding set up parameters**
2. **To select appropriate process parameter for obtaining desired characteristic on work piece.**
3. **To understand the operational problems and suggest remedial solution for adopted manufacturing process.**

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Performed gear cutting operation and study the corresponding set up parameters.	3	Apply
CO2	Select appropriate process parameter for obtaining desired characteristic on work piece.	3	Apply
CO3	Understand the operational problems and suggest remedial solution for adopted manufacturing process	2	Understand

List of Practical's

Pr No	Description	No.of Hours	COs	PO
1	Spur Gear cutting using simple indexing head	4 Hrs.	CO1	
2	Development and execution of one simple turning job on CNC (Trainer) machine.	4 Hrs	CO2	
3	Assembly of composite job having operations like threading, knurling, turning, undercut etc.	4 Hrs	CO3	
	Journal consisting of following assignments.			
1	Two views of at least one jig and one fixture designed, for a component on a half imperial sheet.(manual drafting)	2 Hrs		
2	Process planning sheets for job assembly of plate including Bill of material, Limits Fits Tolerance.	1 Hrs.		
3	Assembly Drawing of job no 3. (Bill of material, Limits Fits Tolerance, Dimensions with tolerances should consider while drawing sheet)	1 Hrs.		

Self-Learning:

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3			1			2						
CO2	2	3	3		3	1			2						
CO3	2	3	3			1			2						

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Elements of Workshop Technology	S. K. Hajra Choudhary, A. K. Hajra Choudhary	Media promoters	
2.	A Course in Workshop Technology Vol. II	B. S. Raghuwanshi	Dhanpat Rai & CO	
3.	Workshop Technology Part 1, 2 and 3	W. A. J. Chapman	Taylor & Francis	
4.	Manufacturing Process – 2,	Anul Goel	Technical Publication	
5.	Production Technology (Manufacturing Processes)	P C Sharma,	S Chand Publication	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	HMT Handbook for Production Technology	--	Tata McGraw-Hill,	
2.	Materials and processes in Manufacturing	Degarmo, Black and Kohser	Prentice Hall of India. 2nd Edition	
3.	Workshop Technology	B.S. Raghuwanshi	Dhanpatrai Publication, 9th Edition, 1999.	
4.	"Production Technology", Vol. I,II,	O.P. Khanna and M. Lal,	Dhanpatrai Publication, 5th Edition, 1999.	
5.	"Workshop Technology", Volume I, II, III,	Chapman W.A.J,	CBS Publishers and distributors, 5th Edition,2002.	

Mandatory Learning Course (Programming Skills) (ME322)

Teaching Scheme		Examination Scheme	
Lectures:	1 Hrs. / Week	**In-Sem Exam :**	---
Practical:	-- Hrs./ Week	**End Sem Exam:**	-- Marks
		Home Assignments:	-- Marks
Credits:	**Non credit**	**Total:**	-- Marks

==========

Prerequisite Course: (if Any): Fundamentals of programming

==========

Course Objectives: (Please specify Six Objectives)

1. Understand the fundamentals of statistical analysis
2. Determine various statistical parameters using MATLAB
3. Understand the basic principles of Data visualization
4. Understand the algorithms used in Artificial Intelligence
5. Understand the fundamentals of Machine learning
6. Predict the behaviour of various mechanical system using SIMULINK

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Cognitive Level	Descriptor
CO1	Understand the fundamentals of statistical analysis	Understand	Conceptual
CO2	Determine various statistical parameters using MATLAB	Apply	Procedural
CO3	Understand the basic principles of Data visualization	Understand	Conceptual
CO4	Understand the algorithms used in Artificial Intelligence	Understand	Conceptual
CO5	Understand the fundamentals of Machine learning	Understand	Conceptual
CO6	Predict the behaviour of various mechanical system using SIMULINK	Apply	Procedural

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	3	-	-	-	-	2	1	1	2	-	-
CO2	3	1	-	-	3	-	-	-	-	2	1	1	2	-	-
CO3	3	1	-	-	3	-	-	-	-	2	1	1	2	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	-	2	2	2	3	-	-	-	-	2	1	1	2	-	-

Course Contents

Unit	Contents	No.of Hours	COs
1	**Statistical Analysis**		
	Relationship between attributes: Covariance, Correlation Coefficient, Chi Square Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution) and other statistical graphs **Probability** Probability (Joint, marginal and conditional probabilities) Probability distributions (Continuous and Discrete) Density Functions and Cumulative functions **Descriptive Statistics** Data exploration (histograms, bar chart, box plot, line graph, scatter plot) Qualitative and Quantitative Data, Measure of Central Tendency (Mean, Median and Mode),Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles), Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation), Anscombe's quartet, Other Measures: Quartile and Percentile, Interquartile Range	8 Hrs.	CO1
2	**MATLAB Essentials Programming**		
	Commands and Syntax, Packages and Libraries, Introduction to Data Types Data Structures in Vectors, Matrices, Arrays, Importing and Exporting Data.	6 Hrs.	C02
3	**Data Visualization**	6	CO3
	Principles of data visualization - different methods of presenting data in business analytics. Concepts of Size, Shape, Color Various Visualization types Bubble charts, Case study for data visualization practices		
4	**Foundations for AI**		
	AI: Application areas, AI Basics (Divide and Conquer, Greedy, Branch and Bound, Gradient Descent), NN basics (Perceptron and MLP, FFN, Backpropagation) Practice assignment	6 Hrs.	C04
5	**Foundations for ML**		
	ML Techniques overview, Validation Techniques (Cross-Validations), Feature Reduction/Dimensionality reduction, Principal components analysis (Eigen values, Eigen vectors, Orthogonality)	6 Hrs.	C05
6	**Modelling and simulation of systems using MATLAB Simulink**		
	Modelling with Artificial Neural Network Modelling of simple fuzzy system using MATLAB Modelling of simple state space system	8 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Applied statistics and probability for engineers	Douglas C Montgomery & George C Runger	Wiley	
2.	MATLAB an introduction with applications	Rao V Dukkipati	New age international	
3.	Introduction to Machine Learning	Alex Smola and S.V.N. Vishwanathan	Cambridge university press	
4.	Modeling and simulation of systems using MATLAB and Simulink	Devendra K chaturvedi	CRC press	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Linear regression Analysis: Theory of computing	Xin Yan & Xiao Gang so	World scientific	
2.	Numerical methods in Engineering with MATLAB	Jaan kiusalaas	Cambridge	
3.	Introduction to Simulink with engineering applications	Steven T Karris	Orchard publications	

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute affiliated to SPPU,Pune)

D E C L A R A T I O N

We, the Board of Studies (Mechanical Engineering) , hereby declare that, We have designed the Curriculum of **TY B Tech Semester-VI** of 2019 Pattern w.e.f. A.Y **2021-2022** as per the guidelines . So, we are pleased to submit and publish this FINAL copy of the curriculum for the information to all the concerned stakeholders.

Submitted by

Dr M V Nagarhalli
BoS Chairman

Approved by

Dr A B Pawar
Dean Academics

Dr A G Thakur
Director

Sanjivani Rural Education Society's

Sanjivani College of Engineering, Kopargaon

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

B. Tech. Mechanical Engineering

2019 Pattern

Curriculum

(B. Tech. with effect from Academic Year 2019-2020)

(B. Tech. Sem-VII & VIII with effect from Academic Year 2022-2023)

At. Sahajanandnagar, Post. Shingnapur Tal. Kopargaon Dist. Ahmednagar,

Maharashtra State, India PIN 423603

Vision of Department

Our vision is to develop world class, multidimensional, competent, disciplined and ethical Mechanical engineers for the society.

Mission of Department

Our mission is,

- To impart the quality education to the students through class-room teaching, innovative projects,and industry-institution interaction.
- To provide a better environment to encourage and support participation in co-curricular and extra-curricular activities.
- To use technology of Mechanical Engineering as a prime tool for the multifaceted developmentof our students in the emerging fields of Engineering.

Program Outcomes (POs)

Mechanical Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriateconsideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activitieswith an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable

development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member andleader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives (PEOs)

PEO1: To develop graduates with a sound technical knowledge for a successful career in industries, higher studies and as an entrepreneur.

PEO2: To prepare graduates with expertise in use of modeling, analysis and programming software.

PEO3: To inculcate interpersonal skills with ethical approach and contribute towards social, personal, economic and environmental issues.

Program Specific Outcomes (PSOs)

At the end of the program graduates will demonstrate ability to

PSO1. Design and manufacture mechanical components and systems
PSO2. Model and analyze machine components using modeling and analysis software's.
PSO3. Specify, analyze and determine the performance of thermal systems including IC engines, refrigeration and air conditioning systems, air compressors, hydraulic turbines and pumps.

LIST OF ABBREVIATIONS			
Abbreviation	**Full Form**	**Abbreviation**	**Full Form**
ES	Engineering Science	HSMC	Humanity Science
PC	Professional Core	CA	Continuous Assessment
PE	Professional Elective	OR	End Semester Oral Examination
OE	Open Elective	PR	End Semester Practical Examination
ISE	In-Semester Evaluation	TW	Continuous Term work Evaluation
ESE	End-Semester Evaluation	BSC	Basic Science Course
PRJ	Project	MC	Mandatory Course

COURSE STRUCTURE- 2019 PATTERN

Final. B.Tech SEM VII 2019

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
			L	T	P		Theory			TW	OR	PR	Total
							CIA	ISE	ESE				
PRJ	ME401	Professional Internship-III	-	-	-	2	-	-	-	-	50	-	50
PCC	ME402	Finite Element Analysis	3	-	-	3	20	30	50	-	-	-	100
PCC	ME403	Mechatronics	3	-	-	3	20	30	50	-	-	-	100
PEC	ME404	Professional Elective-III	3	-	-	3	20	30	50	-	-	-	100
OE	ME405	Open Elective-II	3	-	-	3	20	30	50	-	-	-	100
OE	ME406	Open ELECTIVE-III [Online through MOOCs]	2	-	-	2	20	-	30	-	-	-	50
PCC	ME407	Finite Element Analysis Lab	-	-	2	1	-	-	-	-	-	50	50
PCC	ME408	Mechatronics Lab	-	-	2	1	-	-	-	-	50	-	50
PRJ	ME409	Project Stage-I	-	-	4	2	-	-	-	-	50	-	50
MLC	ME410	Mandatory Learning Course-VII	1	-	-	Non-Credit	-	-	-	-	-	-	-
		Total	**15**	**-**	**8**	**20**	**100**	**120**	**230**	**-**	**150**	**50**	**650**

Final. B.Tech SEM VIII

Cat	Code	Course Title	Hrs./Week			Credits	Marks						
			L	T	P		Theory			TW	OR	PR	Total
							CIA	ISE	ESE				
PCC	ME411	Heating Ventilation and Air Conditioning	3	-	-	3	20	30	50	-	-	-	100
PCC	ME412	Hydraulic and Pneumatics	3	-	-	3	20	30	50	-	-	-	100
PCC	ME413	Dynamics of Machines	3	-	-	3	20	30	50	-	-	-	100
PEC	ME414	Professional Elective-IV	3	-	-	3	20	30	50	-	-	-	100
PCC	ME415	Lab-I (HVAC and HP Lab)	-	-	2	1	-	-	-	-	-	50	50
PCC	ME416	Dynamics of Machines Lab	-	-	2	1	-	-	-	-	50	-	50
PRJ	ME417	Project Stage-II	-	-	8	4	-	-	-	100	50	-	150
MLC	ME418	Mandatory Learning Course-VIII	1	-	-	No Credit	-	-	-	-	-	-	-
		Total	**13**	**-**	**12**	**18**	**80**	**120**	**200**	**100**	**100**	**50**	**650**

Professional Elective – III		**Professional Elective – IV**	
ME404A	Additive Manufacturing	ME414A	Advanced Finite Element Analysis
ME404B	Computational Fluid Dynamics	ME414B	Power Plant Engineering
ME404C	Robotics and Automation	ME414C	Automobile Engg

Open Electives-II		**Open Electives-III**	
ME405A	Supply Chain Management	ME406A	Engineering Project Management
ME405B	Work System Design		
ME410	**Mandatory Learning Course-VII**	**Professional Writing**	
ME418	**Mandatory Learning Course-VIII**	**Learning an Art Form**	

Professional Internship III (ME401)(2019 Pattern)

Teaching Scheme		Examination Scheme	
Credits:	**2**	**OR:**	50 Marks

==========

Prerequisite Course: (if Any)

==========

Course Objectives:

1. To get an opportunity to observe current technological developments relevant to the subject
2. To get opportunities to learn, understand and sharpen the real time technical skills
3. To get exposure to the industrial environment

Course Outcomes (COs):

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Students shall able to understand the attitudes and approach of the workers to problem solving.	2	Understand
CO2	Students shall able to Gain experience in writing technical reports	3	Analysis
CO3	Students shall able to create competent professional environment	6	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	3	2		2	3	2	2	2	2	
CO2		2	2		2				2		2	2
CO3	2		2			2	2		2	2		2

Guidelines for students

SN	Contents
1	Two guides shall supervise the internship project work, one from the department and another one from industry
2	Industry shall submit the month-wise satisfactory attendance of the students to the institute/department
3	Student must regularly use daily diary which is to cultivate the habit of documenting
4	The presentation is way to evaluate student performance, so student must be ready as they are evaluated by institute guide, internal and external examiner
5	Student must submit a comprehensive report to the department before presentation

Steps to apply for internship

SN	Particulars
1	Student shall ask for permission Letter from Mechanical Department office / office of Training & Placement cell of the college in consultation of guide (institute) to allot various slots of 4-6 weeks during as internship periods
2	Students on joining Training at the concerned Industry must submit the permission letter from the office of Training & Placement cell of the college
3	Student must regularly use daily diary to record the details and submit attendance in internship report
5	Students shall be obtained Training Certificate from industry
6	Students shall submit training report after completion of internship to guide

Evaluation process for internship

SN	Particulars
1	Students must submit training report and training certificate from industry after completion of internship to guide
2	Guide will access performance of student through presentation which is evaluated by institute guide and external examiner from institute itself.

Finite Element Analysis (ME402) (2019 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	-	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**Home Assignments:**	20 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: (if Any) The subject Dynamics of Machines has a prerequisite as Machine Design-I, Strength of Materials, and Applied Mechanics, Kinematics of Machines as major subjects

==========

Course Objectives: (Please specify Six Objectives)

1. To understand the philosophy and general procedure of Finite Element Method as applied to solid mechanics and thermal analysis problems.
2. To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools.
3. It provides a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
4. To study approximate nature of the finite element method and convergence of results are examined.
5. It provides some experience with a commercial FEM code and some practical modeling exercises
6. It provides some experience of using commercial finite element analysis software to solve complex problems in solid mechanics

Course Outcomes (COs): At the end of the course students will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Explain the fundamental concepts of FEA	2	Explain
CO2	Examine 1-D element stiffness matrices and load vectors to solve for displacements and stresses	3	Examine
CO3	Examine 2-D element stiffness matrices and load vectors to solve for displacements and stresses	3	Examine
CO4	Find and use Iso-parametric elements and numerical methods to solve for displacements and stresses.	1,2,3	Find, Use, Solve
CO5	Analyse simple mechanical structure by using 1-D thermal element of various 1-D structures and also able to Perform simple 1-D modal analysis	4, 5	Analyze
CO6	Interpret the results of finite element analyses and make an assessment of the results in terms of modelling (physics assumptions) errors, discretization (mesh density and refinement toward convergence) errors, and numerical (round-off) errors.	5	Assess

Course Contents

Unit	**Contents**	No.of Hours	COs
1	**Fundamental Concepts of FEA**		
	Brief history of FEM, Finite Element terminology (nodes, elements, domain, continuum, degrees of freedom, loads & constraints), general steps involved in FEM, applications of FEM in various fields, advantages and disadvantages of FEM, consistent units system, essential and natural boundary conditions, symmetric boundary conditions. Types of Analysis (Introduction): Linear static analysis, Non-linear analysis, Dynamic analysis, Linear buckling analysis, Thermal analysis, Fatigue analysis, Crash analysis.	6 Hrs.	CO1
2	**1D Elements and their Analysis**		
	Types of 1D elements, displacement function, global and local coordinate systems, polynomial form of interpolation functions- linear, quadratic and cubic, properties of shape function, primary and secondary variables. Formulation of elemental stiffness matrix and load vector for bar, truss and beam using FEA approach, Assembly of global stiffness matrix and load vector, properties of stiffness matrix, stress and reaction forces calculations	6 Hrs.	C02
3	**Introduction to 2D Elements**		
	Two-Dimensional Stress Analysis: Plane Stress/Strain problems in 2D elasticity, constitutive relations Constant Strain Triangle(CST), Liner Strain Rectangle (LSR), displacement function, Pascal‘s triangle, compatibility and completeness requirement, geometric isotropy, convergence requirements, strain filed, stress filed, Formulation of element stiffness matrix and load vector for Plane Stress/Strain problems Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement), stress calculations	6 Hrs.	C03
4	**Isoparametric Elements**		
	Concept of isoparametric elements, Terms isoparametric, super parametric and subparametric. *Coordinate mapping* : Natural coordinates, Area coordinates (for triangular	6 Hrs.	C04

	elements), higher order triangular and quadrilateral elements (Lagrangean and serendipity elements), geometry associative mesh, quality checks, mesh refinement-p vs h refinements, Uniqueness of mapping - Jacobian matrix.		
5	**1D Steady State Heat Transfer and Dynamic Analysis**		
	Introduction, Governing differential equation, steady-state heat transfer formulation of 1D element for conduction and convection problem, boundary conditions and solving for temperature distribution. Types of dynamic analysis, General dynamic equation of motion, point and distributed mass, lumped and Consistent mass, Mass matrices formulation of bar element.	6 Hrs.	C05
6	**Introduction to 3-D analysis**		
	3 D problems in stress analysis, convergence requirements, Mesh generation. Techniques such as semi-automatic and fully Automatic use of software such as ANSYS using Hexahedral and Tetrahedral Elements.	6 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	A First Course in the Finite Element Method	Daryl L. Logan	Logan, 2007	
2.	Finite Element Analysis	G Lakshmi Narasaiah	B S Publications	
3.	Text book of Finite Element Analysis	P. Seshu	PHI Learning Private Ltd. , New Delhi	
4.	Introduction to Finite Elements in Engineering	Chandrupatla T. R. and Belegunda A. D	Prentice Hall India	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Fundamental of Finite Element Analysis	David V. Hutton	Tata McGraw-Hill	
2.	Finite Element Procedures	Bathe K. J.,	Prentice, Hall of India (P) Ltd., New Delhi	
3.	Concepts and Applications of Finite Element Analysis	R. D. Cook	Wiley, India	

Mechatronics (ME 403) (2019 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**In-Sem Exam :**	30 Marks
Practical:	-	**End Sem Exam:**	50 Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA**	20 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: Engineering Mathematics, Elements of Electronics and Electrical Engineering

==========

Course Objectives: (Please specify Six Objectives)

1. Enable students to attain the basic knowledge required understanding of mechatronics, principle of sensor and its characteristics
2. Impart knowledge of the concept of signal processing and use of interfacing systems such as ADC, DAC, Digital I/O.
3. To make the block diagram representation and concept of transfer function for control system
4. To prepare for system modelling and analysis in the frequency domain.
5. To provide information about system modelling and analysis in time domain, controller modes and its industrial applications.
6. To aware about the use of mechatronics in industrial applications

Course Contents

Unit	**Contents**	No.of Hours	COs
1	**Introduction to Mechatronics systems and sensors**		
	Introduction to Mechatronics and its applications, Measurement characteristics: - Static and Dynamic, Sensors: Position Sensors- Potentiometer, LVDT, Motion Sensors – Encoder (Absolute & incremental), Lidar, Eddy, Proximity sensors:- Optical, Inductive, Capacitive, Temperature Sensor: RTD, Thermocouples, Pyrometer, Infrared Thermometer; Force / Pressure Sensors-Strain gauges, Flow sensors: - Electromagnetic, MEMS Accelerometer; Piezoelectric sensor; Flow sensors – Electromagnetic, Ultrasonic, Hot-wire anemometer; Color sensor – RGB type; Biosensors – Enzyme, ECG, EMG	8 Hrs.	CO1
2	**Data Acquisition and Signal Conditioning**		

	Signal Communication: Serial, Parallel; Synchronous, Asynchronous Introduction to DAQ, Types, Components of a Data Acquisition System (Sensor, Signal conditioning, processing, controlling and storage/display/action) Data Acquisition: Signal collection, Signal conditioning – Isolation & Filtering, Amplification, Sampling, Aliasing, Sample and hold circuit, Quantization, Analog-to-digital converters (4 bit Successive Approximation type ADC), Digital-to-Analog converters (4 bit R2R type DAC), Data storage Applications: DAQ in Household ,Digital Pressure Gauge, Digital Flow measurement, DVB Digital Video Broadcast, AM/FM	6 Hrs.	C02
3	**Control Systems**		
	Introduction to control systems, need, Types- Open and Closed loop, Concept of Transfer Function, Block Diagram & Reduction principles and problems; Applications (Household, Automotive, Industrial shop floor) Transfer Function based modeling of Mechanical, Thermal and Fluid system; Concept of Poles & Zeros; Pole zero plot, Stability Analysis using Routh Hurwitz Criterion (Numerical Approach)	6 Hrs.	C03
4	**Time and Frequency Domain Analysis**		
	Time Domain Analysis – Unit step Response analysis via Transient response specifications (Percentage overshoot, Rise time, Delay time, Steady state error etc.) Frequency Domain Analysis – Frequency Domain Parameters - Natural Frequency, Damping Frequency and Damping Factor; Mapping of Pole Zero plot with damping factor, natural frequency and unit step response ; Introduction to Bode Plot, Gain Margin, Phase Margin	6 Hrs.	C04
5	**Controllers**		
	Introduction to controllers, Need for Control, Proportional (P), Integral (I) and Derivative (D) control actions; PI, PD and PID control systems in parallel form; (Numerical approach), Feed forward anticipatory control Manual tuning of PID control, Ziegler–Nichols method, Applications: Electro–Hydraulic/Pneumatic Control, Automotive Control	6 Hrs.	C05
6	**Industrial Mechatronics Systems**		
	Principles of feedback and Intelligent control methods-Fuzzy Logic, Fault Detection and isolation, Distributed control systems, Fieldbus technology, Web based Monitoring and control, Autonomous guided vehicle(AGV),Drilling Machine, Conveyor based material handling systems, Introduction to PLC	4 Hrs.	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Mechatronics: Electronics Control Systems in Mechanical and Electrical Engineering	William Bolton, 4th Ed, 2019	pearson	48377
2	Mechatronics: Integrated Mechanical Electronic Systems	K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram,	Willey Publication,	62335
3	Control systems-Principles and design	M.Gopal, 4th edition	Mc-GrawHill	61263

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Process Control Instrumentation Technology	C.D.Johnson	Prentice Hall,New Delhi	23439 ,24224
2	Mechatronics – Principles, concepts and applications,	Mahalik	Tata Mc-Graw Hill publication, New Delhi	40897,40898
3	Measurement systems - Application and design	Ernest O Doebelin 4th Edition	McGrawHill	26431

Additive Manufacturing (ME404A) (2019 Pattern)

Teaching Scheme	Examination Scheme
Lectures: 03 Hrs. / Week	**In-Sem Exam : 30 Marks** **End Sem Exam: 50 Marks** **CIA : 20 Marks**
Credits: 03	**Total: 100 Marks**

Prerequisite Course: **Fundamentals of Mechanical Engineering.**

***Course Outcomes* (Cos): At the end of this course student will be able to:**

CO No.	*Course Outcomes* (Cos):	Bloom's Taxonomy	
		Level	Descriptor
CO1	Understand working principle and process parameters of AM processes	2	Understand
CO2	Distinguish Polymer AM processes in various field.	4	Analyze
CO3	Distinguish Metal AM processes in various field.	4	Analyze
CO4	Apply design constraints and choose a polymer and metal AM process	3	Apply
CO5	Apply process plan for additive manufacturing guidelines in designing.	3	Apply
CO6	Design a working model using additive manufacturing Processes	6	Create

Mapping of Course Outcomes to Program Outcomes (Pos) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	2	--	1	1	1	2	3	3	-
CO2	3	3	3	1	2	3	2	--	1	1	1	2	3	3	-
CO3	3	3	3	1	2	3	2	--	1	1	1	2	3	3	-
CO4	3	3	3	1	2	3	2	--	1	1	1	2	3	3	-
CO5	3	3	3	3	2	3	2	--	1	1	3	2	3	3	-
CO6	3	3	3	3	2	3	2	--	1	1	3	2	3	3	-

Course Contents

Unit No.	Topic	No. of Hours	Cos
I	**Introduction to Additive Manufacturing:** Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Materials for AM.	06	1
II	**Polymer AM Processes:** Stereolithography (SL), Fused Deposition Modelling (FDM), Material Jetting and Binder Jetting, Processed materials used, Process Modelling, Benefits and Drawbacks, Applications.	06	2
III	**Metal AM Processes:** Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Powder Bed Fusion, Directed Energy Deposition. Processed materials used, Process Modelling, Benefits and Drawbacks, Applications.	06	3
IV	**Design for Additive Manufacturing** Design Consideration for AM, Guidelines for internal geometry flow path, Design Optimization for AM., .stl file Generation & Repairing of .stl file.	06	4
V	**Process Plan for AM:** Model Slicing, Machine Handling- FDM , Post Processing (Polymer, Metals),In Situ Processing,	06	5
VI	**Material Science for AM:** Polymers, Metals, Support Materials, Smart Material. Industrial visit in AM. Create 3D model using AM process.	06	6

Text Books:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, by Iqbal Hussein, 2nd Edition, Springer, 2015.
2. Rapid Prototyping: Laser-based and Other Technologies. Patri K. Venuvinod and Weiyin Ma Press Springer, 2004
3. Ian Gibson, David W. Rosen, Brent Stucker Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing Springer, 2010.

Reference Books:

1. 3D Printing and Additive Manufacturing: Principles & Applications. Chua Chee Kai, Leong Kah Fai, 4th Edition, World Scientific, 2015.
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling. D.T. Pham, S.S. Dimov, Springer 2001.

E – Resources: https://onlinecourses.nptel.ac.in/noc22_me122/preview

SRES, Sanjivani College of Engineering, Kopargaon Mechanical Engineering Department			
Semester	II	**Subject Code**	**ME404B**
Subject	Computational Fluid Dynamics (CFD)	**No. of Lectures/Week**	3
Faculty Incharge	Dr. S. S. Ingle	**No. of Practical/Week**	--
Examination Scheme	In Sem (30) End Sem (50)	CA (20)	--
Assignment	(One Each Unit) 06	**Class Test**	--
Examination Hours:	2 hours	Pattern	2019

Pre-requisites: Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

Course Objectives:

1. To Model fluid/heat transfer problems and apply governing equations to flow problem.
2. To discretize the governing equations
3. To solve convection and diffusion equations and understands the role in fluid flow and heat transfer.
4. To develop approach for the use of condition/problem specific turbulence models.
5. To prepare the students for research leading to higher studies.
6. To prepare the students for career in research and industry using software tools.

Course Outcomes:

After learning the course the students will be able to-

CO's	**Course Outcomes**	**Blooms Taxonomy**	
		Level	**Descriptor**
CO1	To **Understand** Governing Equations and **Apply** Mathematical tool to A**nalyze** their Physical Behaviour. Action: **Understand, Apply, Analyze** Knowledge:**Governing Equations** Condition:**Physical Behaviour**	4	Analyze
CO2	To **Solve** and **Analyze** the Discretised Steady Diffusion Equations using Finite Volume Method (FVM) Action: **Solve, Analyze** Knowledge:**Steady Diffusion Equations** Condition: **Finite Volume Method**	4	Analyze
CO3	To **Solve** and **Analyze** the Discretised Steady Convection-Diffusion Equations using Finite Volume Method (FVM) Action: **Solve, Analyze** Knowledge:**Steady Convection-Diffusion Equations** Condition:**Finite Volume Method**	4	Analyze
CO4	**Solution Algorithms** for Pressure-Velocity Coupling in Steady and Unsteady flows Action:**Understand, Apply**	3	Apply

	Knowledge:**Pressure-Velocity Coupling** Condition:**Finite Volume Method**		
CO5	To **Solve** and **Analyze** the Discretised Unsteady Conduction-Convection Equations using Finite Volume Method (FVM). Action: **Solve, Analyze** Knowledge:**Unsteady Convection-Diffusion Equations** Condition:**Finite Volume Method**	4	Analyze
CO6	**Apply** different Turbulent Models and **Analyze** the difference between Turbulence Modelling approach to solve flow problems. Action: **Apply, Analyze** Knowledge:**Turbulence Modelling** Condition: **Turbulent Fluctuations**	4	Analyze

CO's	Blooms Taxonomy			POs/PSOs
	Level	Descriptor	Knowledge Category	
CO1	4	Analyze		PO1, PO2, PO3, PO4, PO5
CO2	4	Analyze		PO1, PO2, PO3, PO4, PO5
CO3	4	Analyze		PO1, PO2, PO3, PO4, PO5,PO12, PSO1, PSO2, PSO3
CO4	3	Apply		PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO10, PO12, PSO1, PSO2, PSO3
CO5	4	Analyze		PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO10, PO12, PSO1, PSO2, PSO3
CO6	4	Analyze		PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO10, PO12, PSO1, PSO2, PSO3

Mapping of COs with POs/PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3										
CO2	3	3	3	3	3										
CO3	3	3	3	3	3							2	1	2	1
CO4	3	3	3	3	3		1		1	1	1	2	1	2	1
CO5	3	3	3	3	3		1		1	1	1	2	1	2	1
CO6	3	3	3	3	3		1		1	1	1	2	1	2	1

Course Contents

Unit 1 **6 hr**

Introduction to CFD, Conservation laws of fluid motion, Governing equations of fluid flow and heat transfer, Mass conservation, Momentum and Energy equation in three dimensions, Equations of state, Navier-Stokes equations for a Newtonian fluid, Conservative form of the governing equations of fluid flow, Differential and integral forms of the general transport equations, Classification of physical behaviours, Classification method for simple PDEs, Classification of fluid flow equations.

UNIT 2 **6 hr**

Diffusion problems, Introduction, Finite volume method for One, Two and Three-dimensional diffusion problems.

Solution of discretised equations, Introduction, The TDMA, Application of the TDMA to One,Two and Three dimensional problems, Point-iterative methods, Jacobi iteration method, Gauss–Seidel iteration method, Relaxation methods.

UNIT 3 **6 hr**

Steady Convection-Diffusion Problems, Steady one-dimensional convection and diffusion, The central differencing scheme, Properties of discretisation schemes (Conservativeness, Boundedness, Transportiveness), Upwind scheme, Hybrid scheme, Power-law scheme, QUICK scheme, TVD schemes

UNIT 4 **6 hr**

Solution Algorithms for Pressure-Velocity Coupling in Steady and Unsteady flows: Introduction, The staggered grid, The momentum equations, The SIMPLE algorithm,The SIMPLER algorithm,The SIMPLEC algorithm, The PISO algorithm.

Boundary conditions, Errors and uncertainty in CFD modelling.

Methods for dealing with complex geometries, Body-fitted co-ordinate grids for complex geometries, Cartesian vs. curvilinear grids, Curvilinear grids, Block-structured grids, Unstructured grids.

UNIT 5 **6 hr**

Discretisation and Solution of Unsteady convection–diffusion Problems: Introduction, One-dimensional unsteady heat conduction, Explicit scheme, Crank–Nicolson scheme, The fully implicit scheme, Implicit method for two and three dimensional problems, Discretisation of transient convection–diffusion equation, Solution procedures for unsteady flow calculations.

UNIT 6 **6 hr**

Turbulence and its modelling, Characteristics of simple turbulent flows, The effect of turbulent fluctuations on properties of the mean flow, Turbulent flow calculations, Reynolds Averaged Navier–Stokes equations and classical turbulence models, Mixing length model, The k–ε model, Reynolds stress equation models.

Introduction to Advance turbulence models, Large eddy simulation, Direct numerical simulation

Text Books:

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	An Introduction to Computational Fluid Dynamics: The Finite Volume Method	H. Versteeg, and W.Malalasekara	Pearson.	
2	Computational Fluid Dynamics- The Basics with Applications	John D Anderson	McGraw-Hill	
3	Numerical Heat Transfer and Fluid Flow	Suhas V. Patankar	Hemisphere Publishing Corporation.	

References Books:

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Turbulence Modeling for CFD	David C. Wilcox	DCW Industries	
2	Computational Fluid Dynamics for Engineers	K. Hoffmann and S. T. Chiang	Engineering Education System, Austin, Texas	
3	Turbulent Flow	Stephen B. Pope	Cambridge University Press	
4	Boundary-Layer Theory	H. Schlichting and K. Gersten	Springer	
5	Computational Fluid Mechanics and Heat Transfer	J.C. Tannehill, D.A. Anderson and R.H. Pletche	Taylor and Francis	
6	Introduction to Computational Fluid Dynamics: Development, Application and Analysis	Atul Sharma	Wiley	

Robotics and Automation (ME404C) (2019 Pattern)

Teaching Scheme			Examination Scheme		
Lectures	**:**	3 Hrs. / Week	**In-Sem Exam**	**:**	30 Marks
Practical	**:**	Not applicable	**End Sem Exam:**		50 Marks
Tutorials	**:**	Not applicable	**CIA**	**:**	20 Marks
Credits	**:**	**3**	**Total**	**:**	100 Marks

==========

Prerequisite Course: Basic mechanical Engineering, Kinematics of machines.

==========

Course Objectives:

1. To apply concepts of robotics to explain robotic configurations and robot gripper force analysis
2. To identify robotic sensors, drives and control system of given application.
3. To analyse kinematics of links, joints and manipulators using DH parameters.
4. To analyse statics and dynamics of RR and PR manipulators.
5. To explain automation and group technologies
6. To explain principles and strategies of automation.

Course Outcomes (COs): On completion of the course of Robotics and Automation, learner will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Apply concepts of robotics to explain robotic configurations and robot grippers to do force analysis of robot grippers.	3	Apply
CO2	Identify best suitable robotic sensors, drives and control system for given application.	2	Identify
CO3	Analyse kinematics of manipulators, links and joints using DH parameters and programming.	4	Analyse
CO4	Analyss statics and dynamics of RR and RP manipulators.	4	Analyse
CO5	Explain various types of automation and group technologies	2	Explain
CO6	Explain principles and strategies of automation	2	Explain

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	3							2	2		
CO2	2	3	2	2	3							2	2		
CO3	2	2	2	2	3							2	2		
CO4	2	2	2	2	3							1	2		
CO5	2	2	2	2	3							1	2		
CO6	2	2	2	2	3							1	2		

High-3: Medium-2: Low-1

Course Contents

Unit no.	Unit title and contents	No. of Hours	COs
1	**Unit 01: Robotics and Robot Anatomy**		
	Introduction: Basic Concepts, laws of Robotics, Robot anatomy, Classification, structure of robots, point to point and continuous path robotic systems. Robot performance- resolution, accuracy, repeatability, dexterity, compliance, RCC device, Applications, Socio-Economic Analysis of Robots. **Robot Actuators and Grippers:** Actuator -Electric, Hydraulic, Pneumatic, Types of Grippers, Design of gripper, (Force analysis for various basic gripper systems including Hydraulic and Pneumatic vacuum and Magnetic systems.)	6 Hrs.	CO1
2	**Unit 02: Robotic Sensors and Control System**		
	Robotic Sensors: Characteristics of sensing devices, Classification, Selection and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot. GPS, IMU, Vision, PVDF Tactile (construction, working and selection) **Drives and Control Systems:** Types and selection of Drives, Types of Controllers, closed loop control, trajectory-following control, modeling and control of a single joint, force control.	6 Hrs.	C02
3	**Unit 03: Robot Kinematics and Programing**		
	Robot Kinematics: Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix, link and joint description, Denavit–Hartenberg parameters, Direct and Inverse Kinematics for industrial robots for Position and orientation. Trajectory planning. **Robot programming**: Programming of Robots and Vision System- overview of	6 Hrs.	C03

	various programming Languages.		
4	**Unit 04: Static and Dynamic Analysis of Robots**		
	Statics & dynamics: Differential Kinematics and static- Dynamics-Lagrangian Formulation, Newton Euler Formulation for RR & RP Manipulators,	6 Hrs.	C04
5	**Unit 05: Automation**		
	Automation : Introduction, Automation strategies, Types of Automation - Hard and Soft Automation, Flexible Manufacturing System – Types, Advantages, Limitations, AGVs and AS/RS [Only theory], Socio-Economic Analysis of Automation. **Group Technology:** Introduction, Coding Methods, Concepts of Computer Integrated Manufacturing (CIM) and Computer Aided Process Planning (CAPP), Variant & Generative methods of CAPP, advantages of CAPP. [Only theory]	6 Hrs.	C05
6	**Unit 06: Strategies of Automation**		
	Principles and Strategies of Automation: Power to Accomplish the Automated Process, program of Instruction, Control System, Advanced automation Functions: safety Monitoring, maintenance and repair Diagnostics, error Detection and Recovery, levels of automations, Merits and Demerits of automation. Introduction to Industry 4.0	6 Hrs.	CO6

CIA –

1. Test 1 – Unit I and Unit II
2. Test 2 – Unit III and IV / Industrial Visit and Report on Industrial Visit
3. Assignment on (Any one)
   a. Gripper Design using Matlab/Python/Similar programming software.
   b. Robot Kinematics – DH parameters Calculation using Matlab
   c. Robot simulation and analysis using Roboanalyser

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Introduction to Robotics	S. K. Saha	McGraw Hill Education	32006
2.	Fundamentals of Robotics analysis and control	Robert J. Schilling	PHI learning Pvt. Ltd.	48382
3.	Industrial Robotics Technology Programming and Applications	Mikell Groover, Mitchel Weiss, Roger Nagel, Nicholas Odrey	Tata Mc Graw Hill Edu. Pvt. Ltd.	47421
4.	Computer Aided Manufacturing	C. Elan Chezhian, T. Sunder Selwyn, G. Shanmuga Sundar	University Science Press	49328

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	Introduction to AI robotics	Robin Murphy	PHI learning Pvt. Ltd.	48385
2.	Robotics and Manufacturing automation	C. Ray Asfahl	Willey India	59865
3.	Robotics Technology and Flexible automation	S. R. Deb, Sankha Deb	Tata Mc Graw Hill Edu. Pvt. Ltd.	56262
4.	Geometric Fundamental of Robotics	J. M. Selig	Springer	70454

OE ME406-- Open ELECTIVE-III-- Project Management

(2019 Pattern)

08 weeks course	**Credits** **02**	**Examination Scheme** **CIA : 50 Marks**

Prerequisites: -
Basic Probability & Statistics, Basic Operations Research

Course layout

- Risk associated with Projects Decision
- Tree Modeling
- Cost Evaluation Techniques in Project Management
- GANNT Chart and Precedence Diagrams
- PER, CPM
- Project Life Cycles
- Concepts of Scheduling
- GERT
- Q-GERT
- Critical Chain and Theory of Constraints
- Activity Network Diagram
- Resource requirement, Resource constraints, Crashing of Jobs
- Project Control Techniques
- Earned Value Project

Books & Other Resources

Text Books & Reference Books:-

Name of Author	Name of Book	Publisher	Accession number
Chandra, P	Projects,	Tata McGraw-Hill Education, 2009	ISBN: 0070077932 |ISBN: 978007007793
Levy, F. K. and Wiest, J. D	A Management Guide to PERT/CPM,	Prentice Hall, 1969	ISBN-10: 0135485118 | ISBN-13: 9780135485118.
Lewis, R.	Project Management	McGraw-Hill, 2006	ISBN 0-07-147160-X.
Moder, J. J. and Phillips C. R	Project Management With CPM, PERT and Precedence Diagramming	Van Nostrand Reinhold,1983	ISBN-10: 0442254156 | ISBN-13: 978-0442254155.
Morris, P. W. G., and Pinto, J. K.	The Wiley Guide to Managing Projects	JohnWiley & Sons, 2004	ISBN: 9780471233022
Phillips, J.	PMP Project Management Professional Study Guide	McGraw-Hill, 2003	ISBN 0-07-223062-2.
Pritsker, A. A. B.	Modeling and analysis using Q-GERT networks	John Wiley & Sons Inc, 1979	ISBN: 0470266481 | ISBN: 9780470266489

Course certificate

1. The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.
   The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).
   Date and Time of Exams: **25 September 2022** Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.
   Registration url: Announcements will be made when the registration form is open for registrations.
   The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.
   Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.

   CRITERIA TO GET A CERTIFICATE

   Average assignment score = 25% of average of best 6 assignments out of the total 8 assignments given in the course.

Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75. If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.

Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Kanpur .It will be e-verifiable at nptel.ac.in/noc.

Only the e-certificate will be made available. Hard copies will not be dispatched.

Once again, thanks for your interest in our online courses and certification. Happy learning.

- NPTEL team

Sanjivani College of Engineering, Kopargaon Department of Mechanical Engineering			
Semester	**VII**	Subject Code	**ME407**
Subject	**Finite Element Analysis Lab**	No. of Hrs. /Week	**2**
Examination Scheme		Practical	**50 Marks**

Guidelines for TW Assessment

- **There should be continues assessment for term work.**
- **Assessment must be based on assessment of theory, attentiveness during practical and understanding of the course.**
- **Timely submission of journals.**

Course Objectives:

1. To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools.
2. It provides a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
3. It provides some experience of using commercial finite element analysis software to solve complex problems in solid mechanics

Course Outcomes:

On completion of the course, learner will be able to–

CO No.	Course Outcomes (COs):
CO1	Examine and calculate element stiffness matrices and load vectors for 1-D and 2-D element to analyze displacements and stresses in 1-D and 2-D structures Action: Examine, Apply, Analyse Knowledge: Examine elements and select suitable elements for particular 1-D and 2-D structure Condition: For given 1-D and 2-D structure.
CO2	Carry out Stress and Deflection Analysis of 1-D and 2-D structures like plate, beam and bars using FEA software Action: Analyse Knowledge: Stress and Deflection Analysis of 1-D and 2-D structures and use of FEA software Condition: Plane stress and stepped bar and axisymmetric
CO3	Carry out Buckling, vibration and thermal analysis of simple engineering structures. Action: Analyse Knowledge: Buckling, vibration and thermal analysis of engineering structures Condition: Use of FEA software

Sr. No.	List of Experiments
	Any Six from following List 1. Stress and Deflection Analysis of 1D Beam using FEA software 2. Stress and Deflection Analysis of 2D truss using FEA software 3. Stress and Deflection Analysis of stepped bar using FEA software 4. Stress and deflection analysis of 2D plate [Plain stress FEA] 5. Stress and deflection analysis of axisymmetric component {Cylindrical Pressure vessel analysis] 6. Modal analysis of any machine component using FEA software 7. Buckling analysis of beam using FEA software 8. 2D Steady state Thermal analysis using FEA software [Composite Plate]
	Software based assignments: 9. Computer program for stress analysis of 2-D truss subjected to plane forces 10. Computer program for 1-D temperature analysis
	CIA- Activity To carry out modeling and 2- D analysis of any practically used structure to find maximum stress and strains in X and Y directions by using available FEA software by the group of 4 to 6 students and to give presentation using PPTs.

Books & Other Resources

Text Books:-

Name of Author	Name of Book	Publisher	Accession number
Daryl L. Logan	A First Course in the Finite Element Method	Logan, 2007	
G Lakshmi Narasaiah	Finite Element Analysis	B S Publications	
P. Seshu	Text book of Finite Element Analysis	PHI Learning Private Ltd. , New Delhi	
Chandrupatla T. R. and Belegunda A. D	Introduction to Finite Elements in Engineering	Prentice Hall India	

Reference Books:

Name of Author	Name of Book	Publisher	Accession number
David V. Hutton	Fundamental of Finite Element Analysis	Tata McGraw-Hill	
Bathe K. J.	Finite Element Procedures	PHI New Delhi	
R. D. Cook	Concepts and Applications of Finite Element Analysis	Wiley, India	

Mechatronics Lab (ME 408) (2019 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	- Hrs. / Week	**OR Exam :**	50 Marks
Practical:	2 Hrs./ Week	**PR Exam:**	-- Marks
Tutorials :	- Hrs./Week (if applicable)	**TW :**	-- Marks
Credits:	**1**	**Total:**	50 Marks

==========

Prerequisite Course: (if Any) The subject Mechatronics has a prerequisite as Basic mechanical engineering, Basic electrical and electronics etc.

==========

Course Objectives: (Please specify Six Objectives)

Enable students to attain the basic knowledge required understanding of mechatronics, principle of sensor and its characteristics

1. Impart knowledge of the concept of signal processing and use of interfacing systems such as ADC, DAC, Digital I/O.
2. To make the block diagram representation and concept of transfer function for control system
3. To prepare for system modeling and analysis in the frequency domain.
4. To provide information about system modeling and analysis in time domain, controller modes and its industrial applications.
5. To aware about the use of mechatronics in industrial applications

List of Practical:

Pr No	Description	CO	PO
1	Experiment on measurement of temperature using a suitable sensor.		
2	Experiment on measurement of displacement using suitable sensor		
3	Experiment on measurement of load using suitable sensor.		
4	Development of a data acquisition / mechatronics system using low cost open source hardware and software		
5	Modelling and analysis of mechanical system and its verification using suitable simulation software		
6	PID control of Mechanical System using suitable simulation software and experimental verification (verification only if experimental setup is available)		
7	Experiment on interfacing of suitable sensor and actuator with DAQ.		

8	Industrial visit to understand integration and application of Mechatronics		

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
	Mechatronics: Electronics Control Systems in Mechanical and Electrical Engineering	William Bolton, 4th Ed, 2019	pearson	48377
	Mechatronics: Integrated Mechanical Electronic Systems	K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram,	Willey Publication,	62335
	Control systems-Principles and design	M.Gopal, 4th edition	Mc-GrawHill	61263

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
	Process Control Instrumentation Technology	C.D.Johnson	Prentice Hall,New Delhi	23439 ,24224
	Mechatronics – Principles, concepts and applications,	Mahalik	Tata Mc-Graw Hill publication, New Delhi	40897,40898
	Measurement systems - Application and design	Ernest O Doebelin 4th Edition	McGrawHill	26431

Sanjivani College of Engineering Kopargaon

Department of Mechanical Engineering

Final B Tech (2019 Pattern) Project Guidelines

Project (Stage I) ME409					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**4 Hrs./Week**	**Practical**	**2**	**Oral**	**50 Marks**

Prerequisites: Project Based Learning, Internship/Mini Project, Laboratory works, Audit Courses

Course Objectives:

1. To provide an opportunity of designing and building complete system or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills.
3. To embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
4. To encourage creative thinking processes to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.
5. To get visibility in industry to Project and Project group

Course Outcomes:

On completion of the course the learner will be able to;

CO1. Implement systems approach.

CO2. To conceptualize a novel idea / technique into a product.

CO3. To think in terms of a multi-disciplinary environment.

CO4. To take on the challenges of teamwork, and document all aspects of design work.

CO5. To understand the management techniques of implementing a project.

Course Contents

Project work in the seventh semester is an integral part of the TW work. The project work shall be based on the knowledge acquired by the student during the graduation and preferably it should meet and contribute towards the needs of the society.

Project work shall be based on any of the following:

1. Fabrication of product/ testing setup of an experimentation unit/ apparatus/ small equipment, in a group.
2. Experimental verification of principles used in Mechanical Engineering Applications.
3. Projects having valid database, data flow, algorithm, and output reports, preferably software based.

4. Study projects are strictly allowed.

Project Lab

1. There has to be a **Project Lab** in the department.
   a. It consists of necessary tools required to do a project.
   b. Previous projects and their components.
   c. Common measuring instruments.
   d. Previous years' project reports.
   e. Project related books and Publications.
   f. Proper linkage with central workshop and various laboratories.
   g. Safety measures.

2. All the project activities must be handled with a digital platform which is developed in the department according to the policies laid down by the institution. Respective authority levels created to maintain the transparency and confidentiality.

Books and other resources

References Books:

- Dissertations and Project Reports: A Step by Step Guide by Dr Stella Cottrell.

Web References:

1. SWAYAM-NPTEL Course.
2. MOOCs'Courses.

Guidelines for Project Execution:

At the end of the 6th Semester

1. Students will make groups according to their suitability.
2. Department faculty will float prospective Project Titles through Project Coordinator.
3. Department will take care of a list of titles at least two times of the groups.
4. Students will interact with guides for scope and outline of the project.
5. Maximum of two groups will be given to a guide.
6. Guide and Project groups will be finalized at the end of sixth semester so that project work can be started at the start of Seventh semester.

During the 7th Semester

1. Project work is expected to be done in the Project Lab.
2. Projects must be executed in association with industrial experts/facilities.
3. Progress of project work is monitored regularly on weekly project slots/project day.
4. Regular interval presentations are to be arranged to review and assess the work.
5. Project work is monitored and continuous assessment is done by guide and authorities.

Term Work:

- The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.
- Recommended performance measure parameters may Include-Problem definition and scope

of the project, Literature Survey, Appropriate Engineering approach used, Exhaustive and Rational Requirement Analysis,

- Comprehensive Implementation - Design, modeling, documentation, Usability, Optimization considerations (Time, Resources, Costing), Thorough Testing, Project Presentation and Demonstration (ease of use and usability), Social and environment aspects.
- The term work under project submitted by students shall include

1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for

a. Searching suitable project work
b. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project.
c. Brief report of feasibility studies carried to implement the conclusion.
d. Rough Sketches/ Design Calculations
e. Synopsis

- The group should submit the synopsis in the following form.

i. Title of Project
ii. Names of Students
iii. Name of Guide
iv. Relevance
v. Present Theory and Practices
vi. Proposed work
vii. Expenditure
viii. References

- The synopsis shall be signed by each student in the group, approved by the guide (along with external guide in case of sponsored projects) and endorsed by the Head of the Department
- Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.

Examination Scheme:

- During university examination Internal examiner (preferably the guide) and External examiners jointly, evaluate the project work.
- During the process of monitoring and continuous assessment & evaluation the individual and team performance is to be measured.
- The project term work shall be evaluated on the basis of reviews. In first semester two reviews are to be taken and evaluated for total 30 marks (15 marks each)
- Review 1 and 2 will be based on synopsis submission (team members, Title of the Project Work, abstract, Problem Definition, work done earlier, Objectives of the Project, Methodology of the Project, Application / Significance of the Project, Duration of the Project, Individual Role of the Student, References, sponsored etc.)
- The final presentation shall be taken in front of external examiner and to be evaluated for 40 marks
  - 10 marks for presentation for group,
  - 15 marks for quality of the project work.
  - 15 marks for quality of the project report

Project Report
• Stage I report shall be in the booklet form. • Plagiarism check is must, and certificate shall be attached in the report.
References: • References format MUST BE STANDARD – ASME, SAE or IEEE

Project (Stage II) ME417					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**08 Hrs./Week**	**Practical**	4	**Term Work**	**100 Marks**
				Oral	**50 Marks**

Prerequisites: Project Based Learning, Internship/Mini Project, Project (Stage I)

Course Objectives:

1. To provide an opportunity of designing and building complete system or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills.
3. To embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
4. To encourage creative thinking processes to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.
5. To get visibility in industry to Project and Project group

Course Outcomes:

On completion of the course the learner will be able to;

CO1. Implement systems approach.
CO2. To conceptualize a novel idea / technique into a product.
CO3. To think in terms of a multi-disciplinary environment.
CO4. To take on the challenges of teamwork, and document all aspects of design work.
CO5. To understand the management techniques of implementing a project.

Course Contents

Extended part of Project Stage I

Guidelines for Project Execution

1. Refer Project stage I guidelines.

Term Work Evaluation

1. In Project Stage II, two reviews are to be taken for total 80 marks (40 marks each)
2. Review III shall be based on the approximate end of fabrication / design validation etc. in front of an expert panel from the department.

3. Review IV will be third party evaluation by Faculty/Student/Industry person/Alumni
4. Evaluation committee will consist of Guide, One Industry person and One Faculty appointed by the Institution.
5. Students shall be encouraged to publish a research paper/patent/technical note. Their credential shall be considered while term work evaluation.

Examination Scheme

1. Examination committee will consist of Guide, (Strictly) One Industry person and One Faculty appointed by the Institution.
2. Well in advance soft copies of the project shall be shared with examination committee.

Presentation of Project Work

Presentation of work in the form of Project Report (s), Understanding individual capacity, Role & involvement in the project, Team Work (Distribution of work, intrateam communication and togetherness), Participation in various contests, Publications and IPR, Manuals (Project Report, Quick reference, System, Installation guide) among other parameters. Team members with guide information shall be added at the end of the report.

Project Report

1. The report shall be both side print hard bound. A hardbound report shall be made after examination and examiner and guide's expected correction, before that report must be loosely bound.
2. Plagiarism check is must, and certificate shall be attached in the report.
3. A group activity shall be presented in report.
4. Report copies shall be submitted in the department, one for university and one for supervisor.
5. For standardization of the project reports the following format shall be strictly followed.
    a. Page size: Trimmed A4
    b. Top Margin: 1.00 Inches
    c. Bottom Margin: 1.32 Inches
    d. Left Margin: 1.5 Inches
    e. Right Margin: 1.0 Inches
    f. Para Text: Times New Roman 12-point font
    g. Line Spacing: 1.15 Lines
    h. Page Numbers: Right aligned at footer. Font 12 point Times New Roman
    i. Headings: Times New Roman, 14 Points, Boldface 10.

Certificate

1. All students should attach a standard format of Certificate as described by the department.
2. Certificates should be awarded to project groups and not individual students of the group.
3. Certificates should have signatures of Guide, External Examiner, Head of Department and Principal.

Index of Report

1. Title Sheet
2. Certificate (Institution)
3. Certificate (Company, if sponsored by company)
4. Acknowledgement
5. Abstract of the Project
6. List of Figures
7. List of Photographs / Plates
8. List of Tables
9. Table of Contents
10. Introduction
11. Literature Survey / Theory
12. Design / Experimentation / Fabrication / Production / Actual work carried out for the same
13. Observation Results
14. Discussion on Result and Conclusion
15. Student and Guide details. (A common photograph with project)

MLC VII Joy of Computing Using Python (ME 410) (2019 Pattern)

Teaching Scheme		Examination Scheme	
Lectures:	- Hrs. / Week	**In-Sem Exam :**	- Marks
Practical:	- Hrs./ Week	**End Sem Exam:**	- Marks
Tutorials :	- Hrs./Week (if applicable)	**CIA:**	- Marks
Credits:		**Total:**	- Marks

==========

Prerequisite Course: (Basic Programming Language)

==========

Course Objectives:

1. To develop an interest in the Python Programming.
2. To establish an ability to use Python Programming to solve the Problems programmatically.
3. To inspire the learner's mind to think logically.

Course Outcomes (COs):

After learning the course the students will be able to-

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand the Basics of Python Programming.	2	understand
CO2	Apply the Python Programming to arrive at a solution of problem.	3	apply
CO3	Demonstrate the art of programming using Python.	2	understand
CO4	Practice and Learn the Culture of Python Programming.	2	understand
CO5	Understand the current advances in computing using python.	2	understand
CO6	Apply the Python programming Logic to solve problems.	3	apply

Course Contents

Unit	Contents	No.of Hours	COs
1	**Unit I**		
	• Motivation for Computing • Welcome to Programming!! • Variables and Expressions : Design your own calculator • Loops and Conditionals : Hopscotch once again • Lists, Tuples and Conditionals : Lets go on a trip	6 Hrs.	CO1
2	**Unit II**		
	• Abstraction Everywhere : Apps in your phone • Counting Candies : Crowd to the rescue • Birthday Paradox : Find your twin • Google Translate : Speak in any Language	6 Hrs	C02
3	**Unit III**		
	• Currency Converter : Count your foreign trip expenses • Monte Hall : 3 doors and a twist • Sorting : Arrange the books • Searching : Find in seconds	6 Hrs	C03
4	**Unit IV**		
	• Substitution Cipher : What's the secret !! • Sentiment Analysis : Analyse your Facebook data • 20 questions game : I can read your mind • Permutations : Jumbled Words • Spot the similarities : Dobble game	6 Hrs	C04
5	**Unit V**		
	• Count the words : Hundreds, Thousands or Millions. • Rock, Paper and Scissor : Cheating not allowed !! • Lie detector : No lies, only TRUTH • Calculation of the Area : Don't measure. • Six degrees of separation : Meet your favourites	6 Hrs	
6	**Unit VI**		
	• Image Processing : Fun with images • Tic tac toe : Let's play • Snakes and Ladders : Down the memory lane. • Recursion : Tower of Hanoi • Page Rank : How Google Works !!	6 Hrs.	C05

Heating, Ventilation and Air Conditioning (ME 411)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA:**	20 Marks
		In-Sem. Exam :	30 Marks
		End Sem. Exam:	50 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: Knowledge of Basic Thermodynamics and Heat Transfer

==========

Course Objectives:

1. Student should able to determine cooling capacity and COP of the VCRS and explain Applications of air conditioning and advanced vapour compression refrigeration cycles.
2. Understand, conceptualize Psychrometry and psychrometric processes.
3. Understand, conceptualize and determine cooling load of the building
4. Explain ventilation and infiltration and advanced air conditioning systems.
5. Understand functions and working of various components of refrigeration system.
6. Understand, conceptualize duct design and air handling unit.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	**Descriptor**
CO1	Determine COP of VCRS and explain, refrigerant properties, advanced vapour compression refrigeration cycles, applications of air conditioning	03	Apply
CO2	Understand Psychometric processes and Calculate different psychometric properties.	03	Apply
CO3	Estimate the heating load and cooling loads for buildings.	03	Apply
CO4	Explain ventilation and advanced air conditioning systems.	02	Understand
CO5	Estimate the thermal performance of refrigeration system component.	02	Apply
CO6	Calculate pressure drop and size of ducts, air handling unit.	03	Apply

Course Contents

Unit	Contents	No.of Hours	COs
1	**Vapour Compression System**		
	Vapour Compression Refrigeration system (VCRS) Basic block diagram of VCRS, Tons of refrigeration (TR), Coefficient of performance (COP),Ideal refrigeration cycle – Reversed Carnot cycle, Numerical, Deviations of practical cycles from Carnot cycle, Saturated vapour compression refrigeration cycle, Numerical, Effect of suction and discharge pressure, sub cooling and superheating on performance, Actual VCRS **Applications of air conditioning:** - Domestic, Automobile, evaporative coolers, Commercial– multiplex, hospitals, Industrial air conditioning. **Refrigerant: -** Survey of Refrigerants, types of refrigerant, Designation of Refrigerants, Thermodynamic, Chemical, Physical, properties of refrigerant. Secondary Refrigerants, Ozone depletion, Global warming, greenhouse effect, Environment friendly refrigerant R134a, R410a, R600a, R290, R32. (Theoretical only) **Advanced Vapor Compression Cycles:** Trans-critical cycle and their types, Ejector refrigeration cycle and their types. Presentation of cycle on P-h and T-s chart.	7	CO1
2	**Psychrometry and Air Conditioning systems**		
	Basic Psychrometry and processes, Psychrometric properties, Psychrometric chart, BPF of coil, ADP, adiabatic mixing of two air streams, SHF, RSHF, GSHF, ESHF. Factors contributing to cooling load, Numerical based on psychometric processes. **Air Conditioning Systems** Introduction ,Classification of Air-conditioning systems, Unitary systems, Central AC system, Classification of Air-conditioning systems, Reheat system, Multizone system, Dual Duct system, Variable Air Volume system (VAV) system, All – air and water systems, Unitary Vs Central systems.	6	C02
3	**load Estimation in Building Structures**		
	Preliminary Considerations, Internal Heat Gains, System Heat Gains, Breakup of ventilation Load and Effective Sensible Heat Factor, Cooling-load Estimate, Heating – load Estimate. Heat gain through solar radiation, Heat gain through fenestrations, Space load characteristics, cooling load and coil load calculations, Overall heat transmission coefficient, air spaces, sol-air temperature, Decrement factor & time lag method,, Cooling load Temperature Difference method (CLTD) or Equivalent Temperature Differential (ETD), detailed calculation procedure using CLTD method.	6	C03

4	**Ventilation and advanced Air Conditioning Systems**		
	Indoor Design Criteria and Thermal Comfort , Indoor Air Quality , Outdoor Design Conditions, Ventilation For Cooling : Natural Ventilation, Mechanical Ventilation **Advanced Air-conditioning Systems** *Desiccant-Based Air Conditioning Systems* : Introduction, Sorbents & Desiccants, Dehumidification, Liquid Spray Tower, Rotary Desiccant Dehumidifiers, Evaporative-Cooling Air Conditioning Systems, Thermal Storage Air Conditioning Systems, (Theoretical treatment), Heat Pump Systems: Heat Pump Cycle, different heats pump Circuits.	6	C04
5	**Thermal Design of Refrigeration System Components**		
	Compressor: Sizing of reciprocating compressor. ***Evaporator:*** Performance analysis of Dx evaporator. ***Condenser*****:** air-cooled condenser, shell & tube condenser and evaporative condenser. ***Expansion Devices*****:** Operating Characteristics, Liquid Charge in the Sensing Bulb , Hunting of Thermostatic Expansion Valve ***Cooling Tower*****:** Types & design of cooling towers, cooling tower thermal performance, tower efficiency.	5	CO5
6	**Air Distribution Systems**		
	Part A] Ducts Classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct (friction losses, dynamic losses), air flow through simple duct system, equivalent diameter, Methods of duct system design: equal friction, velocity reduction, static regain method (numerical on duct system design) **Part B] Air handling unit** Air handling unit, Fan coil unit, types of fans used air conditioning applications, fan laws, filters, supply and return grills, sensors (humidity, temperature, smoke).	6	C06

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	1	2	2	1	2	-	1	-	-	3
CO2	3	2	2	-	-	-	-	-	1	2	-	1	-	-	3
CO3	3	2	2	-	-	-	-	-	1	2	-	1	-	-	3
CO4	3	1	-	-	-	-	-	-	1	2	-	1	-	-	3
CO5	3	2	2	-	-	-	-	-	1	2	-	1	-	-	3
CO6	3	2	2	1	1	1	-	-	1	2	-	1	-	-	3

Text Books

S.N.	Title of Book	Authors	Publication House
1.	Refrigeration and Air conditioning	Arora, C.P	Tata-McGraw Hill
2.	Basic Refrigeration and Air Conditionin	P .N. Ananthanarayanan	McGraw Hill
3.	Refrigeration and Air conditioning.	Manohar Prasad	New Age International
4.	Refrigeration and Air conditioning	R.S. Khurmi J.K. Gupta	Eurasia Publishing House (P) Ltd.
5.	Elementary Refrigeration and Air-conditioning	Stoecker, W.F., and Jones, J.W.,	McGraw Hill , 2002
6.	Principle of Refrigeration	Roy J.Dossat	Wiley Eastern limited, 1987 Third Edition

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	2020, ASHRAE Handbook – Refrigeration.	ASHRAE Technical Committees, Task Groups, and Technical Resource Groups	ASHRAE
2.	Refrigeration and Air Conditioning.	Langley, Billy C.	Engie wood Cliffs (N.J) Prentice Hall 1986.
3.	Air Conditioning Engineering.	W.P.Jones	English Language Book Society Edward Arold pub.
4.	Refrigeration and Air Conditioning Technology	Whitman, Johnson, Jomcztk	Delmar Thomson learning

Hydraulics and Pneumatics (ME412)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA:**	20 Marks
		In-Sem Exam :	30 Marks
		End Sem Exam:	50 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course:

==========

Course Objectives:

1. To teach learners the about fundamental principles of hydraulic and Pneumatic
2. To teach learners working principle of various components used in hydraulic and pneumatic systems.
3. To teach learners about selection different components used in hydraulic and pneumatic systems.
4. To teach learners about design of hydraulic and pneumatic circuits
5. To teach the learners about the working of pneumatic system
6. To teach the learners electro-hydraulic and electro-pneumatics circuits.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Identify and analyze the functional requirements of a fluid power transmission system for a given application	3	Apply
CO2	Visualize how a hydraulic/pneumatic circuit will work to accomplish the function	3	Apply
CO3	Select the hydraulic control valves for different applications.	3	Apply
CO4	Design an appropriate hydraulic circuit or electro-hydraulics for a given application	3	Apply
CO5	Choose the appropriate component for Pneumatic applications	3	Apply
CO6	Make hydraulics and Pneumatics circuits using PLC	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	2	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	2	-	-	-
CO4	3	3	3	-	3	-	-	-	-	-	-	2	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	2	-	-	-
CO6	3	3	3	-	3	-	-	-	-	-	-	2	-	-	-

Course Contents

Unit	Contents	No.of Hours	COs
1	**Introduction to fluid power systems**		
	Introduction to fluid power systems Fluid power system: components, advantages and applications. Transmission of power at static and dynamic states. Pascal's law and its applications. Fluids for hydraulic system: types, properties, and selection. Additives, effect of temperature and pressure on hydraulic fluid. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, and quick acting couplings. Pressure drop in hoses/pipes. Fluid conditioning through filters, strainers; sources of contamination and contamination control; heat exchangers	6	CO1
2	**Pumps and actuators**		
	Pumps: Classification of pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump selection factors, problems on pumps. **Accumulators and Actuators :** Types, and applications of accumulators. Types of Intensifiers, Pressure switches /sensor, Temperature switches/sensor, Level sensor. Actuators: Classification cylinder and hydraulic motors, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, special types of cylinders, problems on cylinders. Construction and working of rotary actuators such as gear, vane, piston motors, and Hydraulic Motor. Theoretical torque, power, flow rate, and hydraulic motor performance; numerical problems. Symbolic representation of hydraulic actuators (cylinders and motors)	6	C02
3	**Hydraulics Control Valves**		
	Classification of control valves, Directional Control Valves-symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, and check valves.	6	C03

	Pressure control valves - types, direct operated types and pilot operated types. **Flow Control Valves** -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.		
	Hydraulic Circuit Design		
4	**Control of single and Double** -acting hydraulic cylinder, regenerative circuit, pump unloading circuit, counter balance valve application, hydraulic cylinder sequencing circuits, hydraulic circuit for force multiplication; speed control of hydraulic cylinder- metering in, metering out and bleed off circuits. Pilot pressure operated circuits., Simulation of Hydraulics Circuit using suitable software. PLC based hydraulics circuits, Simulation of Pneumatic circuits using Fluid Sim software	6	CO4
5	**Pneumatic power systems**		
	Introduction to Pneumatic systems: Pneumatic power system, advantages, limitations, applications, Choice of working medium. Characteristics of compressed air and air compressors. Structure of pneumatic control System, fluid conditioners-dryers and FRL unit. **Pneumatic Actuators:** Linear cylinder – types of cylinders, working, end position cushioning, seals, mounting arrangements, and applications. Rotary cylinders-types, construction and application, symbols. **Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves**, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols.	6	C05
6	**Pneumatic control circuits**		C06
	Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and exhaust air throttling. **Signal Processing Elements:** Use of Logic gates - OR and AND gates in pneumatic applications. Practical examples involving the use of logic gates. **Multi- Cylinder Application:** Coordinated and sequential motion control, motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves). **Electro- Pneumatic Control:** Principles - signal input and output, pilot assisted solenoid control of directional control valves, use of relay and contactors, PLC Control circuitry for simple signal cylinder application., Simulation of Pneumatic circuits using suitable Fluid Sim software	6	

Text Books

1.	Anthony Esposito,Fluid Power with applications, Pearson edition, 2000
2.	Majumdar S.R, Oil Hydraulics Tala McGRawHllL, 2002
3.	Majumdar S.R, Pneumatic systems, Principles and Maintenance Tata McGraw-Hill 2005,

Reference Books:

1.	John Pippenger,Industrial Hydraulics , Tyler Hicks McGraw Hill International Edition 1980
2.	Andrew Par, Hydraulics and pneumatics, Jaico Publishing House 2005
3.	Fundamentals of Pneumatics, Vol I, II and III. FESTO
4.	Herbert E. Merritt, Hydraulic Control Systems John Wiley and Sons, Inc
5.	Thomson,Introduction to Fluid power Prentcie HaIl 2004
6.	John Watton, Fundamentals of fluid power control Cambridge University press 2012
7.	Allen C. Morse. Electrohydraulic Servo mechanisms. McGraw-Hill, 1963.
8.	John Watton. Fluid Power Systems. Prentice-Hall International (UK) Ltd.,1989.

Dynamics of Machines (ME 413)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA:**	20 Marks
		In-Sem Exam :	30 Marks
		End Sem Exam:	50 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: Machine Design-I,II, Strength of Materials, Applied Mechanics, Kinematics of Machines

==========

Course Objectives:

1. Provide fundamentals of vibration and noise so that the students can solve real engineering problems and design engineering systems.
2. Make students able to prepare a mathematical model of the mechanical system in the form of spring, mass and damping elements.
3. Provide knowledge of solving multi degree of freedom problems using matrix method
4. Make aware about the instrumentation used for measurement of vibration and noise
5. Provide fundamentals of control of vibration and noise in machines
6. Analyse the vibration measurement signatures

Course Outcomes (COs): At the end of the course students will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Calculate natural frequency for a single degree of freedom undamped free vibratory systems.	3	Apply
CO2	Determine natural frequency for a single degree of freedom damped free vibratory systems.	3	Apply
CO3	Determine response to forced vibration due to harmonic excitation, base excitation and excitation due to unbalance forces.	3	Apply
CO4	Estimate natural frequency and mode shapes for two DOF undamped free longitudinal and torsional vibratory systems.	3	Apply
CO5	Determine vibration and noise measurement parameters for industrial / real life applications.	3	Apply
CO6	Determine vibration and noise control parameters.	3	Apply

Course Contents

Unit	Contents	No.of Hours	COs
1	**Free undamped vibration**		
	Single Degree of Freedom Systems – Free Vibration: Fundamentals of Vibration: elements of a vibratory system, vector representation of S.H.M., Degrees of freedom, Introduction to physical and mathematical modelling of vibratory systems: Bicycle, Motor bike, quarter car, Types of vibration, equivalent stiffness and damping, Formulation of differential equation of motion (Newton, D Alembert and energy method) Undamped free vibrations: Natural frequency for longitudinal, transverse and torsional vibratory systems.	6	CO1
2	**Free damped Vibration**		
	Damped free vibrations: Different types of damping, free vibrations with viscous damping - overdamped, critically damped and under damped systems, initial conditions, logarithmic decrement, introduction to equivalent viscous damping, dry friction or coulomb damping - frequency and rate of decay of oscillations.	6	C02
3	**Forced Vibration**		
	Single degree of freedom forced vibrations of longitudinal and torsional systems, Frequency Response to harmonic excitation, Excitation due to reciprocating and rotating unbalance, Base excitation, magnification factor, Force and motion transmissibility, Quality Factor, Half power bandwidth method, Critical speed of shaft having single rotor of undamped systems.	6	C03
4	**Two Degree of Freedom**		
	Two degree of freedom system- Undamped Vibrations: Free vibration of spring coupled systems, longitudinal and torsional, Torsionally equivalent shaft, Natural frequency and mode shapes, Eigen value and Eigen vector by Matrix method, Combined rectilinear and angular motion, Vibration of Geared systems	6	C04
5	**Vibration and Noise Measurement**		
	Vibration Measuring devices, Accelerometers, Impact hammer, Vibration shaker- Construction, principles of operation and uses, Vibration Analyzer, Vibration based condition monitoring, Standards related to measurement of vibration, Human response to vibrations, Analysis of Vibration Spectrum. Numerical on vibration measurement sensors Fundamentals of noise Sound concepts, Decibel Level, white noise, weighted sound pressure level, Logarithmic addition, subtraction and averaging, sound intensity, noise measurement. Numerical on noise level measurement.	6	C05
6	**Design for Vibration and noise suppression/control**		
	Introduction to control of vibration, Vibration control methods, Vibration isolation, Vibration absorbers, i) passive, ii) semi-active, iii) active vibration control. Noise controls at source, along the path and at the receiver, pass by noise. Numerical on vibration isolation and absorbers. . Introduction to NVH	6	CO6

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	-	-	-	-	-	2	-	-	-	2	-	-
CO2	3	3	3	-	2	-	-	-	2	-	-	2	3	-	-
CO3	3	2	2	-	3	-	-	-	-	2	-	2	2	-	-
CO4	3	3	3	-	2	-	-	-	-	2	-	-	2	-	-
CO5	2	3	2	-	-	3	-	2	-	2	-	2	2	-	-
CO6	3	3	2	-	-	2	-	2	-	-	-	2	3	-	-

Text Books

Sr. No.	Title of Book	Authors	Publication House
1	Mechanical Vibrations	Grover G. K.	New Chand and Bros. , Roorke
2	Mechanical Vibrations	S. S. Rao	Pearson Education Inc. New Delhi.
3	Mechanical Vibrations	V. P. Singh	Dhanpat Rai and Co.
4	Vibration and Noise for Engineers	Kewal Pujara	Dhanpat Rai and Co.

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1	Vibration of Mechanical System	Alok Sinha	Cambridge university Press , India
2	Vibration Problems in Engineering.	Weaver	Wiley India Pvt. Ltd, New Delhi.
3	Mechanical Vibration	William J Palm III,	Wiley India Pvt. Ltd, New Delhi
4	Engineering Vibration	Daniel J. Inman	Pearson Education Inc.

Advanced Finite Element Methods (ME414A)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA**	20 Marks
		In-Sem Exam :	30 Marks
		End Sem Exam:	50 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: Finite Element Analysis.

==========

Course Objectives:

1. To understand the concept of to Axi-symmetric problems.
2. To familiarize students with the Heat transfer problems.
3. It provides a solution to Fluid flow problems.
4. To study approximate nature of the structural dynamics.
5. To extend FE approach to bending of plate structure.
6. To provide FE solution methods to nonlinearity problems.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand the fundamental concepts of Axi-symmetric problems.	2	Understand
CO2	Analysis of 1-D Heat transfer problems.	3	Apply
CO3	Solve various 1-D Fluid flow problems.	3	Apply
CO4	Determine Eigen values and vectors in structural dynamics.	3	Apply
CO5	Analyse plate structure for bending behaviour.	3	Apply
CO6	Classify the nonlinearity problems based on geometry & material.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	-	-	1	1	1	-	1	2	-	-
CO2	3	2	-	1	2	-	-	-	1	1	-	1	2	-	-
CO3	3	2	-	-	2	-	-	-	1	1	-	1	2	-	-
CO4	3	2	1	-	2	-	-	1	1	1	-	1	2	-	-
CO5	3	2	-	1	2	-	-	-	1	1	-	1	2	-	-
CO6	3	2	-	-	2	-	-	-	1	1	-	1	2	-	-

Course Contents

Unit No.	Content	No. of Hours	COs
1	**Finite element analyses of Axi-symmetric solids**		1
	Finite element modelling and analyses of two-dimensional (2-D) form of structures using constant strain triangles, Estimation of Load Vector, Stresses. Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Introduction to 2-D four noded Isoparametric elements and numerical integration.	6	
2	**Heat Transfer Problems**		2
	Steady State Heat Transfer Analysis: One dimensional (1-D) analysis of Slab, composite Wall, Fin and 2-D analysis of thin plate.	6	
3	**Fluid Flow Problems**		3
	Basic Differential Equations of Heat Flow, 1-D & 2-D Finite Element Formulation of a Fluid Flow Problems.	6	
4	**Introduction to Explicit Dynamics**		4
	Structural dynamic considerations, Dynamic equations, Lumped & Consistent mass matrix, Eigen Values, Eigen vector, Natural frequencies, Mode shapes, Modal analysis of Stepped bar and beam.	6	
5	**Bending of Plates**		5
	Introduction, thin and thick plates: Kirchoff theory, Mindlin plate element, Conforming and nonconforming elements, C0 & C1 continuity Elements, Reduced & selective integration, shear locking and hour glass phenomenon, FE approach to composite plates	6	
6	**Nonlinearity**		6
	Overview and kinds of nonlinearity, Formulation of Geometrical and Material non-linearity problems.	6	

Text Books

Sr.No.	Title of Book	Authors	Publication House
1.	A First Course in the Finite Element Method	Daryl L. Logan	Logan, 2007
2.	Finite Element Analysis	G Lakshmi Narasaiah	B S Publications
3.	Text book of Finite Element Analysis	P. Seshu	PHI Learning Private Ltd. , New Delhi
4.	Introduction to Finite Elements in Engineering	Chandrupatla T. R. and Belegunda A. D	Prentice Hall India

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Fundamental of Finite Element Analysis	David V. Hutton	Tata McGraw- Hill
2.	Finite Element Procedures	Bathe K. J.,	Prentice, Hall of India (P) Ltd., New Delhi
3.	Concepts and Applications of Finite Element Analysis	R. D. Cook	Wiley, India

Power Plant Engineering (ME414B)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA:**	20 Marks
		In Sem Exam:	30 Marks
		End Sem Exam:	50 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: Thermodynamics and Heat Transfer

==========

Course Objectives:

1. study the power generation scenario, and basics of economics of power generation
2. study layout, component details of thermal power plant.
3. study layout, component details of hydroelectric power plant, hydrology and elements, types of nuclear power plant
4. understand components; layout of diesel power plant, components; methods to improve thermal efficiency of gas power plant
5. study the working principle, construction of power generation from non-conventional sources of energy
6. learn the different instrumentation in power plant

Course Outcomes (COs): **At the end of the course, learner will be able to**

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Calculate the cost of electrical energy and Describe the power generation scenario.	3	Apply
CO2	Calculate the performance of improved Rankin cycle, Cogeneration cycle and the performance parameters of steam condenser	3	Apply
CO3	Explain the layout, component details of hydroelectric power plant and nuclear power plant	2	Understand
CO 4	Determine the performance parameters of gas turbine power plant and diesel Engine power plant	3	Apply
CO 5	Explain solar power plants, tidal power plant, fuel cell, wind turbine power plant	2	Understand
CO 6	Explain the electrical equipment's in power plants and the methods to control environmental impacts of thermal power plant	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	3	3	-	-	-	-	2
CO2	3	3	2	-	-	-	-	-	3	3	-	-	-	-	2
CO3	3	2	2	-	-	-	-	-	3	3	-	-	-	-	2
CO4	3	2	2	-	-	3	-	-	3	3	-	-	-	-	2
CO5	3	2	2	-	-	-	-	-	3	3	-	-	-	-	2
CO6	3	2	2	-	-	3	-	-	3	3	-	-	-	-	2

Course Contents

Unit	Contents	No. of Hours	COs
1	**Introduction and Economics of Power Generation**		
	Power Generation : Concept of Power Plants, Classification of Power Plants, Energy, Types of Energy, Power Development in India, Resources for Power Generation, Present Power Position in India ,in Maharashtra, Power Corporations in India, load shedding, carbon credits **Economics of Power Generation** : cost of electric energy, fixed and operating cost [methods to determine depreciation cost, load curves, performance and operation characteristics of power plants, load division, all terms related to fluctuating load plant, Types of Tariffs	6	CO1
2	**Steam Power Plant**		
	Steam Power Plant : General layout of modern thermal power plant with different circuits, site selection criteria, classification of coal, coal blending, selection of coal for thermal power plant, pulverized fuel handling systems, fuel combustion methods, FBC systems,high pressure boilers, ash handling system, Rankine cycle with reheat and regeneration, Cogeneration plant, **Steam Condenser** : Necessity of steam condenser, elements of steam condensing plant, classification, cooling water requirements, condenser efficiency, vacuum efficiency, cooling towers	6	CO2
3	**Hydroelectric and Nuclear Power Plant**		
	Hydroelectric Power Plant : Site selection, classification of HEPP, criteria for turbine selection, dams, spillways, surge tank and forebay, advantages and disadvantages of HEPP, hydrograph ,flow duration curve ,mass curve, environmental	6	CO

	impacts of HEPP. **Nuclear Power Plants** : elements of NPP, types of nuclear reactor, PWR, BWR, CANDU, GCR, LMCR, OMCR, fast breeder, fusion, material for nuclear fuel, cladding, coolants, control rod and shielding, nuclear waste disposal, environmental impacts of NPP.		
4	**Diesel Engine and Gas Turbine Power plant**		
	Diesel Power Plants : applications, components of DPP, different systems of DPP, plant layout, performance of DPP advantages & disadvantages of diesel power plant, environmental impacts of DPP **Gas Turbine Power Plant** : general layout of GTPP, components of GTPP, open, closed & semi- closed cycle gas turbine plant, Brayton cycle analysis for thermal efficiency, work ratio, maximum & optimum pressure ratio, methods to improve thermal efficiency of GTPP: inter-cooling; reheating & regeneration cycle, gas and steam turbine combined cycle plant, environmental impacts of GTPP	6	CO4
5	**Non-Conventional Power Generation.**		
	Solar Power Plant based on: basic definition**,** flat plate collector, solar ponds, parabolic solar collector, heliostat, solar chimney, SPV cell based plants: working principal, solar photovoltaic systems, applications, site selection **Tidal Power Plant:** components, single basin, double basin systems. Green Hydrogen Technology **Wind Power Plant** : wind availability, wind mills and subsystems, classification of wind turbines, operating characteristics, wind solar hybrid power plants, challenges in commercialization of non- conventional power plants, environmental impacts of NCPP, site selection	6	CO5
6	**Instrumentation and Environmental Aspects of power station**		
	Power Plant Instruments : layout of electrical equipment, generator, exciter, generator cooling, short circuits & limiting methods, switch gear, circuit breaker, power transformers, methods of earthling, protective devices & control system used in power plants, measurement of high voltage, current and power, control room **Environmental impact of thermal power plants** : Different pollutants from thermal power plants, their effects on human health and vegetation, methods to control pollutants such as particulate matter; oxides of sulphur; oxides of nitrogen, dust handling systems, ESP, scrubbers, water pollution, thermal pollution, noise pollution from TPP and its control	6	CO6

Text Books:

Sr. No.	Title of Book	Authors	Publication House
1	Power Plant Engineering	Domkundwar & Arora	Dhanpat Rai & Sons, New Delhi
2	Solar Energy and Non-Conventional Sources of Energy	Domkundwar & Domkundwar-	Dhanpat Rai & Sons, New Delhi.
3	Power Plant Engineering	R.K.Rajput	Laxmi Publications New Delhi.
4	Power Plant Engineering	D.K.Chavan & G.K.Phatak,	Standard Book House, New Delhi.

References Books:

Sr. No.	Title of Book	Authors	Publication House
1	Power Plant Engineering	E.I.Wakil,	McGraw Hill Publications New Delhi
2	Power Plant Engineering‖	P.K.Nag	McGraw Hill Publications New Delhi.
3	Steam and Gas Turbines	R.Yadav	Central Publishing House, Allahabad
4	Non-Conventional Energy Sources,	G.D.Rai,	Khanna Publishers,Delhi
5	Power Plant Engineering	G.R. Nagpal,	Khanna Publication
6	Solar Energy	S.P.Sukhatme	Tata McGraw-Hill Publications, New Delhi

Automobile Engineering (ME 414C)

Teaching Scheme		Examination Scheme	
Lectures:	3 Hrs. / Week	**CIA :**	20 Marks
		In-Sem Exam :	30 Marks
		End Sem Exam:	50 Marks
Credits:	**3**	**Total:**	100 Marks

==========

Prerequisite Course: I.C. Engine, Basic mechanical Engineering, Kinematics of machines.

==========

Course Objectives :

1.To make the student conversant with fundamentals of automobile systems.

2. To demonstrate automobile steering systems, wheels and tyres.

3. To learn suspension and braking system of automobile

4. To develop competencies in performance analysis of vehicles.

5. To make the student conversant with automobile batteries and electrical system.

6. To understand the emerging trends of electric vehicles and hybrid electric vehicles.

Course Outcomes (COs): At the end of the course, learner will be able to

CO's	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Understand fundamentals of automobiles, types of chassis, material and load acting on chassis of automobile.	2	Understand
CO2	explain construction and working of wheels and steering system of automobile.	2	Understand
CO3	Compare different suspension and braking system of four wheeler.	3	Apply
CO4	Calculate vehicle performance by using performance curves.	4	Analyse
CO5	Discuss various batteries and electrical systems used in automobile.	3	Apply
CO6	Compare construction and working of electric and hybrid electric vehicle.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	-	-	2	-	-	1	2	2	-	-	2	-	-
CO3	3	-	-	-	2	-	-		2	2	-	1	2	-	-
CO4	3	2	-	2		-	-	2	-	-	-	1	2	-	-
CO5	3	-	-	-	2	-	1	-	2	2	-	1	2	-	-
CO6	3	-	2	-	-	3	2	-	2	2	2	2	2	-	-

Course Contents

Unit no.	Contents	No. of Hours	COs
1	**Introduction to automobile, Chassis and Frames**		
	Introduction to automobile: vehicle specifications and classification depending of different parameters like engine mount, number of wheels, weight carrying capacity, type of driving. **Chassis and Frames:** Types of chassis layout with reference to power plant locations and drive, various types of frames, constructional details, chassis material, chassis impact analysis.	6	CO1
2	**Tyre, Wheels and Steering System**		
	Wheels and Tyres: Wheel construction, alloy wheel, type of tyres, tyre construction, Tyre Terminology and specifications and selection of tyre. **Steering system:** Front axle, Wheel geometry, Wheel alignment and balancing, Steering geometry like Caster, camber, king pin inclination, Toe-in, Toe-out Steering linkages, Ackerman Steering system, Rack and Pinion and power steering	6	C02
3	**Suspension and Braking system**		
	Suspension System: Types of suspension linkages, types of suspension springs- leaf spring, type of leaf springs, self levelling suspension, shock absorbers. Air suspension. **Braking System**: disc & drum brakes, factors affecting braking, hydraulic, air brakes, Antilock Braking System, **Vehicle safety:** Types of active and passive safety, seat belt, Air bags.	6	C03

4	**Vehicle Performance and Maintenance**		
	Vehicle Performance: Parameters, vehicle resistances, traction and tractive effort, power requirement for propulsion, road performance curves (numericals) **Vehicle Maintenance:** Preventive maintenance, trouble shooting, servicing/overhauling of gear box, steering system, suspension system, break system	6	C04
5	**Batteries and Electric System**		
	Batteries: Principles and construction of lead-acid battery, rating capacity and efficiency of batteries, charging methods, introduction to lithium batteries. **Electric System:** Starting & Ignition system. Automotive lighting, Automotive sensors & actuators, Engine Management Control System (EMS).	6	C05
6	**Electric and Hybrid Electric Vehicle**		
	Electric Vehicle: Layout, construction and working of electric vehicle. Advantages, limitations of EV. **Hybrid electric vehicles:** Types, layout, hybridization factor, plug in hybrid electric vehicles Challenges and future scope of EVs and HEVs. Introduction to hydrogen fuel cell.	6	CO6

Text Books

Sr. No.	Title of Book	Authors	Publication House
1.	Automotive Mechanics	William H. Crous	Tata McGraw-Hill
2.	SAE Manuals and Standards		
3.	Automobile Electrical Equipment	P. S. Kohali	Tata McGraw Hill Publishing House.
4.	Automobile Engineering	Narang G. B. S	S. Chand and Company Ltd.
5.	Automobile Engineering	Dr. Kirpal Singh,	Standard Publishers distributors.

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1.	Automobile Engineering	R. B. Gupta,	Satya Prakashan.
2.	Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives	Chris Mi, M .Abul Masrur	Willey.
3.	Electric and hybrid vehicles	Husain, Iqbal	CRC Press.

Lab-I HVAC and HP Lab (ME 415)

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs./ Week	**PR Exam:**	50 Marks
Credits:	**1**	**Total:**	50 Marks

==========

Prerequisite Course: Basic Knowledge of Basic Thermodynamics and Heat Transfer

==========

Course Objectives:

1. Student should able to conduct test on vapour compression test rig
2. Student should able to conduct test on air conditioning test rig
3. Student should able to estimate cooling load of simple air conditioning system
4. To teach learners about selection different components used in hydraulic and pneumatic systems.
5. To teach learners about making of hydraulic and pneumatic circuits
6. To teach the learners electro-hydraulic and electro-pneumatics circuits.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Determine COP in vapor compression refrigeration cycle and ice plant	3	Apply
CO2	Determine psychrometric properties of air	3	Apply
CO3	Simulate heat load of the building using suitable software	3	Apply
CO4	Design an appropriate hydraulic circuit or electro-hydraulics for a given application	3	Analyze
CO5	Choose the appropriate component for Pneumatic applications	3	Analyze
CO6	Make hydraulic/pneumatic circuits using PLC	4	Apply

List of Practicals

Pr No	**Description**	No.of Hours	COs
1.	Trial on vapor compression test rig to determine COP	2	1
2.	Trial on air conditioning test rig	2	3
3.	Building heat load simulation using open source software.	2	3
4.	Trial on Ice plant to calculate COP	2	1
5.	Testing of vane pump	2	4
6.	Making following hydraulic circuits on hydraulic trainer a. Speed control circuit using metering in and metering out technique b. Regenerative and sequencing circuits. c. Extend-Retract and Stop system of a linear actuator d. Automatic reciprocation of linear hydraulic actuator using Electro Magnetic DCV	2	4
7.	Making following pneumatic circuits on pneumatic trainer a. Automatic reciprocating circuit b. Speed control circuit c. Pneumatic circuit involving shuttle valve/ quick exhaust valve d. Electro pneumatic valves and circuit	2	5
8.	Design of PLC based Pneumatic circuit for any suitable application	2	6

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	2	3	-	-	-	-	3
CO2	3	2	-	-	-	-	-	-	2	3	-	-	-	-	3
CO3	3	2	-	-	2	-	-	-	2	3	-	-	-	-	3
CO4	3	2	-	3	-	-	-	-	2	-	-	3	-	-	-
CO5	3	2	-	3	3	-	-	-	2	-	-	3	-	-	-
CO6	3	2	-	3	3	-	-	-	2	-	-	3	-	-	-

Text Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1	Refrigeration and Air conditioning	Arora, C.P	Tata-McGraw Hill	
2	Basic Refrigeration and Air Conditioning	P .N. Ananthanarayanan	McGraw Hill	
3	Refrigeration and Air conditioning	Manohar Prasad	New Age International	
4	Refrigeration and Air conditioning	R.S. Khurmi J.K. Gupta	Eurasia Publishing House (P) Ltd.	
5	Elementary Refrigeration and Air-conditioning	Stoecker, W.F., and Jones, J.W.,	McGraw Hill , 2002	
6	Heating, Ventilating and Air Conditioning: Analysis and Design	McQuiston, F.C., Parker, J.D. and Spitler, J.D.	6th edition, John Wiley & Sons, 2005	
7	Fundamentals of Pneumatics, Vol I, II and III. FESTO	FESTO Mannual	--	
8	Fluid Power Systems..	John Watton.	Prentice-Hall International (UK) Ltd.,1989	

Reference Books

Sr. No.	Title of Book	Authors	Publication House	Accession No
1.	2018 ASHRAE Handbook -Refrigeration	ASHRAE Technical Committees, Task Groups, and Technical Resource Groups	ASHRAE	ISBN 978-1-939200-98-3 ISSN 1930-7217
2.	2013 ASHRAE Handbook -Fundamentals	ASHRAE Technical Committees, Task Groups, and Technical Resource Groups	ASHRAE	ISBN 978-1-936504-46-6 ISSN 1523-7230
3.	Refrigeration and Air Conditioning	Langley, Billy C.	Engie wood Cliffs (N.J) Prentice Hall 1986.	
4.	Air Conditioning Engineering	Jones	Edward Amold pub. 2001	
5.	Thermal Environmental Engineering	J.L. Threlkeld	Prentice Hall, 1970.	

Dynamics of Machines Lab (ME 416)

Teaching Scheme		Examination Scheme	
Practical:	2 Hrs./ Week	OR Exam :	50 Marks
Credits:	1	Total:	50 Marks

==========

Prerequisite Course: Machine Design, Strength of Materials, and Applied Mechanics, Kinematics of Machines.

==========

Course Objectives:

1. Provide fundamentals of vibration and noise so that the students can solve real engineering problems and design engineering systems.
2. Make students able to prepare a mathematical model of the mechanical system in the form of spring, mass and damping elements.
3. Provide knowledge of solving multi degree of freedom problems using matrix method
4. Make aware about the instrumentation used for measurement of vibration and noise
5. Provide fundamentals of control of vibration and noise in machines
6. Analyse the vibration measurement signatures

Course Outcomes (COs): At the end of the course students will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Demonstrate the experimental verification of dynamic balancing and gyroscopic couple/governor/moment of inertia	3	Apply
CO2	Perform analysis of vibratory system to determine its natural frequency	3	Apply
CO3	Conduct measurement and analysis of vibration and noise for machines and equipment	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	-	-	1	2	2	-	2	2	-	-
CO2	3	2	3	2	2	2	-	2	2	2	-	2	3	-	-
CO3	3	3	2	2	2	2	-	2	2	2	-	2	2	-	-

List of experiments:

Pr. No	Description	CO
1.	Balancing of wheel / rotor on computerized balancing machine and experimental verification of dynamic balancing of rotating masses in different planes	CO1
2.	Verification of principle of gyroscope and determination of gyroscopic couple magnitude	CO1
3.	Determine the effect of varying mass on the centre of sleeve in Governor	CO1
4.	Determination of moment of Inertia by using compound pendulum method	CO1
5.	Determination of natural frequency of damped vibration of single degree freedom system and to find it‘s damping coefficient.	CO2
6.	Determination of critical speed of shaft with single rotor.	CO2
7.	Verification of natural frequency of torsional vibration of two rotor system and position of node	CO2
8.	Determination of natural frequency of transverse vibration of beam using vibration analyzer and using virtual lab.	CO3
9.	Measurement and analysis of noise using vibration analyzer.	CO3
10.	Simulation of free response of SDOF damped system to demonstrate different damping conditions using suitable software numerically.	CO2

At least eight experiments should be performed from the above list, any two from 1 to 4.

Text Books

Sr. No.	Title of Book	Authors	Publication House
1	Mechanical Vibrations	Grover G. K.	New Chand and Bros. , Roorke
2	Mechanical Vibrations	S. S. Rao	Pearson Education Inc. New Delhi.
3	Mechanical Vibrations	V. P. Singh	Dhanpat Rai and Co.
4	Vibration and Noise for Engineers	Kewal Pujara	Dhanpat Rai and Co.

Reference Books

Sr. No.	Title of Book	Authors	Publication House
1	Vibration of Mechanical System	Alok Sinha	Cambridge university Press , India
2	Vibration Problems in engineering.	Weaver	Wiley India Pvt. Ltd, New Delhi.
3	Mechanical Vibration	William J Palm III,	Wiley India Pvt. Ltd, New Delhi
4	Engineering Vibration	Daniel J. Inman	Pearson Education Inc.

Project Stage-II (ME417)

Teaching Scheme		Examination Scheme	
Practical:	8 Hrs / week	**Oral:**	--- 50
		Term Work:	--- 100
Credits:	4	**Total:**	--- 150

==========

Prerequisite Course: Project Based Learning, Internship/Mini Project, Project (Stage I)

==========

Course Objectives:

1. To provide an opportunity of designing and building complete system or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills.
3. To embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
4. To encourage creative thinking processes to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.
5. To get visibility in industry to Project and Project group

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Identify, formulate and solve engineering problems.		
CO2	Design, simulate, manufacture and test the Mechanical systems and finally make a prototype of a system		
CO3	Communicate effectively in both verbal and written forms.		
CO4	Develop confidence for self-education and ability for lifelong learning in individual and team		

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes

(PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	2	2	2	2	3	3	3	2	2	2
CO2	3	3	3	2	3	3	2	2	3	3	3	2	3	3	3
CO3	2	-	-	-	-	2	-	1	3	3	-	2	1	1	1
CO4	2	-	-	-	-	-	-	2	2	3	-	3	2	2	2

Course Contents

Extended part of Project Stage I

Guidelines for Project Execution

1. Refer Project stage I guidelines.

Term Work Evaluation

1. In Project Stage II, two reviews are to be taken for total 80 marks (40 marks each)
2. Review III shall be based on the approximate end of fabrication / design validation etc. in front of an expert panel from the department.
3. Review IV will be third party evaluation by Faculty/Student/Industry person/Alumni
4. Evaluation committee will consist of Guide, One Industry person and One Faculty appointed by the Institution.
5. Students shall be encouraged to publish a research paper/patent/technical note. Their credential shall be considered while term work evaluation.

Examination Scheme

1. Examination committee will consist of Guide, (Strictly) One Industry person and One Faculty appointed by the Institution.
2. Well in advance soft copies of the project shall be shared with examination committee.

Presentation of Project Work

Presentation of work in the form of Project Report (s), Understanding individual capacity, Role & involvement in the project, Team Work (Distribution of work, intrateam communication and togetherness), Participation in various contests, Publications and IPR, Manuals (Project Report, Quick reference, System, Installation guide) among other parameters. Team members with guide

information shall be added at the end of the report.

Project Report

1. The report shall be both side print hard bound. A hardbound report shall be made after examination and examiner and guide's expected correction, before that report must be loosely bound.
2. Plagiarism check is must, and certificate shall be attached in the report.
3. A group activity shall be presented in report.
4. Report copies shall be submitted in the department, one for university and one for supervisor.
5. For standardization of the project reports the following format shall be strictly followed.
    a. Page size: Trimmed A4
    b. Top Margin: 1.00 Inches
    c. Bottom Margin: 1.32 Inches
    d. Left Margin: 1.5 Inches
    e. Right Margin: 1.0 Inches
    f. Para Text: Times New Roman 12-point font
    g. Line Spacing: 1.15 Lines
    h. Page Numbers: Right aligned at footer. Font 12 point Times New Roman
    i. Headings: Times New Roman, 14 Points, Boldface 10.

Certificate

1. All students should attach a standard format of Certificate as described by the department.
2. Certificates should be awarded to project groups and not individual students of the group.
3. Certificates should have signatures of Guide, External Examiner, Head of Department and Principal.

Index of Report

1. Title Sheet
2. Certificate (Institution)
3. Certificate (Company, if sponsored by company)
4. Acknowledgement
5. Abstract of the Project
6. List of Figures
7. List of Photographs / Plates
8. List of Tables
9. Table of Contents
10. Introduction
11. Literature Survey / Theory
12. Design / Experimentation / Fabrication / Production / Actual work carried out for the same
13. Observation Results
14. Discussion on Result and Conclusion
15. Student and Guide details. (A common photograph with project)

Mandatory Learning Course (Learning an Art Form) (ME418)

Teaching Scheme **Examination Scheme**

Lectures: 1 Hr / Week
Credits: **Nil** **Total:** -NA-

==========

Prerequisite Course: -

==========

Course Objectives:

1. To develop an interest of students in the Learning and Art.
2. To acquire practical knowledge within the chosen category of Learning and Art form.
3. To acquire not just creative but also team collaboration and leadership skills from actively participating in the artforms of their interest.
4. To motivate students for participation and interaction in extra-curricular activities, events.

Course Outcomes (COs): At the end of the course, learner will be able to

COs	Course Outcomes	Blooms Taxonomy	
		Level	Descriptor
CO1	Discuss about ideas, thoughts and experiences, which leads to a lot of co-constructive experiential learning.	2	Understand
CO2	Apply knowledge gained from previous experience to participate in different events as well as extra-curricular activities	3	Apply
CO3	Create art and apply their artistic skills in day-to-day activities	6	Create
CO4	Develop visual art knowledge and skills and Habits of Mind	6	Create

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	2	-	1	3	1	-	1	-	-	-
CO2	-	-	-	-	-	2	-	1	3	1	-	1	-	-	-
CO3	-	-	-	-	-	2	-	1	3	1	-	1	-	-	-
CO4	-	-	-	-	-	2	-	1	3	1	-	1	-	-	-

Guidelines

1. Collect choices from students as per their interest (Minimum three choices).
2. Choices will be from below mentioned category.
   - **i) Music**- Song, Instrumental
   - **ii) Dance**
   - **iii) Art and Craft**
   - **iv) Sports**- Cricket, Holly ball, Kabaddi, Kho-Kho, Fencing.
   - **v) Yoga**
   - **vi) Collection of information of Historical Places (Survey)**
   - **vii) Rangoli, Mehndi**
   - **viii) Painting**
   - **ix) Short Videos**
   - **x) Skit or Drama**
   - **xi) Research Story Writing**
   - **xii) Blog writing**
3. After Collection of choices, students will be divided in groups which should consists minimum 30 and maximum 50.
4. Events will be conducted to participate students.
5. Certificates will be given to all participants.
6. It is mandatory to all students to participate minimum one and maximum three events.
7. If any student not participating any event, then he will be considered as fail in MLC 418 course.

References:

1. An Implementation Study of the Art in Action Program, Manuelito Biag, Erin Raab, and Mary Hofstedt, November 13, 2015,