SHIVAJI UNIVERSITY KOLHAPUR

REVISED SYLLABUS AND STRUCTURE

THIRD YEAR (B. Tech.)

MECHANICAL ENGINEERING

To be introduced from the academic year 2020-21 (i.e. from June 2020) onwards

First Year ENGINEERING – CBCS PATTERN

Sr. No	Course	TEACHING SCHEME									EXAMINATION SCHEME							
		THEORY			TUTORIAL			PRACTICAL			THEORY					PRACTICAL (Term wok)		
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Hours	Mode	Marks	Total Marks	%Min	Hours	Max	%Min
SEMESTER - I																		
1	BSC-P / BSC-C	3	3	3	-	-	-	1	2	2		CIE / ESE	30 / 70	100	40%	As per BOS Guidelines	25	40%
2	BSC-M-I	3	3	3	1	1	1	-	-	-		CIE / ESE	30 / 70	100	40%		25	40%
3	ESC	3	3	3	-	-	-	1	2	2		CIE / ESE	30 / 70	100	40%		25	40%
4	ESC	3	3	3	-	-	-	1	2	2		CIE / ESE	30 / 70	100	40%		25	40%
5	ESC	3	3	3	-	-	-	1	2	2		CIE / ESE	30 / 70	100	40%		25	40%
6	HM-I	1	1	1	-	-	-	1	2	2		-	-	-	-		25	40%
7	ESC-W-I	1	1	1	-	-	-	1	2	2		-	-	-	-		50	40%
	TOTAL	**17**	**17**	**17**	**1**	**1**	**1**	**6**	**12**	**12**				**500**			**200**	
SEMESTER –II																		
1	BSC-P / BSC-C	3	3	3	-	-	-	1	2	2		CIE / ESE	30 / 70	100	40%	As per BOS Guidelines	25	40%
2	BSC-M-II	3	3	3	1	1	1	-	-	-		CIE / ESE	30 / 70	100	40%		25	40%
3	ESC	3	3	3	-	-	-	1	2	2		CIE / ESE	30 / 70	100	40%		25	40%
4	ESC	3	3	3	-	-	-	1	2	2		CIE / ESE	30 / 70	100	40%		25	40%
5	ESC	3	3	3	-	-	-	1	2	2		CIE / ESE	30 / 70	100	40%		25	40%
6	HM-II	1	1	1	-	-	-	1	2	2		-	-	-	-		25	40%
7	ESC-W-II	1	1	1	-	-	-	1	2	2		-	-	-	-		50	40%
	TOTAL	**17**	**17**	**17**	**1**	**1**	**1**	**6**	**12**	**12**				**500**			**200**	
	TOTAL	**34**	**34**	**34**	**2**	**2**	**2**	**12**	**24**	**24**				**1000**			**400**	

CIE – Continuous Internal Evaluation
ESE – End Semester Examination

Note :

• Candidate contact hours per week : 30 Hours (Minimum)	• Total Marks for B.E. Sem I & II : **1400**
• Theory and Practical Lectures : 60 Minutes Each	• Total Credits for B.E.-I (Semester I & II) : **48**
• In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.	
• There shall be separate passing for theory and practical (term work) courses.	
A) Non-Credit Self Study Course : Compulsory Civic Courses (CCC) **For Sem I: CCC – I :** Democracy, Elections and Good Governance **(B) Non-Credit Self Study Course : Skill Development Courses (SDC)** **For Sem II: SDC – I :** Any one from following (i) to (v) i) Business Communication & Presentation ii) Event management iii) Personality Development, iv) Yoga & Physical Management v) Resume, Report & proposal writing	

1. **BSC** : Basic Science Courses are compulsory.
2. **HM :**Humanities and Management are compulsory.
3. **ESC :** Engineering Science Course **: ESC – P** courses (subjects) are mandatory for **Physics** group, while**ESC – C** courses (subjects) are mandatory for **Chemistry** group.
4. There will be two groups for Sem I & II Physics and Chemistry. The Candidate's those opting Physics group in Sem I shall appear for Chemistry group in Sem II and Vice-versa.
5. **ESC-W:** Engineering Science Course-Workshops are compulsory.

SECOND YEAR MECHANICAL ENGINEERING– CBCS PATTERN

Sr. No	Course (Subject Title)	TEACHING SCHEME									EXAMINATION SCHEME											
		THEORY			TUTORIAL			PRACTICAL			THEORY					PRACTICAL			TERM WORK		
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Hours	Mode	Marks	Total Marks	Min	Hours	Max	Min	Hours	Max	Min
SEMESTER - III																						
1	BSC-ME201	3	3	3	1	1	1	-	-	-		CIE	30	100	40	As per BOS Guidelines	-	-	2	25	10
												ESE	70								
2	BSC-ME202	3	3	3	-	-	-	1	2#	2#		CIE	30	100	40				2	25	10
												ESE	70								
3	PCC-ME203	3	3	3	-	-	-	1	2	2		CIE	30	100	40		25	10	2	25	10
												ESE	70								
4	PCC-ME204	3	3	3	-	-	-	1	2	2		CIE	30	100	40		25	10	2	25	10
												ESE	70								
5	PCC-ME205	3	3	3	-	-	-	1	2	2		CIE	30	100	40		25	10	2	25	10
												ESE	70								
6	PCC-ME206	-	-	-	-	-	-	1	2	2		-	-	-	-		-	-	2	25	10
7	PCC-ME207	-	-	-	-	-	-	1	2	2		-	-	-	-		-	-	-	25	10
8	PCC-ME208	-	-	-	-	-	-	1	2#	2#		-	-	-	-		-	-	-	25	10
9	MC-ME209	3	3	3	-	-	-	-	-	-		CIE	30	100	40		-	-	-	-	-
												ESE	70								
	TOTAL	**18**	**18**	**18**	**1**	**1**	**1**	**7**	**12**	**12**				**600**			**75**			**200**	
SEMESTER –IV																						
1	PCC-ME210	3	3	3	-	-	-	1	2	2		CIE	30	100	40	As per BOS Guidelines	-	-	2	25	10
												ESE	70								
2	PCC-ME211	3	3	3	-	-	-	1	2	2		CIE	30	100	40		-	-	2	25	10
												ESE	70								
3	PCC-ME212	3	3	3	-	-	-	1	2	2		CIE	30	100	40		25	10	2	25	10
												ESE	70								
4	PCC-ME213	3	3	3	-	-	-	1	2	2		CIE	30	100	40		-	-	2	25	10
												ESE	70								
5	PCC-ME214	4	4	4	-	-	-	-	-	-		CIE	30	100	40		-	-	-	-	-
												ESE	70								
6	PCC-ME215	-	-	-	-	-	-	1	2	2		-	-	-	-		25	10	2	25	10
7	PCC-	-	-	-	-	-	-	1	2	2		-	-	-	-		-	-	2	25	10

	ME216																							
8	PCC-ME217	-	-	-		-	-	-		1	2	2			-	-	-	-		-	-	2	25	10
9	PCC-ME218	-	-	-		-	-	-		1	2	2						-	-	25	10	2	25	10
	TOTAL	**16**	**16**	**16**		-	-	-		**8**	**16**	**16**					**500**			**75**			**200**	
	TOTAL	**34**	**34**	**34**		**1**	**1**	**1**		**16**	**28**	**28**					**1100**			**150**			**400**	

CIE- Continuous Internal Evaluation

ESE – End Semester Examination

• Candidate contact hours per week : 30 Hours (Minimum)	• Total Marks for S.E. Sem III & IV: **1650**
• Theory/Tutorial Duration : 60 Minutes and Practical Duration : 120 Minutes	• Total Credits for S.E. Sem III & IV : **50**
• In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.	
• There shall be separate passing for theory and practical (term work) courses.	

Note :

1. Basic Science Courses -Mechanical Engineering (BSC-ME) are compulsory.
2. Professional Core Courses-Mechanical Engineering (PCC-ME) are compulsory.
3. Mandatory Course (MC-ME)Environmental Studies which is compulsory for theory 70 marks and project work 30 marks.

COURSE CODE AND DEFINITION

Semester III

Sr. No	Code No.	Subject	Credits
1.	BSC-ME201	Engineering Mathematics - III	4
2.	PCC-ME202	*Electrical Technology	4
3.	PCC-ME203	Applied Thermodynamics	4
4.	PCC-ME204	Metallurgy	4
5.	PCC-ME205	Fluid Mechanics	4
6.	PCC-ME206	Machine Drawing	1
7.	PCC-ME207	*Computer Programming Using C++	1
8.	PCC-ME208	Workshop Practice – III	1
9.	MC-ME209	Environmental studies	3
		Total	26

Semester IV

Sr. No	Code No.	Subject	Credits
1.	BSC-ME210	Applied Numerical Methods	4
2.	PCC-ME211	Analysis of Mechanical Elements	4
3.	PCC-ME212	Fluid and Turbo Machinery	4
4.	PCC-ME213	Theory of Machines – I @	4
5.	PCC-ME214	Machine Tools and Processes	4
6.	PCC-ME215	Testing and Measurement	1
7.	PCC-ME216	Computer Aided Drafting	1
8.	PCC-ME217	Computer Graphics	1
9.	PCC-ME218	Workshop Practice – IV	1
		Total	24

THIRD YEAR MECHANICAL ENGINEERING – CBCS PATTERN

SEMESTER – V

Sr. No	Course (Subject Title)	TEACHING SCHEME									EXAMINATION SCHEME											
		THEORY			TUTORIAL			PRACTICAL			THEORY					PRACTICAL			TERM WORK		
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Hours	Mode	Marks	Total Marks	Min	Hours	Max	Min	Hours	Max	Min
1	PCC-ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40	As per BOS Guidelines			2	25	10
2	PCC-ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10
3	PCC-ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10
4	PCC-ME	3	3	3	1	1	1					CIE ESE	30 70	100	40				2	25	10
5	PCC-ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40				2	25	10
6	OEC-ME	3	3	3	-	-	-					CIE ESE	30 70	100	40				--	--	--
7	PCC-ME	-	-	-	-	-	-	1	2	2									2	25	10
8	PCC-ME	-	-	-	-	-	-	1	2	2									2	25	10
	TOTAL	**18**	**18**	**18**	**1**	**1**	**1**	**6**	**12**	**12**				**600**			**50**			**175**	

SEMESTER –VI

1	PCC-ME	3	3	3	1	1	1	-	-	-		CIE ESE	30 70	100	40	As per BOS Guidelines	-	-	2	25	10
2	PCC-ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		-	-	2	25	10
3	PCC-ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		-	-	2	25	10
4	PCC-ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10
5	PCC-ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10
6	OEC-ME	3	3	3	- -	- -	- -	-	-	-		CIE ESE	30 70	100	40		-	--	--	--	--
7	PCC-ME	-	-	-	-	-	-	1	2	2		-	-	-	-		-	-	2	25	10
8	PCC-ME	-	-	-	-	-	-	1	2	2		-	-	-	-	-	-	-	2	25	10
9	PCC-ME** (Audit Course)	-	1	1	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-

	TOTAL	**18**	**19**	**19**	**1**	**1**	**1**	**6**	**12**	**12**		**600**		**50**		**175**	
	TOTAL	**36**	**37**	**37**	**2**	**2**	**2**	**12**	**24**	**24**		**1200**		**100**		**350**	

CIE- Continuous Internal Evaluation

ESE – End Semester Examination

• Candidate contact hours per week : 30 Hours (Minimum)	• Total Marks for T.E. Sem V& VI:**1650**
• Theory/Tutorial Duration : 60 Minutes and Practical Duration : 120 Minutes	• Total Credits for T.E. Sem V & VI : **50**
• In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.	
• There shall be separate passing for theory and practical (term work) courses.	
• **Sem V &SemVI** :- Open Elective Course has 3 credits for one course. Each department / branch has to run at least one Open Elective Course in Sem-V and Sem-VI from the list of Elective Course. It is compulsory.	

Note :

1. Professional Core Courses-Mechanical Engineering (PCC-ME) are compulsory.
2. Open Elective Course- Mechanical Engineering (OEC-ME) is compulsory.
3. **PCC-ME**(Audit Course):- Students has to complete audit course as compulsory.**

Semester V

Sr. No	**Code No.**	**Subject**	**Credits**
1.	PCC-ME 301	Control Engineering	4
2.	PCC-ME 302	Theory of Machines – II	4
3.	PCC-ME 303	Heat and Mass Transfer	4
4.	PCC-ME 304	Machine Design – I	4
5.	PCC-ME 305	Manufacturing Engineering @	4
6.	OEC-ME 306	Open Elective-I	3
7.	PCC-ME 307	CAD/CAM Laboratory	1
8.	PCC-ME308	Workshop Practice – V	1
		Total	25

Semester VI

Sr. No	Code No.	Subject	Credits
1.	PCC-ME 311	Industrial Management and Operations Research	4
2.	PCC-ME 312	Industrial Fluid Power	4
3.	PCC-ME 313	Metrology and Quality Control	4
4.	PCC-ME 314	Machine Design – II	4
5.	PCC-ME 315	Internal Combustion Engines	4
6.	OEC-ME 316	Open Elective-II	3
7.	PCC-ME 317	Computer Integrated Manufacturing Lab	1
8.	PCC-ME318	Workshop Practice –VI	1
9.	**PCC-ME319** (Audit Course)**	**Professional Skill Development****	**--**
		Total	**25**

FINAL YEAR MECHANICAL ENGINEERING – CBCS PATTERN

Sr. No	Course (Subject Title)	TEACHING SCHEME									EXAMINATION SCHEME											
		THEORY			TUTORIAL			PRACTICAL			THEORY					PRACTICAL			TERM WORK		
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Hours	Mode	Marks	Total Marks	Min	Hours	Max	Min	Hours	Max	Min
SEMESTER –VII																					
1	PCC ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40	As per BOS Guidelines	25	10	2	25	10
2	PCC ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		-	-		25	10
3	PCC ME	3	3		-	-	-	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10
4	PCE ME	3	3	3	-		-	1	2	2		CIE ESE	30 70	100	40				2	25	10
5	PCE ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		-	-	2	25	10
6	PCC ME	-	-	-	-	-	-	1	2	2									2	25	10
7	SI ME	-	-	-				1	-	-		-	-	-	-		-	-	2	25	10
8	PW ME	-	-	-				3	6	6		-	-	-	-		25	10		25	10
	TOTAL	**15**	**15**	**15**				**10**	**18**	**18**				**500**			**75**			**200**	
SEMESTER –VIII																					
1	PCC ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40	As per BOS Guidelines	25	10	2	25	10
2	PCC ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10
3	PCC ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		-	-	2	25	10
4	PCE ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		-	-	2	25	10
5	PCE ME	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		-	-	2	25	10
6	PCC ME***	2	-	-	-	-	-	-	-	-		-	-	-					2	25	10
8	PW ME	-	-	-	-	-	-	3	6	6		-	-	-	-		25	10	6	50	20
	TOTAL	**17**	**15**	**15**				**8**	**16**	**16**				**500**			**75**			**200**	
	TOTAL	**32**	**30**	**30**				**18**	**34**	**34**				**1000**			**150**			**400**	

CIE- Continuous Internal Evaluation

ESE – End Semester Examination

• Candidate contact hours per week : 30 Hours (Minimum)	• Total Marks for B.E. Sem VII & VIII : **1550**
• Theory/Tutorial Duration : 60 Minutes and Practical Duration : 120 Minutes	• Total Credits for B.E. Sem VII & VIII : **50**
• In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.	
• There shall be separate passing for theory and practical (term work) courses.	

Note :

1. Professional Core Courses-Mechanical Engineering(PCC-ME) are compulsory.
2. Professional Core Electives -MechanicalEngineering (PCE-ME) are compulsory.
3. Summer Internship -Mechanical Engineering (SI-ME) is compulsory.
4. Project Work Mechanical Engineering (PW-ME) is compulsory.
5. **PCC-ME***- Online Certificate Course based on Project topic.**

Semester VII

Sr. No	Code No.	Subject	Credits
1.	PCC ME 401	Refrigeration and Air Conditioning	4
2.	PCC ME 402	Mechanical System Design	4
3.	PCC ME 403	Finite Element Analysis	4
4.	PCE ME 404	Elective I	4
5.	PCE ME 405	Elective II	4
6.	PCC ME 406	Seminar	1
7.	SI ME 406	Summer Internship @	1
8.	PW ME 407	Project Phase -I	3
		Total	25

Semester VIII

Sr. No	Code No.	Subject	Credits
1.	PCC ME 408	Mechatronics	4
2.	PCC ME 409	Energy and Power Engineering	4
3.	PCC ME 410	Noise and Vibration	4
4.	PCE ME 411	Elective III	4
5.	PCE ME 412	Elective IV	4
6.	**PCE ME413*** **	**Online Certificate Course**	**2**
7.	PW ME 414	Project Phase –II	3
		Total	25

SUBJECT NAME: Control Engineering

SUBJECT CODE: PCC-ME 301

Teaching Scheme:	**Examination Scheme:**
Lectures: 03Hrs.perweek	**ESE: 70Marks**
Practical: 02Hrs.perweek	**CIE: 30Marks**
Credit: 04	**Term Work: 25 Marks**

Pre-requisites: Electrical Technology, Engg. Mathematics

Course Objectives:

1.	Student should be able to understand control system, its types andapplications.
2.	Student should be able to model physicalsystem.
3.	Student should be able to determine system stability and systemresponse.
4.	Student should be able to use MATLAB software to analyze controlsystem

Course Outcomes: At the end of this course, student will be able

1.	To understand control system, its type andapplications
2.	To model physicalsystem.
3.	To determine system stability and systemresponse.
4.	To understand various controlactions.
5.	To use MATLAB software to analyze controlsystem

Unit 1	Introduction to Automatic Control	[6]
	Generalized feedback Control System, Types, Mathematical Model of Control System, Mechanical Translational Systems, Rotational System, Grounded Chair Representation, Electrical Elements, Analogous Systems, Force – Voltage Analog, Force – Current Analog,	

Unit 2	Representation of control system	[7]
	Linearization of non linear functions, Linearization of operating curves, Block Diagram Algebra, Rules for Reduction of Block Diagram.	

Unit 3	Transient Response	[7]
	General Form of Transfer Function, Concept of Poles and Zeros, Distinct,	

	Repeated and Complex Zeros. Response of systems (First and Second Order) to Various Inputs (Impulse, Step, Ramp & Sinusoidal). Damping Ratio and Natural Frequency, Transient Response Specification

Unit 4	Stability and Root Locus Technique:	[8]
	Routh's Stability Criteria, Significance of Root Locus, Construction of Root Loci, General Procedure, Effect of Poles and Zeros on the System Stability.	

Unit 5	Frequency Response Analysis	[7]
	Frequency Response Log Magnitude Plots and Phase angle Plots, Gain Margin, Phase Margin, Evaluation of Gain 'K'.	

Unit 6	State Space Analysis	[5]
	System Representation, Direct, Parallel, Series and General Programming.	

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1. Mathematical Model of Liquid Level System, Thermal System, Gear Train.
2. Study of Control System Components – Tachometer, Hydraulic Servomotor, Stepper Motor, Jet – Pipe Amplifier, Pneumatic Amplifier.
3. One numerical assignment on each unit.
4. Assignment based on use of Software 'MATLAB' on Unit 3,4,5,6.

REFERENCE BOOKS:

	Write Title of Book, Authors Name, Publication & Edition
1.	Control System Engineering: R Anandnatarajan, P. Ramesh Babu, SciTech Publi.
2.	Control Systems: A. Anand Kumar, Prentice Hall Publi.
3.	Automatic Control Engineering: F.H. Raven (5th ed.), Tata McGraw Hill Publi.
4.	Modern Control Systems: K Ogata, 3rd Ed, Prentice Hall Publi
5.	Automatic Control Systems: B.C. Kuo, 7th Ed, Willey India Ltd. / Prentice Hall Publi.
6.	Automatic Control Engineering: D. Roy and Choudhari, Orient Longman Publi. Calcutta
7.	Modern Control Engineering K. Ogata Pearson Education

SUBJECT NAME: Theory of Machines - II

SUBJECT CODE: PCC-ME 302

Teaching Scheme:	**Examination Scheme:**
Lectures: 3Hrs.perweek	**ESE: 70Marks**
Practical: 2Hrs.perweek	**CIE: 30Marks**
Credit: 04	**Term Work: 25 Marks**
	Practical/Oral : 25 Marks

Course Objectives:

1.	understand the basic theory on gears.
2.	analyze the various types of gear trains used for transmission of motion and power.
3.	study the gyroscopic effect on different vehicles, aero plane and ship.
4.	study and analyze the problems on balancing of rotary masses.
5.	study the force analysis of simple mechanisms.
6.	study turning moment diagram.

Course Outcomes: At the end of this course, student will be able to

1.	Identify the various types of gears.
2.	Select a gear drive for practical purpose.
3.	Analyze the gyroscopic effects for practical life.
4.	Solve a balancing problem.
5.	Do the balancing of practical devices to reduce vibration.
6.	Do force analysis of mechanisms.

Unit 1	**Toothed Gearing:**	**[07]**
	Geometry of motion, Gear geometry, Types of gear profile- Involute & cycloidal, Theory of Spur gear, Interference in Involute tooth gears and methods for its prevention, Path of contact, Contact ratio.	

Unit 2	**Gear Trains**	**[07]**
	Types of Gear trains - Simple, Compound, Reverted, Epicyclic gear train, Tabular method for finding the speeds of elements in epicyclic gear train, Torque in epicyclic gear train, Differential gear box.	

Unit 3	**Gyroscope**	**[06]**
	Gyroscopic couple, spinning and Precessional Motion, Gyroscopic couple and its effect on i) Aero plane ii) Ship iii) Four-Wheeler iv) Two –Wheeler.	

Unit 4	**Static and dynamic Force analysis of Mechanisms**	**[07]**
	Velocity and acceleration of slider crank mechanism by analytical method, Inertia force and torque, D'Alembert's principle, Dynamically equivalent system, force analysis of reciprocating engine mechanism and four bar chain mechanism.	

Unit 5	**Balancing**	**[07]**
	Static and Dynamic balancing of rotary masses. Number of masses rotating in single plane and different planes.	

Unit 6	**Flywheel**	**[06]**
	Turning moment diagrams, Fluctuation of energy, Coefficient of fluctuation of speed, Rimmed flywheel	

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Any nine of following

1. Generation of involute profile using rack cutter method.
2. Experiment on Torque Measurement in epicyclical Gear Train.
3. Experiment on Gyroscope.
4. Determination of M.I. using bifilar suspension system.
5. Determination of M.I. using Trifilar Suspension system.
6. Experiment on Balancing of rotary masses (Static and Dynamic).
7. Problems on balancing of reciprocating masses. (Minimum 3)
8. Determination of M.I. of connecting rod by Compound pendulum method.
9. Assignment on Flywheel.
10. Computer aided force analysis of any one of following
    a. Slider crank mechanism
    b. Four bar mechanism

TEXT BOOKS:

1.	Theory of Machines by Rattan S.S. (Tata McGraw Hill)
2.	Mechanism and Machine Theory by Rao, Dukkipati, New Age International.
3.	Theory of Machines by Dr. V.P.Singh, Dhanpat Rai Publications
4.	Theory of Machines by Sadhu Singh ((Pearson, Edition 3rd)
5.	Theory of Machines by Ballaney, Khanna Publications.

REFERENCE BOOKS:

1.	Theory of Machines & Mechanisms by Shigley (Tata McGraw Hill)
2.	Theory of machines by Thomas Beven (Pearson, Edition 3rd)
3.	Theory of Machines by Jagdishlal, Metropolitan Publi.
4.	Mechanisms and Dynamics of machines by J.Srinivas (SciTech Publications)
5.	Kinematics, Dynamics and Design of Machinery by Walidron, Wiley India Publi.

SUBJECT NAME: Heat & Mass Transfer

SUBJECT CODE: PCC-ME 303

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 Hrs. per week	**ESE: 70 Marks**
Practical: 02 Hrs. per week	**CIE: 30 Marks**
Credit: 04	**Term Work: 25 Marks**
	Practical/Oral: 25 Marks

Pre-requisites: Fluid Mechanics, Basic Thermodynamics, Engineering Mathematics

Course Objectives:

1.	Studentswilllearnaboutwhatisheattransfer, what are the modes of heat transfer and their basic laws, and analysis of heat transfer problems in conduction, convection, radiation and combined modes.
2.	Theywillalsolearngeneral ordifferential equations for conduction and radiation as well as governing equations of convection so that students can solve real time heat transfer problem.
3.	Studentswilllearnabout design and analysis of heat exchanger devices by using LMTD and NTU approach.

Course Outcomes: At the end of this course, student will be able to

1.	Formulate basic equations for heat transferproblems.
2.	Applyheattransferprinciplestodesignandevaluateperformanceofthermal systems.
3.	Calculate the effectiveness and ratingof heat exchangers.
4.	Calculate heat transfer byradiation between objects withsimple geometries.
5.	Calculateandevaluatetheimpactofboundary conditionsonthesolutionsof heat transfer problems.
6.	Evaluate the relative contributions of different modes of heat transfer.

Unit 1	**IntroductiontoHeatandMassTransfer**	**[10]**
	Basic concepts: Modesofheattransfer,Basiclawsofheattransfer,Introductiontocombinedmodesofheat transfer,Thermalconductivityanditsvariationwithtemperatureforvarious Engg.Materials (Descriptiononly),Introductiontomasstransfer,Modesofmasstransfer, Analogy betweenheat,massandmomentumtransfer,Fick'slawofdiffusion, Derivation ofGeneralized differential equation of heat conduction in Cartesian co-ordinates, itsreductiontoFourier,LaplaceandPoisson'sequations,GeneralizedHeatconduction equationin cylindricaland spherical coordinates (noderivation). **One dimensional steady state heat conduction without heat generation:**ReductionofGeneralizeddifferentialequationofHeatConductiontoonedimension(1D), Heatconductionthroughplanewall;cylinder;sphere,electricalanalogy,conceptofthermal resistance andconductance,compositeslab,compositecylinderandcompositesphere,critical radiusof insulation for cylinderand sphere.	

Unit 2	**HeatConductionwithHeatGenerationandUnsteadyStateHeatConduction**	**[06]**
	Onedimensionalsteadystateheatconductionwithheatgeneration: Onedimensionalsteadystateheatconductionwithuniformheatgenerationforplanewall; cylinder; and sphere (with numerical on plane wall and cylinder) **Onedimensionalunsteadystateheatconduction:** LumpedHeatcapacity Analysis,BiotandFouriernumberandtheirsignificance,(Numerical basedonLumpedHeatcapacityAnalysis)	

Unit 3	**ExtendedSurfaces**	**[06]**
	Typesandapplicationsoffins,Heattransferfromrectangularandpinfins.Fineffectiveness and efficiency, Analysis of fin with insulated end and infinite long fin, Error estimation intemperaturemeasurement inthermo well (No numerical on error estimation).	

Unit 4	**Convection**	**[06]**
	Mechanismofnaturalandforcedconvection.ConceptofHydrodynamicandthermal boundarylayer,Localandaverageconvectivecoefficientforlaminarandturbulentflowfor flat plate and pipe. **Natural convection:** Dimensionalanalysis,Physicalsignificanceofdimensionlessnumbers,correlationsfor natural convectionover vertical plate,cylinder, & sphereandflow patterns. **Forced convection:** Dimensional analysis, Physicalsignificance ofdimensionless numbers, Reynoldsanalogy for laminar flow, Correlations for forced convection overflat plateand closedconduits.	

Unit 5	**Radiation**	**[06]**
	Natureofthermalradiation,absorptivity,reflectivity,transmissivity,emissivepowerand emissivity, spectral and total concept,blackbody,graybody,andwhitebodyKirchhoff'slaw, Wein'slawandPlanck'slaw,anddeductionofStefanBoltzmannlaw.Lambertcosinerule, Intensityofradiation. Energyexchangebyradiationbetweentwoblacksurfaceswithnon-absorbingmediuminbetweenandinabsenceofreradiatingsurfaces.Shapefactorandits characteristics. Energ yexchangebyradiationbetweentwograysurfaceswithoutabsorbing medium, conceptofradiosityandirradiation.Radiationnetworkmethod,networkfortwo surfaces which seeeachother and nothingelse, radiation shields.	

Unit 6	**HeatExchangers & Phase change phenomenon**	**[06]**
	Heat Exchangers: Classificationandtypesof heatexchangers,Foulingfactor,andOverallheattransfer coefficient,HeatExchangeranalysisusingLMTDandNTUmethodsforparalleland counterflow,DesignconsiderationofHeatexchangersandintroductiontodesignstandards like TEMA, **Boiling & Condensation:**	

Typesofboiling,Poolboilingandforcedconvectionboiling,Film wise and drop wise condensation.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Any8 Experiments based on followinglist.

1. Determination of thermalconductivityofinsulatingpowder.
2. Determination of thermalconductivityof aMetalrod
3. DeterminationofthermalresistanceandtemperaturedistributioninaComposite wall.
4. Determination of thermal conductivityofinsulatingmaterial inLagged pipe.
5. DeterminationoflocalandaverageheattransfercoefficientinNaturalconvection heattransferfromavertical cylinder.
6. DeterminationofHeatTransferCoefficientunderforcedconvectiontoairthrough pipe.
7. Determination of emissivityof aNonblack surface.
8. Determination of Stefan Boltzmann Constant.
9. DeterminationofoverallheattransfercoefficientandeffectivenessinaParallel Flow and Counter flow Heat Exchanger.
10. Studyand Demonstration of Heat Pipe
11. Determination of heat transfer coefficient in dropwise and film-wise condensation.
12. Determination of Critical Heat Flux.

TEXT BOOKS:

1.	"HeatandMassTransfer",R.K.Rajput,S.ChandandCompanyLtd.,NewDelhi., 5th Edition
2.	"HeatTransfer",J.P.Holman,TataMcGrawHillBookCompany,New York,2nd Edition
3.	"Fundamentals of Heat and Mass Transfer",R.C.Sachdeva, WilleyEasternLtd., New York, 2nd Edition
4.	"Heat and Mass transfer", M.M.Rathod, Laxmi Publications

REFERENCE BOOKS:

1.	. “Heat Transfer– A Practical approach”,Yunus. A .Cengel, Tata McGraw Hill
2.	“Heat Transfer” Chapman A.J., Tata McGraw HillBook Company, NewYork
3.	“FundamentalsofHeatandMassTransfer”,FrankP.Incropera,DavidP.Dewitt,WisleyIndia. 5^{th}Edition
4.	“ATextBookonHeatTransfer”,Dr.S.P.Sukhatme,OrientLongmanPublication Hyderabad
5.	“HeatandMassTransfer”,S.C.AroraandS.Domkundwar,DhanpatRaiandSons, Delhi

SUBJECT NAME: Machine Design-I

SUBJECT CODE:PCC-ME304

Teaching Scheme:	**Examination Scheme:**
Lectures: 03Hrs.perweek	**ESE: 70Marks**
Tutorial: 01Hrs.perweek	**CIE: 30Marks**
Credit: 04	**Term Work: 25 Marks**
	Practical/Oral : 00 Marks

Pre-requisites:

Elementary knowledge of Mechanics, Mathematics and Science.

Course Objectives:

1.	Study basic principles of machine design.
2.	Understand the principles involved in evaluating the dimensions of a component to satisfy functional and strength requirements.
3.	Learn use of catalogues and design data book.

Course Outcomes: At the end of this course, student will be able to

1.	Apply basic principles of machine design
2.	Design machine elements on the basis of strength concept.
3.	Use design data books and standard practices.
4.	Select machine elements from Manufacturer's catalogue.

Unit 1	**Fundamentals of Machine Design**	**[05]**
	Concept of Machine design, Types of loads, Factor of safety- its selection and significance, Theories of failure(Maximum Principle stress, Maximum shear stress and Maximum Distortion Energy), Phases of design of machine elements, Review and selection of various engineering material properties and I.S. coding for ferrous materials, Factors governing selection of Engineering materials.	

Unit 2	**Design of Mechanical Elements**	**[09]**
	a) Design of machine elements under static loading- Knuckle joint, Turn buckle and bell crank Lever. (Numerical on Knuckle Joint and Bell crank Lever). b) Forms of threads, Terminology of threads, Trapezoidal and Acme thread, Design of power screw and nuts, Introduction to Recirculating ball Screw. (Numerical on Power Screw with Square thread).	

Unit 3	**Design of Shaft, Keys, and Couplings**	**[06]**
	Design of solid and hollow shafts, splined shafts, ASME code for shaft design, Types and Design of Keys, Types of Couplings, Rigid Coupling, flexible bushed pin type flanged coupling.	

Unit 4	**Design of Joints**	**[08]**
	Design of bolted joints subjected to following conditions- 1) Joints in shear 2) joints subjected to load perpendicular to the axis of bolt. Design of welded joints- 1) Strength of transverse and parallel fillet welds 2) Eccentric load in the plane of weld 3) Welded joint subjected to bending moment. Riveted Joint (Theoretical treatment only).	

Unit 5	**Design of springs**	**[06]**
	Types of springs and their applications, Styles of end, Design of Helical Compression Spring subjected to static loading.	

Unit 6	**Design of Pulley and Selection of Belts**	**[06]**
	Design of Pulley- flat and V belt pulley, Selection of flat belt, V belt as per the standard manufacturer's catalogue, Introduction to timing belts.	

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1) Case study of components (include selection of materials for various components showing their IS codes, composition and properties).

2) Design and Drawing of Knuckle joint.

3) Design and Drawing of flexible bushed pin type flanged coupling.

4) Case study each joint.

5) Design of helical compression spring subjected to static load.

6) Selection of Belts as per the manufacturer's catalogue.

NOTE:

1) A detail report of design procedure calculation and sketches should be submitted along with drawing Sheet containing details and assembly.

2) All the assignments should be solved by using standard design procedure using design data book such as PSG Design Data Book.

TEXT BOOKS:

1.	"Design of Machine Elements", V.B.Bhandari., Tata McGraw Hill Publication, 3rd Edition.
2.	"A Text Book of Machine Design", R.S. Khurmi and J.K.Gupta.
3.	"Machine Design A Basic Approach", Dr. S.S.wadhwa S S Jolly Dhanapat Rai and Sons.
4.	"Machine Design", U.C.Jindal, Pearson Education.
5.	"Machine Design", Pandya Shah, Charotar Publication.

REFERENCE BOOKS:

1.	"Design of Machine Element", J.F. Shigley, Tata McGraw Hill Publication.
2.	"Design of Machine Element" M.F.Spotts, Pearson Education Publication, 6th Edition.
3.	PSG Design data Book.
4.	"Machine Component Design",Robert C. Juvniall, Willey Ltd, 5th Edition.

SUBJECT NAME: Manufacturing Engineering

SUBJECT CODE:PCC-ME305

Teaching Scheme:	**Examination Scheme:**
Lectures: 03Hrs.perweek	**ESE: 70Marks**
Practical: 02Hrs.perweek	**CIE: 30Marks**
Credit: 04	**Term Work: 25 Marks**

Pre-requisites: Machine Tools Processes

Course Objectives:

1.	Study of metal cutting technology including the process, measurements.
2.	Design and selection of various cutting tools and their industrial specifications
3.	Study of Geometry of various cutting tools.
4.	Introduce the students to design practices of toolings (Jigs and Fixtures)
5.	Study of various press working tools
6.	Study of various aspects of CNC machine technology and its tooling.

Course Outcomes: At the end of this course, student will be able to

1.	Understand various metal cutting technology including the process and measurement etc.
2.	Identify and select proper cutting tool with respect to work piece materials
3.	Identify parameters of single and multipoint cutting tools.
4.	Design and Draw Jig and Fixture.
5.	Select and design dies for press working operations.
6.	Understand and apply CNC Technology

Unit 1	**Theory of Metal Cutting**	**[06]**
	Wedge action, Concept of speed, Feed and depth of cut, orthogonal and oblique cutting. Mechanics of metal cutting-Chip formation, Types of chips, cutting ratio, shear plane and shear angle, velocity relationships, force measurement by tool dynamometers.	

Unit 2	**Tool Life and Tool geometry**	**[06]**
	Cutting tool materials and their properties, Advanced cutting tools. Machinability of Metals- Factors affecting, improvement and machinability index. Tool life - Types of wear, relationship with cutting parameters, Taylor's equation, improvement measures. Surface finish- Factors affecting, effect of cutting parameters, improvements. Heat generation in machining, its effect on cutting force, tool life and surface finish, types and selection criteria of cutting fluids.	

Unit 3	Tool geometry	**[04]**
	Tool geometry Parts, angles and types of single point cutting tools, tool geometry of single point cutting tool, tool geometry of multipoint cutting tools.-drills, milling cutters, reamers.	

Unit 4	**Drilling Jigs and Milling Fixtures**	**[12]**
	Applications, basic elements, principles and types of locating, clamping and indexing elements, auxiliary elements like tenon, setting block etc. Type of Drilling jigs and Milling fixtures-Design consideration of Jigs and fixtures with respect to different operations.	

Unit 5	**Press Tools**	**[06]**
	Dies, punches, types of presses, clearances, types of dies, strip layout, calculation of press capacity, center of pressure, Design consideration for die elements (Theoretical treatment only). Problems on Blanking and Piercing operations	

Unit 6	**CNC Technology and Tooling**	**[06]**
	CNC Technology and CNC tooling: Introduction, Construction and working of CNC, DNC and machining center. CNC axes and drives. Automatic Tool Changer (ATC) and Automatic pallet changer (APC) New trends in Tool Materials, Turning tool geometry, Tool inserts (coated and uncoated), Modular tooling system for Turning.	

	Milling tooling systems, Tools presetting, Work holding

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1) Study of Theory of metal Cutting
2) Study of cutting Tools (Tool Life, Tool Materials etc.)
3) Study of Tool Geometry (Single and Multipoint cutting Tools)
4) Design and drawing of any one Drilling jig.
5) Design and drawing of any one Milling fixture.
6) Assignment on Press Tools (Numerical Based)
7) Study and Demonstration of tools used in CNC machining.
8) Industrial visit to study jig and fixtures, sheet metal.

TEXT BOOKS:

1.	"Elements of Workshop Technology Vol. II", S. K Hajra Choudhury , Media Promoters and Publishers, Mumbai.
2.	"Text Book of Production Engineering", P.C. Sharma, S. Chand Publication, 11th Edition.
3.	"Machine Tool Engineering" G.R. Nagarpal, Khanna Publication.
4.	"Principles of Modern Manufacturing", Groover, Wiley Publication., 5th Edition.

REFERENCE BOOKS:

1.	"Production Technology", HMT –Tata McGraw-Hill Publishing Ltd,. ISBN, 0070964432, 9780070964433., (2001).
2.	"Metal Cutting Theory and Tool design" Mr. Arshinnov, MIR Publication.
3.	"Fundamentals of Tool Design" ASTME,Prentice-Hall of India Private Ltd., New Delhi Publication, (1976).
4.	"Tool Design", Donaldson,THM Publication, 3rd Edition.
5.	"Machine Tool Engineering", G.R. Nagarpal, Khanna Publication.
6.	"Theory of Metal Cutting", Sen and Bhattacharya, New Central Book Agency, (1965).
7.	"Production Engg. Design (Tool Design)", S. Chandar and K. Surendra, Satya

	Prakashan, Delhi.
8.	"Jigs and Fixtures", Kempster ,ELBS.
9.	"Metal Cutting and Machine Tools", Thirupati Reddy, Scitech Publication, 1st Edition.

SUBJECT NAME: Enterprise Resource Planning

SUBJECT CODE:OEC-ME 306

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 Hrs.perweek	**ESE: 70Marks**
Practical: --	**CIE: 30Marks**
Credit: 03	

Pre-requisites:

Course Objectives:

1.	Know the basics, evolution , importance of ERP
2.	Correlate ERP and related technology
3.	Understand manufacturing perspectives of ERP
4.	Know business modules of ERP
5.	Understand the key implementation issues and some popular products in ERP
6.	Understand implementation of ERP package

Course Outcomes: At the end of this course, student will be able to

1.	Understand the structure of an ERP system and know how process chains in Materialsmanagement, production, controlling and sales are implemented in an ERP system
2.	Implementation and customize an ERP system using the appropriate modeling methods,that are Entity Relationship Modeling (ERM) and Event-Driven Process Chains (EPC)
3.	Understand the customization of an ERP system and customize essential parts of materials management, production, controlling and sales in SAP ECC
4.	Understand software design issues in state-of-the-art business software and realize theimportance of project management in an ERP implementation project
5.	Understand what to expect, and not to expect, from a consultant implementing an ERPsystem
6.	Understand the importance of IT governance in long-term relationships with a

softwarevendor, such as SAP

Unit 1	**Introduction to ERP**	**[05]**
	Introduction, Evolution, Reasons for the growth of ERP market, Advantages, Reasons for failure of ERP. Benefits of ERP-Reduction of lead time, On time shipment, Reduction in cycle time, Improved resource utilization, Better customer satisfaction, Input supplier performance,Increased flexibility.	

Unit 2	**ERP and Related Technologies**	**[06]**
	Data warehousing, Data mining, OLAP, Business Process Reengineering (BPR), Management Information System (MIS), Supply Chain Management (SCM), Decision Support System (DSS),Executive Information System (EIS),Customer relationship management (CRM)	

Unit 3	**A Manufacturing Perspective**	**[03]**
	CAD/CAM, MRP, MRP II, Distribution Requirement Planning (DRP), Product Data Management (PDM).	

Unit 4	**ERP Modules**	**[05]**
	Introduction and study of Business modules like Finance, Mfg. and Production, HR, Plantmaintenance, Quality and Material Management, Sales and Distribution.	

Unit 5	**ERP Implementation Life Cycle**	**[05]**
	Introduction, Pre-evaluation Screening, Package evaluation, Project planning, Gap Analysis, Reengineering, Configuration, Team training, Testing, End user training and Post-implementation phases, Expanding ERP boundaries, Service oriented architecture, Enterprises application integration.	

Unit 6	**ERP Market and Case Studies**	**[04]**
	Brief account of ERP market, various ERP packages like SAPAG, Oracle, PeopleSoft, etc. Indian scenario for ERP implementation, Case studies based on implementation of ERP for various areas in mfg., Marketing and other businesses, E-commerce, cloud based ERP system.	

TEXT BOOKS:

1.	"Enterprise Resource Planning", Alexis Leon, Tata McGraw Hill Publication, ISBN 0-07-463712-6.
2.	"Enterprise Resource Planning", Bret Wagner, Delmar Learning, International Edition, ISBN 10: 1439081085, ISBN–13: 978-1439081082.
3.	"Enterprises Resource Planning", Venkateshswara, Scitech Publication.
4.	"Entrepreneurship",Chris Boulton, Patric Turner, Willey India.
5.	"Management Information System",S. Sadagopan, PHI, New Delhi, 2nd Edition.

REFERENCE BOOKS:

1.	"Modern ERP: Select Implement and Use", Marianne Bradford, Hand M Books, ISBN: 978-0-557-01291-6.
2.	"Enterprises Resource Planning", E.F. Monk, B.J. Wagner, Cengage Learning.
3.	"Enterprises Resource Planning", A. R Singla, Cengage Learning.
4.	"Enterprises Resource Planning-Concepts and Practices", Vinod Kumar Garg and Venkitakrishnan N. K. , PHI, New Delhi.

SUBJECT NAME: Optimization Techniques

SUBJECT CODE: OEC-ME 306

Teaching Scheme:	**Examination Scheme:**
Lectures: 03Hrs.perweek	**ESE: 70Marks**
Practical: 00Hrs.perweek	**CIE: 30Marks**
Credit: 03	**Term Work: --**

Pre-requisites: Engg. Mathematics

Course Objectives:

1.	To Provide students with the basic mathematical concepts of optimization. .
2.	To Provide students with the modeling skills necessary to describe and formulate optimization problems
3.	To Provide students with the skills necessary to solve and interpret optimization problems in engineering
4.	To Enhance students' skills related to optimization in engineering, open-ended problem solving, critical thinking and life-long learning

Course Outcomes: At the end of this course, student will be able

1.	To understand importance of optimization of industrial process management
2.	To apply basic concepts of mathematics to formulate an optimization problem
3.	To analyse and appreciate variety of performance measures for various optimization problems
4.	To recognition of the need for, and an ability to engage in life-long learning

Unit 1	Introduction	04
	Concept of optimization – classification of optimization – problems.	

Unit 2	Linear Programming	09
	Examples of linear programming problems –formulation simplex methods variable with upper bounds –principle-duality -dual simplex method -sensitivity analysis – revised simplex procedure –solution of the transportation problem –assignment – network minimization –shortest route problem –maximal two problem –L.P. representation of networks.	

Unit 3	Queuing Theory	07
	Queuing Model, poison and exponential distributions -Queues with combined arrivals and departures-random and series queues.	

Unit 4	Unconstrained Optimization	07
	Maximization and minimization of convex functions. Necessary and sufficient conditions for local minima – speed and order of convegence – unibariate search – steepest and desent methods- metcher reeves method -conjugate gradient method.	

Unit 5	Constrained Optimization	07
	Necessary and sufficient condition – equality constraints, inequality constraints - kuhu – tucker conditions – gradient projection method – penalty function methods – cutting plane methods of sibel directions.	

Unit 6	Dynamic Programming	06
	Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution – examples illustrating the tabular method of solution.	

TEXT BOOK(S)

1.	Rao S.S,"Optimization – Theory and applications", Wiley Easter Ltd., 1979.
2.	Operations Research by NVR Naidu, G Rajendra, T Krishna Rao, I K International Publishing house, New Delhi.
3.	Operations Research: An Introduction by H A Taha, 5th Edition, Macmillan, New York

REFERENCE BOOKS:

1.	David G.Luerbeggan, "Introduction to Linear and Non Linear Programming", Addison Wesley Publishing Co. 1973.
2.	Hadley G. "Nonlinear and – dynamic programming" Addison Wesley Publishing Co. 1964.
3.	Cordan C.C. Beveridge and Robert S. Schedther, "Optimization, Theory and Practice" McGraw Hill Co.1970.
4.	D. Bertsekas Nonlinear programming, 2nd Edition, Athena Scientific, 1999, Nashua.
5.	A. Ruszczynski, Nonlinear optimization, 2006, Princeton University Press, Princeton

SUBJECT NAME:CAD CAM Laboratory

SUBJECT CODE:PCC-ME307

Teaching Scheme:	**Examination Scheme:**
Practical: 02Hrsperweek	**Term Work: 25Marks**
Credit: 01	

Course Objectives:The course aims to:

5.	UnderstandParametric Modeling Fundamentals and Procedure
6.	Developan ability to create constrained 2-D Sketches.
7.	Create Solid Models of machine components.
8.	Create assembly model with drafting.
9.	Create solid models using surfacing technique.
10	UnderstandComputer Aided Manufacturing.

Course Outcomes: At the end of this course, student will be able to:

6.	Understand and read engineering Drawings.
7.	Prepare solid and surface models from 2D drawings.
8.	Prepare assemblies and BOM.
9.	Conversion of 3D Models into orthographic views.
10	Know the process of CAD data exchange between the software.
11	Understand the basics of Computer Aided Manufacturing.

Unit 1	**Introduction to CAD**	**04**
	1. Introduction to CAD 2. Introduction to graphical user interface (GUI) 3. Application and modification of contents and dimensions 4. Introduction to different CAD software	

Unit 2	**3D and Surface Modeling**	**10**
	1. Generation of 2D and 3D models with the help of various toolbars and	

	commands for industrial based product. 2. Introduction to commands in surface modeling.

Unit 3	Assembly and drafting	08
	1. Introduction to Assembly modeling. 2. Top down and Bottom up method of assembly. 3. Creation of exploded view, ballooning & BOM. 4. Drafting and GD & T	

Unit 4	Introduction to CAM	02
	1. Introduction to CAM 2. Various CAM Software to generate Tool path	

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1. Solid Modeling- Four exercises (Print outs on A4 size sheet)
2. Surface modeling-Two exercises (Print outs on A4 size sheet)
3. Drafting-Two exercises (Print outs on A4 size sheet)
4. Assembly (with Minimum 5 components) (Print outs on A3 size sheet)

TEXT BOOKS:

1.	"CAD/CAM- Principals and Applications", P.N. Rao, Tata McGraw Hill, 2nd Edition.
2.	"CAD/CAM/CAE",N.K.Chougule, SciTech Publication, Revised Edition.

REFERENCE BOOKS:

1.	CAD/CAM by M.P.Grover. and E.W.Zimmer, Prentice Hall of India Pvt. Ltd.
2.	CATIA V5R20 for Engineers and Designers, Prof.ShyamTickoo andDeepak Maini,DreamTech Press.

3.	CAD/CAM/CIM, Radhakrishnan, Subramanyam, Raju (2nd Ed.), New Age International Publishers.
4.	Respective Software manuals.
5.	CAD/CAM/CAE Chougule N.K SCITECH PUBLICATION.

SUBJECT NAME: WORKSHOP PRACTICE – V

SUBJECT CODE: PCC-ME308

Teaching Scheme:	**Examination Scheme:**
Lectures: 00Hrs. per week	**ESE: 00 Marks**
Practical: 02 Hrs. per week	**CIE: 00 Marks**
Credit: 01	**Term Work: 25 Marks**

Course Objectives:

	The course aims to:
1	Understand and perform the various machining operations.
2	Implement principles of metrology.
3	Design the sequence of various processes required to manufacture the components.

Course Outcomes: At the end of this course, student will be able to

1	Select the suitable machining operations and prepare process sheet to manufacture a Component and implement the same.
2	Control key dimensions on a component using principles of metrology and assembly To make any one assembly / sub – assembly comprising of minimum three components in Workshop Practice V and Workshop Practice VI

	Syllabus To make any one assembly / sub – assembly comprising of minimum three components in Workshop Practice V and Workshop Practice VI **A.** To prepare process sheets with working drawings of all components. **B.** To manufacture the components as per the drawing requiring following operations i) Turning, ii) Facing iii) Step turning iv) taper turning v)knurling vi)threading vii) Drilling **C**. A visit report based on the industrial visit to study the following machining processes i) Broaching, ii) Slotting iii) Grinding iv) Milling	-

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Assignments

Write any three assignments out of following.

1. Study and demonstration of Lathe machine.
2. Study and demonstration of grinding machine.
3. Study and demonstration of drilling machine.
4. Study of Broaching machine. (Theoretical treatment only.)

TEXT BOOKS:

1.	1. “Workshop Technology Vol. II”, Raghuvanshi
2.	2. “Workshop Technology Vol. II”, Hajara Choudhary, Media Promoters and Publishers, Mumbai

REFERENCE BOOKS:

3.	1. “Production Technology”, P. C. Sharma, S. Chand Publication ,11th Edition.
4.	2. “Production Technology”, HMT handbook
5.	3. “Workshop Practice Manual”,V. Venkata Reddy, 6th edition

T.Y.B.TECH (MECHANICAL ENGINEERING) Semester-VI

SUBJECT NAME: Industrial Management and Operations Research

SUBJECT CODE: PCC-ME 311

Teaching Scheme:	**Examination Scheme:**
Lectures: 03Hrs.perweek	**ESE: 70Marks**
Tutorial: 01Hrs.perweek	**CIE: 30Marks**
Credit: 04	**Term Work: 25 Marks**

Pre-requisites:

Course Objectives:

1	State various functions of management.
2	Know Production and marketing functional area of management.
3	Aware about norms of SSI, Industrial safety, MIS.
4	Apply Various Models of Operation Research Such as Linear Programming Model, Assignment Model, Transportation Model, Network Model and Sequencing Model.

Course Outcomes: At the end of this course, student will be able to

1	Apply the concepts of Industrial management and operations research approaches. Know various functional areas of management.
2	They will analyses issues in Managing operations and projects and various approaches to resolve those issues.
3	Formulate and solve a wide variety of applications and problems that can be addressed using Operations Research techniques as Linear programming problems.
4	Formulate and solve a wide variety of applications and problems that can be addressed using Operations Research techniques as Transportation and Assignment problems.
5	Apply the various techniques of Project Management such as Network Model and Sequencing Model.

Unit 1	Functions of Management	[8]
	Definition of Management, Planning –Objectives, Steps in Planning, elements of planning, Organizing – Process of Organizing importance and principle of organizing, departmentation, Span of control. Staffing – Nature, Purpose, Scope, Human resource management, Policies, Recruitment procedure, training and development, appraisal methods. Leading – Leadership style, Communication process, Barriers, remedies, Motivation, importance Herzberg's theory, Maslow's theory, McGregor's theory . Controlling–Process, Requirement for control management	

Unit 2	Functional areas of Management	[7]
	Production Management-Product mix, line balancing, break even analysis, Material Handling Equipments, TPM, Problem solving Techniques. Marketing Management –Principles & Functions, Types of Market, Market Research, Market Segmentation, Marketing Mix, Advertisement, Channel Of Distribution.	

Unit 3	Entrepreneurship Development	[5]
	Types of small scale industries (SSI), stages in starting SSI, Qualities required to be Entrepreneur, Government policies for SSI, Problems of SSI, Feasibility Report writing, Industrial Safety, Management Information System.	

Unit 4	Introduction to Operations Research and Linear Programming Problems	[6]
	History and development of OR, Applications, OR models and their Applications, Formulation of LPP problem, Graphical solution of LPP, Simplex procedure for maximization, Simplex procedure for minimization, Duality concept.	

Unit 5	Assignment Model and transportation model	[7]
	Assignment Model- Mathematical statement, Methods to solve balanced assignment problems, Unbalanced assignment problems, Maximization problems, Assignment with restrictions. Transportation model- Mathematical formulation, methods to obtain initial basic feasible solution (IBFS)- NWCR ,LCM and VAM, Conditions for testing optimality, MODI method for testing optimality of solution of balanced problems and unbalanced problems	

Unit 6	Network model and sequencing	[7]
	CPM-Construction of network, Critical path, forward and backward Path, Floats and their significance. PERT- construction of networks, Time estimates, Probability of completing project by given date. Sequencing-Sequencing of n jobs & 2 machines, Sequencing of n jobs & 3 machines	

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Term Work: case studies on:
1) Recruitment procedure
2) Market Research/Market Segmentation
3) MIS
4) Office communication
5) Line Balancing.

Content Assessment Tool
1. Case studies on above topic

2. Case studies on above topic
3. Case studies on above topic
4. Formulation of LPP and Graphical Solution, Assignment on Maximization and Minimization problems using Simplex Method.
5. Assignment on Assignment Problems, Assignment on Transportation Problems.
6. Assignment on Sequencing Problems, Development of PERT/CPM Network for any live project involving at least seven activities

TEXT BOOKS:

1.	"Industrial Engineering and Management", Vishwanath ,Scitech Publication,1st Edition.
2.	"Industrial Management and Operation Research", NandkumarHukeri, Electrotech Publication.
3.	"Operations Research", J. K. Sharma, McMillan India Publication New Delhi,5th Edition
4.	"Operations Research", Hira and Gupta, S.Chand and Co. New Delhi.
5.	"Operation Research an Introduction", Hamdy A. Taha, Pearson,10 th Edition

REFERENCE BOOKS:

1.	"Management, Today – Principles and Practice", Gene Burton and Manab Thakur, Tata McGraw Hill Publishing Company, New Delhi.
2.	"Essentials of Management", Koontz and H.Weinrich, Tata McGraw Hill Publication, 12th Edition.
3.	"Business Management", J.P.Bose, S. Talukdar, New Central Agencies (P) Ltd.,
4.	"Production and Operation Management", Tripathy, Scitech Publication, 2nd Edition.
5.	"Management", James A.F. Stoner, R. Edward Freeman, Prentice Hall of India New Delhi.
6.	"Introduction to Operation Research", Paneer-Selvam, Prentice Hall of India publication, 2nd Edition.
7.	"Operation Research", Pradeep J. Jha, Tata McGraw Hill Publication.
8.	"Operation Research", Mariappan, Pearson Education.
9.	"Operation Research – Principle and Applications", G.Shriniwasan, Prentice Hall of India Publication, 3rd Edition.

SUBJECT NAME: Industrial Fluid Power

SUBJECT CODE: PCC-ME 312

Teaching Scheme:	**Examination Scheme:**
Lectures: 03Hrs.perweek	**ESE: 70Marks**
Practical: 02Hrs.perweek	**CIE: 30Marks**
Credit: 04	**Term Work: 25 Marks**

Pre-requisites:
Basic Mechanical Engineering,Fluid power, Manufacturing Processes.

Course Objectives:

1.	To impart knowledge about the fundamentals ofHydraulic and pneumatic system
2.	To prepare the students to study different pumps and compressors in hydraulic and pneumatic system.
3.	To educate the students about hydraulic fluidsandcharacteristics of fluids.
4.	To impart knowledge about various control valves and its functions
5.	To enable the students to design components of Hydraulic and pneumatic system

Course Outcomes: At the end of this course, student will be able to

1.	Do analysis of performance of Hydraulic and pneumatic system
2.	Demonstrate Hydraulic and pneumatic system
3.	Apply Hydraulic and pneumatic system fundamentals to industrial applications
4.	Demonstrate knowledge about the fundamentals of Hydraulic and pneumatic system

Unit 1	**Introduction to Fluid Power**	**[08]**
	a) Classification, general features, applications in various fields of engineering, various hydraulic and pneumatic ISO/JIC Symbols, transmission of power at static and dynamic states, advantages and disadvantages b) Principle of hydraulic system, Types of hydraulic fluids and their properties, selection of fluid, effect of temperature on fluids c) Introduction and Application of pneumatics, Physical properties, Principles, basic Requirement of pneumatic system, comparison with hydraulic system.	

Unit 2	**Hydraulic System Elements**	**[08]**
	a) Classification, types of seals, sealing material, pipes, hoses, compatibility of seal withfluid, sources of contamination and its control, strainer, filter, heat- exchanger, reservoir. b) Pumps-types, selection of pumps from Gear, vane, piston, screw, ball pump etc. forvarious applications. c) Actuators-linear and rotary, hydraulic motors, types of hydraulic cylinders and theirmountings. d) Accumulators, intensifier and their applications.	

Unit 3	**Control of Fluid Power Elements**	**[08]**
	a) Requirements of Pressure control, direction control and flow control valves. b) Principle of pressure control valves, directly operated and pilot operated pressurerelief valve, pressure reducing valve, sequence valves, counter balance valve. c) Principles and Types of direction Control valves-2/2, 3/2, 4/2, 4/3, 5/2. Open center, close center, tandem center, manual operated, mechanical operated solenoid, pilot operated direction control valves, check valves. d) Principles of flow control valves, temperature compensated, pressure compensated, temperature and pressure compensated flow control valve. e) Hydraulic servo system for linear and rotary motion.	

Unit 4	**Elements of Pneumatic System**	**[08]**
	a) Air compressor- Types, selection criteria, capacity control, piping layout, fitting andconnectors, Pneumatic controls, Direction control valves (two way, three way, fourway), check valves, flow control valves, pressure control valves, speed regulators,quick exhaust valves, time delay valve, shuttle valve and twin pressure valve. Solenoidoperated, pilot operated valves, Pneumatic actuators, Rotary and reciprocatingcylinders–types and their mountings, Air motor – types, Comparison with hydraulicand electric motor. b) Serving of compressed air – types of filters, regulators, lubricators (FRL unit), mufflers, dryers. c) Maintenance ,troubleshooting and safety of hydraulic and pneumatic system.	

Unit 5	**Hydraulic Circuits and its Application**	**[04]**
	i. Speed control circuits – Meter-in, Meter-out, Bleed off, Regenerative, Fast approach and slow traverse. ii. Sequence circuits – Travel dependent and Pressure dependent iii. Synchronizing circuit. iv. Regenerative circuit.	

Unit 6	**Pneumatic Circuits and its Application**.	**[04]**
	i. Speed control circuits ii. Impulse operation circuit. iii. Sequence circuits. iv. Time delay circuit.	

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1. Study and Demonstration of basic hydraulic and pneumatic system.
2. Study and Demonstration of ISO/JIC Symbols for hydraulic and pneumatic systems.
3. Study and Demonstration of different types of valves used in hydraulic and pneumatic system.
4. Study and Demonstration of accumulators/actuators/intensifiers/hydraulic and pneumatic power brakes.
5. At least five circuit preparations on hydraulic trainer kit.
6. At least five circuit preparations on pneumatic trainer kit.
7. At least two Circuit preparations using Fluid Simulation Software.
8. Industrial visits are recommended for applications of pneumatic and hydraulic system and their reports.

TEXT BOOKS:

1.	"Oil hydraulics Systems", S. R. Mujumdar, Tata McGraw Hill Publication.
2.	"Pneumatic Systems", S. R. Mujumdar- Tata McGraw Hill Publication.
3.	"Industrial Fluid Power",D. S. Pawaskar, Nishant Prakashan.
4.	"Hydraulics and Pneumatics", Shaikh and Khan, R.K. Publication
5.	. "Fluid Power with Application", Esposito, Pearson Education, 7th Edition.

REFERENCE BOOKS:

1.	"Industrial Fluid Power", S.S. Kuber, NiraliPrakashan, 3rd Edition.
2.	"Hydraulic and Pneumatic", H.L.Stewart, Industrial Press.
3.	"Industrial Hydraulic", J. J. Pipenger, Tata McGraw Hill.
4.	"Power Hydraulics", Goodwin 1st Edition.
5.	"Introduction to Hydraulic and Pneumatics",S. Ilango and V Soundararajan, Prentice Hall of India, 2nd Edition.

SUBJECT NAME: Metrology and Quality Control

SUBJECT CODE: PCC-ME 313

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 Hrs.perweek	**ESE: 70 Marks**
Practical: 02 Hrs.perweek	**CIE: 30 Marks**
Credit: 04	**Term Work: 25 Marks**

Pre-requisites: Machine Drawing.

Course Objectives:

1.	Understand the use of standards in measurement, gauges and tolerances
2.	Understand the principle/s, construction, working and use of comparators and angle measuring instruments.
3.	Study the advanced methods in metrology and measurement of surface roughness
4.	Study the methods used for the measurement of screw threads and gears.
5.	Understand the concept of quality control and SQC techniques.
6.	Apply knowledge of measuring instruments in actual industry practice.

Course Outcomes: At the end of this course, student will be able to

1.	Identify and use various measuring instruments and select appropriate instrument for particular feature measurement.
2.	Distinguish and understand quality assurance and quality control. They can use control charts and sampling plans to manufacturing and service sector problems.
3.	Learn advanced techniques of metrology in various industrial applications.
4.	Prepare and understand drawings with general dimensions, tolerances and surface finish.

Unit 1	**Linear measurement and Limits fits and tolerances.**	**[08]**
	Need of measurement, International standards of length, line and end measurement, errors in measurement, slip gauges. Importance of limits system in mass production, IS specifications of limits, Unilateral and bilateral tolerances, Types of Fits, Design of gauges (Numerical treatment).	

Unit 2	**Compactors and Angle Measurement**	**[06]**
	Classification of Comparator, Mechanical comparator (dial indicator, Sigma and Johansson mikrokator. Pneumatic comparator (Solex and differential), Bevel	

	protractor, sine bar, sine center,clinometers. Use of angle dekkor, auto collimator for straightness and flatness measurement.

Unit 3	**Advancements in Metrology and surface roughness**	**[07]**
	Introduction & applications of: Coordinate Measuring Machine, use of Laser in Metrology, machine vision system. Principle of interferometry and application for checking flatness. Surface roughness terminology, Direction of lay, textures, symbols, Numerical assessment of surface roughness, Instruments used in surface roughness assessment (Tomlinson and Talysurf surface testers).	

Unit 4	**Metrology of Screw Threads and Gears**	**[07]**
	Different errors in screw threads, Measurement of forms of thread with profile projector, Pitch measurement, Measurement of thread diameters with standard wire, screw thread micrometer. Errors in gears, Measurement of Spur Gears, Run out checking, Pitch measurement, Profile checking, Backlash checking, Tooth thickness measurement.	

Unit 5	**Quality Control**	**[06]**
	Concept of Quality, Quality control and quality assurance, Specification of quality, Factors controlling quality of design and conformance, Cost of quality, Balance between cost and quality and value of quality, Seven QC tools.	

Unit 6	**Statistical Quality Control and Acceptance Sampling**	**[06]**
	Importance of statistical method in quality control, ND curve, Different types of control charts (Numerical treatment on X Bar, R, P and C charts), their constructions and applications, process capability. Basic concept of sampling inspection, Single and double sampling plans, Operating characteristic curves.	

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Minimum eight experiments/assignments from the following list including quality control should be performed.

1) Study and use of Linear Measuring Instruments.
2) Study and Use of Comparators (practical use of pneumatic/Mechanical comparator).
3) Study and Use of Angle Measuring Instruments.
4) Screw Thread Measurement.
5) Spur Gear Measurement.
6) Study and use of Optical Flat.
7) Use of Tool Makers Microscope.
8) Use of Optical Profile Projector.
9) Assignment on Control Charts.
10) Industrial case study on geometric features by using industrial component drawing.

TEXT BOOKS:

1.	"Engineering Metrology", I.C. Gupta, Dhanpat Rai Publications.
2.	"Engineering Metrology", R.K.Jain, Khanna Publisher.
3.	"Engineering Metrology", M. Mahajan, Dhanpat Rai and Sons.
4.	"Engineering Metrology and Measurements", N.V.Raghvendra and L. Krishnamurthy Oxford University Press.

REFERENCE BOOKS:

1.	"Practical Engineering Metrology", Sharp K.W.B. Pitman, London.
2.	"Statistical Quality Control", A.L. Grant, Tata McGraw Hill International, New York. 6th Edition.
3.	"Metrology", Taher ELBS.
4.	"Statistical Quality Control", R.C. Gupta,9th Edition.
5.	I.S. 919/1963.
6.	I.S. 2709/1964.
7.	"Engineering Metrology", Hume K.G., MC Donald, Technical and Scientific, London ,2nd Edition.
8.	"Quality Control and Indl Statistics", Duncon A.J., D.B. Taraporevela and Co. Bombay.
9.	"Fundamentals of Quality Control and Improvement", Amitva Mitra, 3rd Edition.
10.	"Statistical Quality Control", Douglas Montgomery, Wiley India Pvt. Ltd., 6th Edition.
11.	"Statistical Quality Control",E. L. Grant, R. S. Levenworth,5th Edition .
12.	"Quality Control", D.H. Besterfield Pearson Education Sections,7th Edition.
13.	"Metrology and Measurements", A.K.Bewoor, Tata Mc Graw Hill Publication.

SUBJECT NAME: Machine Design-II

SUBJECT CODE: PCC-ME314

Teaching Scheme:	**Examination Scheme:**
Lectures:03Hrs.perweek	**ESE: 70Marks**
Practical:02Hrs.perweek	**CIE: 30Marks**
Credit: 04	**Term Work: 25 Marks**
	Practical/Oral: 25 Marks

Pre-requisites:

Elementary knowledge of Mechanics, Mathematics and science, Machine Design-I

Course Objectives:

1.	Design machine elements subjected to fluctuating loading.
2.	Study effect of wear considerations and their relevance to design.
3.	Study and select rolling contact bearings used for mechanical systems.
4.	Design hydrodynamic bearing using Raimondi and Boyd's method and heat balance.
5.	Design various types of gears using strength and wear considerations.

Course Outcomes: At the end of this course, student will be able to

1.	Design machine elements subjected to fluctuating loading
2.	Understand effect of tribological considerations on design
3.	Select rolling contact bearings from manufacturer's catalogue.
4.	Design sliding contact bearings used in various mechanical systems
5.	Design various types of gears such as spur, helical, bevel and worm gear

Unit 1	**Design for Fluctuating Loads**	**[06]**
	Stress concentration - causes and remedies, Fluctuating stresses, S-N. diagram under fatigue load, Endurance limit, Notch sensitivity, Endurance strength- modifying factors, Design for finite and infinite life under reversed stresses, Cumulative damage in fatigue failure, Goodman diagram, Modified Goodman diagram, Fatigue design for components under combined stresses such as shafts, Thin pressure vessels, Beams subjected to point loads etc.	

Unit 2	**Design of Rolling Contact Bearings**	**[07]**

	Rolling Contact Bearing: Types, Static and dynamic load capacities, Steinbeck's equation**(No Derivation),** Equivalent bearing load, Load-life relationship, Bearing life, Load factor, Selection of bearing from manufactures catalogue, Ball and Roller bearing, Design for variable load and speed, Bearings with probability of survival other than 90 %. Lubrication and mountings, Dismounting and preloading of bearings, Oil seal and packing.

Unit 3	**Design of Sliding Contact Bearings**	**[06]**
	i. Introduction to Tribological consideration in design Friction, Wear, Lubrication. ii. Sliding Contact Bearing: Bearing material and their properties: Sintered bearing materials, bearing types and their construction details. iii. Hydro-Dynamic Lubrication: Basic theory, Thick and thin film lubrication, Reynolds's equation (**No Derivation)**, Sommerfield Number, Design consideration in hydrodynamic bearings, Raimondi and Boyd method relating bearing variables, Heat balance in journal bearings, Temperature rise	

Unit 4	**Design of Spur Gear**	**[07]**
	a) Introduction to Gears: Gear terminology, Material selection, Types of gear failure. **b) Spur Gear**: Tooth loads, No. of teeth, Face width, Strength of gear teeth, Static beam strength (Lewis equation) Barth equation, Dynamic tooth load (spot's equation and Buckingham equation), Wear strength (Buckingham's equation), Estimation of module based on beam strength and wear strength. Gear design for maximum power transmission capacity, Methods of gear lubrication.	

Unit 5	**Design of Helical and Bevel Gears**	**[09]**
	a) Helical Gears: Formative number of teeth in helical gears, Force analysis, Beam and wear strength of helical gears, Effective load and design of helical gear. **b) Bevel Gear:** Straight tooth bevel gear terminology and geometrical relations, Guidelines for selection of dimensions and minimum number of teeth, Force analysis, Mounting of bevel gear and bearing reactions, Beam and wear strength, Dynamic tooth load, Design of straight tooth bevel gears based on beam and wear strength.	

Unit 6	**Design of Worm Gears**	**[05]**
	Terminology and geometrical relations. Standard dimensions and recommendation of worm gearing, Force analysis, Friction, Efficiency of worm gear drive, Design of	

worm drive as per IS 7443-1974 based on beam strength and wear strength rating, Thermal consideration in worm drive

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Note: Reference to Design Data Book is mandatory

Term Work:

A) Total two design project

A detail design report and two sheets containing working drawing of details and assembly

i) Spur gear/ Helical gear.

ii) Bevel gear / Worm and Worm Wheel.

B) Assignments based on

- Study of Ball bearing mountings and its selection preloading of bearings.
- Industrial visit based on above syllabus (Optional).
- Construction of gears such as hub, web, arm, rim type etc.Design considerations of gear box.

TEXT BOOKS:

1.	"Design of Machine Elements", V.B.Bhandari., Tata McGraw Hill Publication, 3rd Edition.
2.	"Machine Design", R.K.Jain, Khanna Publication.
3.	"Machine Design A Basic Approach", Dr. S.S.wadhwa S S Jolly Dhanapat Rai and Sons.
4.	"Machine Design", U.C.Jindal, Pearson Education.
5.	"A Text Book of Machine Design", R.S. Khurmi and J.K.Gupta.

REFERENCE BOOKS:

1.	"Design of Machine Element", J.F. Shigley, Tata McGraw Hill Publication.
2.	"Design of Machine Element" M.F.Spotts, Pearson Education Publication, 6th Edition.
3.	PSG Design data Book
4.	"Machine Component Design",Robert C. Juvniall, Willey Ltd, 5th Edition.
5.	"Machine Design", Black and Adams ,Tata McGraw Hill International.
6.	PSG Design Data Book
7.	Bearing Manufacturers Catalogue.

SUBJECT NAME: Internal Combustion Engines

SUBJECT CODE:PCC-ME315

Teaching Scheme:	**Examination Scheme:**
Lectures:03 Hrs Per Week	**ESE: 70Marks**
Practical:02Hrs.perweek	**CIE: 30Marks**
Credit: 04	**Term Work: 25Marks**
	Practical/Oral : 25 Marks

Pre-requisites: Basic Mechanical Engineering,Applied Thermodynamics, Heat & Mass Transfer

Course Objectives: The course aims to

1.	Study constructional details and various types of internal combustionengine.
2.	Understand and analyze thermodynamic cycles of ICengines.
3.	Understand combustion phenomenon in SI engine and CIengines.
4.	Impart knowledge about various systems on the ICengines.
5.	Impart knowledge about various engine performance characteristics and itstesting.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1.	Demonstrate engine construction, function of various parts of theengine and classify I.C.Engines.
2.	Demonstrate combustionmechanism.
3.	Demonstrate importance and functions of various systems on theengine.
4.	Demonstrate need and methods of enginetesting.
5.	Understand the impact of vehicular pollution and ways to reduce or control thepollution.

Unit 1	**Introduction to I.C. Engines**	**06**
	Introduction: Classification of I. C. Engines, applications, Selection of IC Engine for different applications, Engine specifications **Engine Cycles:** Engine cycles (Carnot, Otto, Diesel), Only numericals on Air standard cycles (Otto and Diesel cycles only), Deviation of actual cycles from air standard cycles, Valve timing diagram for high and low speed engine, Port timing diagram.	

Unit 2	**Fuel Systems for SI and CI Engines**	**08**
	Engine fuel requirements, complete carburetor, Derivation for calculation of A/F ratio, Calculation of main dimensions of carburetors (Only Approximate analysis numericals), Effect of altitude on Air fuel ratio. Electronic Petrol injection system (MPFI) – components such as sensors, ECU etc., merits and demerits Fuel Systems for C.I. Engines: Requirements of injection system, Types of injection systems – Individual pump, Common rail and Distributor systems, Unit injector, Types of fuel nozzles- single hole, multi hole, pintle, and pintaux, Formation of Spray, Atomization and penetration, Electronic diesel injection system. Calculations of main dimension of fuel injection system of diesel engine.	

Unit 3	**Combustion in S. I. Engines**	**06**
	Stages of combustion, Ignition lag, Flame propagation, Factors affecting flame speed, Abnormal combustion, Influence of engine design and operating variables on detonation, Fuel rating, Octane number, Fuel additives, HUCR, Requirements of combustion chambers of S.I. Engines and itstypes.	

Unit 4	**Combustion in C.I. Engines**	**06**
	Stages of combustion, Delay period, Factors affecting delay period, Abnormal combustion- Diesel knock, Influence of engine design and operating variables on diesel knock, Comparison of abnormal combustion in S.I. and C.I. Engines, Cetane number, Additives. Requirements of combustion chambers for C.I. Engines and its types	

Unit 5	**Performance Testing of Engines**	**06**
	Performance parameters, Measurement of performance parameters like torque, power, Volumetric Efficiency, Mechanical Efficiency, BSFC, Brake and Indicated Thermal efficiencies. Numerical on Heat Balance Sheet and engine performance, Performance curves.	

Unit 6	**Engine Emission and Control**	**08**
	Introduction to Supercharging and Turbo-charging, S.I. engine emission (HC, CO, NOx) Control methods- Evaporative (ELCD), Thermal, Catalytic converters, C.I. Engines Emission (CO, NOx, Smog, Particulate), Control methods- Chemical, EGR, Standard pollution Norms like EURO, Bharat, Introduction to alternative fuels for I.C. engines.	

Practicals:

Study group:-

1. Constructional detail of I.C. engines, dismantling andassembly.

2. Study and Demonstration of Engine systems: Air intake, Exhaust, Cooling, Lubrication systems.
3. Study and Demonstration of Ignition systems, startingsystems.
4. Study and Demonstration of Carburetor and Petrol injectionsystem
5. Study and Demonstration of fuel injection system of dieselengine.

Test group:- (Any Five)

1. Test on four stroke DieselEngine.
2. Test on four stroke PetrolEngine.
3. Test on two stroke Petrol Engine. (Variable SpeedTest)
4. Morse Test on Multi CylinderEngine
5. Visit to an engine manufacturing company / repairingunit
6. Test on computer controlled I.C. Engine
7. Test on variable compression ratio engine
8. Visit PUC centre and submit PUC certificate photocopy of your own vehicle.
9. Visit to Fuel Injection Pump testing unit for calibration of FIP and submit report.

TEXT BOOKS:

1.	Ganesan. V. , "Internal Combustion Engines", Tata McGraw Hill
2.	Mathur & Sharma, "A Course in Internal Combustion Engines", R. P. Dhanapat Rai Publications.
3.	"Internal Combustion Engines", Domkundwar, Dhanpat RaiPublication.
4.	"Internal Combustion Engines",Ramlingam, SciTech Publication.

REFERENCE BOOKS:

1.	"Internal Combustion Engines",Maleev, CBS Publication andDistributors.
2.	"Internal Combustion Engines", J. B. Heywood,Tata McGraw Hill Publication.
3.	"Internal Combustion Engines",Gills and Smith , Oxford and IBH PublishingCompany
4.	"Diesel and High Compression Gas Engines", P. M.Kates.
5.	"Internal Combustion Engines Fundamentals", E. F. Obert, Harper and Row Publication ,New York
6.	"Engineering Fundamentals of the I.C.Engines", W.W.Pulkrabek , PearsonEducation
7.	Crouse W.H., "Automotive Mechanics", McGraw Hill

SUBJECT NAME: Computer Aided Design and Manufacturing

SUBJECT CODE: OEC-ME 316

Teaching Scheme:	**Examination Scheme:**
Lectures: 03Hrs.perweek	**ESE: 70Marks**
Practical: 00Hrs.perweek	**CIE: 30Marks**
Credit: 03	**Term Work: --**

Pre-requisites: NA

Course Objectives:

1.	To Provide basic foundation in computer aided design / manufacturing
2.	To Understand the fundamentals used to create and manipulate geometric models
3.	To Get acquainted with the basic CAD software designed for geometric modeling
4.	To Learn working principles of NC machines CNC control and part programming

Course Outcomes: At the end of this course, student will be able

1.	To Compare and Represent 2-D and 3-D entities
2.	To Apply transform techniques on 2-D and 3-D entities
3.	To Examine CNC program for production of components
4.	To Express the principles and methods of Rapid Prototyping

Unit 1	**Fundamentals of CAD/CAM**	04
	Product cycle and scope of CAD/CAM/CIM in product cycle, Features of CAD/CAM Hardware and software, selection of software. CAD workstation configurations	

Unit 2	**Representation of Curves and surfaces**	08
	Introduction to Analytic Curves, Synthetic Curves: Hermite Cubic Spline, Bezier Curve, B-Spline curve. Surface Representation: Synthetic Surfaces	

Unit 3	**Solid Modeling**	08

	2D Vs 3D modeling, Comparison of Wireframe, surface and solid modeling techniques, Geometry Vs Topology, Requirements of Solid Modeling, Solid Modeling Methods: Constructive Solid Geometry (CSG), Boundary Representation (B-rep), etc.

Unit 4	**Geometric Transformation**	06
	2D geometric transformations, Homogeneous co-ordinate representation, Composite transformations, 3D transformations, Inverse transformations, geometric mapping	

Unit 5	**Computer Numerical Control and Part Programming**	09
	Introduction to NC/CNC/DNC machines, Classification of NC systems, Axis nomenclature, Interpolation, features of CNC controllers, Types of CNC machines,Construction features of CNC machines, Manual Part Programming, , NC word format, Details of G and M codes, Canned cycles, subroutines and Do loops, Tool radius and length compensations	

Unit 6	**Rapid Prototyping and Manufacturing**	05
	Introduction to Rapid Prototyping, rapid tooling and rapid manufacturing. Process of rapid prototyping. Different techniques of Rapid prototyping and their applications	

Text Books:

1.	IbrahimZeid ,CAD/CAM Theory and Practice, Tata McGraw-Hill Publishing Company Ltd., New Delhi,2012
2.	Dacid F. Rogers, J Alan Adams, Mathematical Elements for Computer Graphics, McGraw-Hill publishing Company Ltd.,2001
3.	Chougule N.K., CAD/CAM/CAE, Scitech Publications Ltd, 2017

Reference Books:

1.	M.E. Mortenson, Geometric Modelling , Wiley, 2016
2.	Bedworth, Wolfe & Henderson Computer Aided Design & Manufacturing, McGraw Hill 2003

SUBJECT NAME: Electric Vehicle

SUBJECT CODE: OEC-ME 316

Teaching Scheme:	**Examination Scheme:**
Lectures: 03Hrs.perweek	**ESE: 70Marks**
Practical: 00Hrs.perweek	**CIE: 30Marks**
Credit: 03	**Term Work: --**

Pre-requisites: NA

Course Objectives:

1.	To impart the basic knowledge of Electric Vehicle Technology
2.	To make the student conversant with power sources of todays and future EV
3.	To prepare the students for a career in the drastically changing automotive industry
4.	To acquaint the student with prerequisite for higher studies in Electric Vehicle
5.	To make the students aware with different areas of research in the field of Electric Vehicle

Course Outcomes: At the end of this course, student will be able

1.	To Understand the basic knowledge of electric vehicle technology.
2.	To Select power sources for electric vehicles
3.	To Choose various configurations of an electric vehicle.
4.	To Configure power transmission system in electric vehicle

Unit 1	**Introduction to Electric Vehicles**	05
	Energy crises, Need of future transportation, Introduction and overview of Electric Drive Technologies and Configurations, Traction power requirement for vehicle propulsion under different road and speed condition, EV – Indian strategies, policies, R&D and Collaboration, Introduction to Energy Storage.	

Unit 2	**Batteries for Electric Vehicles**	07
	Electrochemical Batteries – Reactions and Thermodynamic, Voltage, Specific power and Energy, Working of Pb-Acid batteries, Ni-Fe, Ni- Cd, Ni-MH Batteries, Li-Polymer, Li-ion, Battery selection for Electric Vehicle, Regenerative Braking for battery charging, Effects of Current Density and Heat on Battery Cycle and Life. Battery Storage, Battery Pack Design	

Unit 3	**Battery Charging Technology for Electric Vehicles**	07
	Types of battery charging, Normal charging, Opportunity charging, Fast charging, Battery swapping. Battery Charging algorithms, Improve the charging efficiency, Reduce the charging time, enhancing the battery life, Protect the battery, Constant current and constant voltage Charging, Multistage charging (MSC), Pulse Charging, Trickle Charging (TC), Wire and Wireless charging, Charging station infrastructure,	

Unit 4	**Electric Motors in Electric Vehicles**	07
	Electric Motors used in electric vehicles, DC motors, Induction motors, Permanent Magnet motors, Switched Reluctance motors., Torque –speed characteristics of above mentioned motors, Comparison and its layout in EV, Selection of motor for EV, Motor location and drive from motor to wheels,	

Unit 5	**Motor control in Electric Vehicles**	07
	Power conversion required in EV. Principle of operation of power electronics devices like: SCR, TRIAC, DIAC, GTO, MOSFET, IGBT and power BJT, Battery to Motor with speed control, Regenerative Braking requirements, Bi-directional and multiple input to single output power conversion in EV. Power conversion required for DC charging and AC charging on board and off board.	

Unit 6	**Safety, Norms and Testing of Electric Vehicles**	07
	Type approval procedure for electric and hybrid electric vehicles, Government scheme, Electric vehicle conductive AC charging system, DC charging system, V2X technology like V2 home, V2Grid, Self-driving from level 1 to level 5, Autonomous driving	

Recommended Books

1.	James Larmine and John Lowry, *Electrical Vehicle Technology Explained*,John Wiely and Sons Ltd.,2nd Edition WSE 2015.
2.	Iqbal Husain, *Electric and Hybrid Vehicles: Design Fundamental.* CRC Press, 2nd Edition, e-library 2011
3.	C.C. Chan, K.T. Chau, *Modern Electric Vehicle Technology*, Oxford Publication, New York, 1st edition 2001

SUBJECT NAME: Computer Integrated Manufacturing

SUBJECT CODE: PCC-ME 317

Teaching Scheme:	**Examination Scheme:**
Lectures : 00 Hrs. per week	**ESE : 00 Marks**
Practical : 02 Hrs. per week	**CIE : 00 Marks**
Credit : 01	**Term Work : 25 Marks**

Pre-requisites: Computer Integrated Manufacturing

Course Objectives:

1.	Study role of CAD/CAM in CIM and CIM implementation issues
2.	Apply various classification and coding system in group technology.
3.	Study concepts of Computer Aided Production Planning and Control
4.	To expose the students to the tequinics of CNC programming and cutting tool path generation through CNC simulation software by using G and M codes

Course Outcomes: At the end of this course, student will be able to

1.	Locate modern techniques for integrating CAD/CIM in CIM
2.	Obtain an overview of computer technology in Production Planning and Control including Computers
3.	Apply classification and coding in Group Technology.
4.	Elaborate Computer Aided Production Planning and Control.
5.	Generate CNC lathe part programming for turning ,facing,stepturning,taper turning.

Unit 1	Assignment on Introduction to CIM.	(1)
	Meaning, Scope, Evolution, Architecture, Elements, Benefits, Limitations, Social Aspects, etc.	

Unit 2	Assignment on Role of CAD/CAM in CIM.	(1)
	Role of Computers in design and manufacturing, integration.	

Unit 3	Exercise on Group Technology, Part Classification and Coding System. OPITZ and MICLASS : one exercise on each.	(2)

Unit 4	Part Programming	(8)
	Introduction to manual Part programming buse of G and M Codes to generate part product on CNC,VMC,HMC etc.generation model on milling/turnning/Drilling using suitable CAM Software	

Unit 5	Presentations (by group of minimum 2 and maximum 4 students).	(2)
	I. Computer Aided Process Planning II. Shop Floor Control III. Manufacturing Resource Planning (MRP-II) IV. CIM Planning and Implementation Issues	

Unit 6	Industrial Visit	
	exploring CMM, Material Handling and Storage System, Robotics/ Automation covering, CIM major parts.	

TEXT BOOKS:

1.	"CAD/CAM Computer Aided Design and Manufacturing", M. Groover, E. Zimmers, Pearson Publications, ISBN 9788177584165.
2.	"Automation, Production systems and Computer Integrated Manufacturing", M.P. Groover ,Prentice Hall of India.
3.	"Computer Aided Manufacturing",P.N. Rao, N.K. Tewari and T.K. Kundra, Tata McGraw Hill, ISBN 9780074631034.

REFERENCE BOOKS:

1.	"Computer Integrated Design and Manufacturing", Bedworth, Henderson Wolfe ,Tata McGraw Hill Publication.
2.	"Principles of Computer Integrated Manufacturing",S. Kant Vajpayee ,Prentice Hall of India.
3.	"CIM Handbook",Teicholtz and Orr, Tata McGraw Hill Publication.
4.	"Computer Integrated Manufacturing", James Rehg, H.W. Kraebber, Pearson Education.

SUBJECT NAME: Workshop Practice–VI

SUBJECT CODE:PCC-ME318

Teaching Scheme:	**Examination Scheme:**
Lectures: 00Hrs. per week	**ESE: 00 Marks**
Practical: 02 Hrs. per week	**CIE: 00 Marks**
Credit: 01	**Term Work: 25 Marks**

Course Objectives:

	The course aims to:
1	Understand and perform the various machining operations.
2	Implement principles of metrology.
3	Design the sequence of various processes required to manufacture the components.

Course Outcomes: At the end of this course, student will be able to

1	Select the suitable machining operations and prepare process sheet to manufacture a Components and implement the same.
2	Control key dimensions on a component using principles of metrology and assembly

Syllabus

A. To manufacture the components as per the drawing requiring at least four of the following operations
i) Milling, ii) Shaping, iii) Grinding, iv) Tapping, v) Die threading vi) Boring vii) Slotting

B. To carry out assembly of all components.

C. A visit report based on the industrial visit to study at – least two of the following machining processesi.) CNC Turning / Milling, ii.) Honing, iii.) Thread Rolling

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Assignments

Write any **three** assignments out of following.

1. Study and demonstration of Milling machine.

2. Study and demonstration of Shaping machine.

3. Study and demonstration of CNC machine.

4. Study of Slotting machine. (Theoretical treatment only.)

TEXT BOOKS:

1.	"Workshop Technology Vol. II", Raghuvanshi
2.	"Workshop Technology Vol. II", Hajara Choudhary, Media Promoters and Publishers, Mumbai

REFERENCE BOOKS:

3.	"Production Technology", P. C. Sharma, S. Chand Publication ,11th Edition.
4.	"Production Technology", HMT handbook
5.	"Workshop Practice Manual",V. Venkata Reddy, 6th edition

SUBJECT NAME: Professional Skill Development**

SUBJECT CODE: PCC-ME319**

(Audit Course)

Teaching Scheme:	**Examination Scheme:**
Lectures: 01Hrs.perweek	**ESE: 00 Marks**
Practical: 00Hrs.perweek	**CIE: 00 Marks**
Credit: 00	**Term Work: 00 Marks**

Pre-requisites: NA

Course Objectives:

1.	Enable students to imbibe all those skills that are needed to be successful in their professional life
2.	Develop behavioral competencies amongst students
3.	Develop effective communication skills in business situations
4.	Develop effective writing and presentation skills in business situations
5.	Enhance team building and time management skills
6.	Develop interpersonal skills

Course Outcomes: At the end of this course, student will be able to

1.	Effectively use techniques for self-awareness and self-development to increase confidence in abilities
2.	Strengthen soft skills to achieve success in professional career
3.	Smoothly transit from student life to professional life
4.	Create professional documents using MS office tools

Unit 1	**Technical Writing and Business Communication**	**[02]**
	Informal and formal letter writing,quotations, purchase orders, enquiry letter, invitation and acceptance letter, notice of meeting,circular, agenda and minutes of meeting.	

Unit 2	**Report and Proposal Writing**	**[02]**

	Different types of report, structure of a report, characteristics of a good report, project report, structure of a general format proposal, importance of a proposal.

Unit 3	**The e-English**	**[02]**
	Writing email to an unknown person, guidelines for continuing the conversation on emails, the top ten Do's, Business emails, marketing emails.	

Unit 4	**Team Building and Time Management**	**[02]**
	Interpersonal skills, what is needed to form smart team. Different approaches to team building. Techniques of a time management: ABC analysis, Pareto analysis.	

Unit 5	**Corporate Etiquettes**	**[02]**
	Business dress and grooming, office etiquettes, telephone etiquettes, dining etiquettes, meeting etiquettes, travel etiquettes.	

Unit 6	**Working with Professional Documents**	**[04]**
	Creating professional quality documents using MS Office applications. MS Word: Create, store, organize. Font & paragraph formatting, inserting tables, smart art, page breaks. MS Excel: Creating, editing, saving and printing spreadsheets, functions & formulas, charts & graphs, filtering data. MS Power Point: Creating slides, applying auto layouts, adding animation, slide transitions, graphically representing data.	

TERM WORK / LIST OF ASSIGNMENTS:

1. Quotation and Purchase order for the Engineering goods.
2. Agenda, notice, and minutes of a meeting.
3. One report based on the literature review or comparison.
4. One page biodata.
5. Power Point presentation based on hobby or favorite topic.

TEXT BOOKS:

1.	"Soft skills for managers",Dr. T. KalyanaChatravarthi, Dr. T. LathaChatravarthi Biztantra.
2.	"Soft skills for young managers", by Prof. M. S. Rao Wiley India Pvt. Limited.

REFERENCE BOOKS:

1.	"Technical English", Dr. M. Hemamalini, Published by Wiley India Pvt.ltd.
2.	"Soft skills", S. Hariharan MJP PubliishersChennai , (2010).