COEP Technological University [COEP Tech]
(A Unitary Public University of Government of Maharashtra)
(Formerly College of Engineering Pune [COEP])

Department of Manufacturing Engineering and Industrial Management

NEP Compliant Curriculum Structure (UG Program)

S.Y. B. Tech. (Manufacturing Science and Engineering)
(Effective from: A.Y. 2024-25)

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Program Education Objectives (PEOs):

The Undergraduate students will demonstrate:

I. **PEO1**: Advance professionally as a result of his/her ability to solve complex technical problems using the knowledge of mathematics, science, engineering and humanities and to work in multidisciplinary areas whose solutions lead to significant societal benefits.

II. **PEO2**: Demonstrate professional engineering competence to real life problems and compete successfully using principles of manufacturing and time and quality management in the design and manufacture of products and services.

III. **PEO3**: Exhibit professionalism, ethical attitude, communication skills, teamwork in their profession and adapt to current trends by engaging in lifelong learning.

Program Outcomes (POs):

The Undergraduate Students will demonstrate:

a. Graduates will apply the basic knowledge of mathematics, science, engineering and humanities to Production Engineering field
b. Graduates will have the ability to define the problems and provide solutions by designing and conducting experiments, interpreting, and analyzing data for manufacturing.
c. Graduates will design manufacturing systems that would encompass machining science and technology, production processes, metal forming, tool and die design with the fully acquaintance with engineering thermodynamics and heat transfer, theory of machines, strength of material and would meet specifications and requirements as demanded by the customers.
d. Graduates will apply design and tooling for manufacturing, Kinematics of Machine Elements, Quality Control, modeling of manufacturing systems to solve production engineering problems.
e. Graduates understand manufacturing technologies like computer-controlled processes and Industrial Engineering, production management, SCLM, and Total Quality Management concepts.
f. Graduates will have the confidence to apply engineering solutions in global and societal contexts.
g. Graduates will understand quantitative modeling and analysis of a broad array of systems-level decision problems concerned with economic efficiency, work design, productivity and quality with environmental focus.
h. Graduates should be capable of self-education and clearly understand the value of achieving perfection in their professional endeavors.
i. Graduates will participate as members of engineering and science laboratory teams, as well as members of multidisciplinary design teams.
j. Graduates will be proficient in English language in both verbal and written forms which will enable them to compete with graduates of international engineering institutions.
k. Graduates will have the ability to choose and apply appropriate resource management technique/s so as to optimally utilize resources in manufacturing systems.
l. Graduates will be broadly educated and will have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues.

Correlation between the PEOs and PO's/PSO's

Program Objectives		Program Outcome												Program Specific Outcomes		
		a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2	PSO 3
PEO's	I	P	P	P	P	P		P		P	P	P	P	P	P	P
	II	P	P	P	P	P	P					P	P	P		
	III	P	P				P		P	P	P		P			P

Program Specific Outcomes:

After completion of the program, the graduates should be able to:

PSO1: Apply knowledge of manufacturing systems, industrial engineering and analytical techniques to solve real world problems.

PSO2: Apply knowledge of machine tool design, measurement systems, quality control and management systems to identify, formulate and solve complex engineering problems.

PSO3: Design, develop and manufacture innovative products using emerging manufacturing and computing technologies like CAD/CAM/CIM, rapid prototyping, machine learning, artificial intelligence etc.

UG Program Structure of B. Tech. (Manufacturing Science and Engineering)

List of Abbreviations:

Abbreviation	Title	No of courses	Credits	% of Credits
BSC	Basic Science Course	**5**	**14**	**8.75**
ESC	Engineering Science Course	**6**	**16**	**10**
PCC	Programme Core Course	**19**	**54**	**33.75**
PEC	Programme Elective Course	**6**	**20**	**12.5**
OE/SE	Open/School Elective (other than particular program)	**3**	**6**	**3.75**
MD M	Multidisciplinary Minor	**5**	**14**	**8.75**
VSEC	Vocational and Skill Enhancement Course	**5**	**6**	**3.75**
AEC-01	Ability Enhancement Course	**1**	**2**	**1.25**
AEC-02	Indian Language	**1**	**2**	**1.25**
HSSM	Entrepreneurship/Economics/ Management Courses	**2**	**4**	**2.5**
IKS	Indian Knowledge System	**1**	**2**	**1.25**
VEC	Value Education Course	**2**	**2**	**1.25**
RM	Research Methodology	**1**	**2**	**1.25**
CEA	Community Engagement Activity /Field Project	**1**	**2**	**1.25**
CCA	Co-curricular & Extracurricular Activities	**2**	**2**	**1.25**
INT	Internship	**3**	**12**	**7.5**
	Total	**63**	**160**	**100**

F.Y. B. Tech
Manufacturing Science and Engineering
[Level 4.5, UG Certificate] Semester -I

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
1	BSC	<tbd>	Matrix Algebra Univariate Calculus and Probability	2	1	0	1	3	30	10	60	--	--
2	BSC	<tbd>	Engineering Physics	2	0	2	1	3	30	20	50	CIE: 100	
3	ESC	<tbd>	Basics of Electrical & Electronics Engineering	2	0	2	1	3	30	20	50	CIE: 100	
4	ESC	<tbd>	Engineering Drawing and Graphics	1	0	4	1	3	CIE: 100			CIE: 100	
5	ESC	<tbd>	Engineering Mechanics	3	0	2	1	4	30	10	60	CIE: 100	
6	AEC- I	<tbd>	Communication Skills	1	0	2	0	2	CIE: 100			CIE: 100	
7	CCA	<tbd>	Liberal Learning Course	0	0	2	2	1	--	--	--	CIE: 100	
8	VSEC - I	<tbd>	Manufacturing Practices and Fab Lab - I	0	0	2	1	1	--	--	--	CIE: 100	
			Total	**11**	**1**	**16**	**8**	**20**					

[Level 4.5, UG Certificate] Semester -II

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
1	BSC	<tbd>	Engineering Chemistry #	2	0	2#	1	3	30	20	50	CIE: 100	
2	BSC	<tbd>	Ordinary Differential Equations and Multivariate Calculus	2	1	0	1	3	30	10	60	--	--
3	BSC	<tbd>	Biology for Engineers	2	0	0	1	2	30	20	50	--	--
4	ESC	<tbd>	Systems in Mechanical Engineering	2	0	2	1	3	30	20	50	CIE: 100	
5	ESC	<tbd>	Programming for Problem solving	1	0	2	2	2	CIE: 100			CIE: 100	
6	ESC	<tbd>	Design Thinking and Idea Lab	0	0	2	1	1	--	--	--	CIE: 100	
7	PCC	<tbd>	Materials Science	2	0	0	1	2	30	20	50	--	--
8	VSEC - II	<tbd>	Manufacturing Practices and Fab Lab - II	0	0	2	0	1	--	--	--	CIE: 100	
9	IKS	<tbd>	Indian Knowledge System	2	0	0	1	2	CIE: 100			--	--
10	CCA	<tbd>	Co-Curricular/ Extra - Curricular Activities (Office Automation)	0	0	2	0	1	--	--	--	CIE: 100	
			Total	**13**	**1**	**12**	**9**	**20**					

Combined lab for Engineering Chemistry and Material Science

Legends: **L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits ISE-In-Semester-Evaluation, ESE-End-Semester-Evaluation , MSE-Mid-Semester-Evaluation, TA-Teachers' Assessment, CIE-Continuous-Internal-Evaluation**

Exit Course options to qualify for certification of School of Mechanical and Materials Engineering

Any Two (02) Skill based Courses of 8 credits:

1. Computer aided Geometric modelling (4 Credits)
2. Additive Manufacturing (4 Credits)
3. Metallurgical Lab Practice - I (4 Credits)
4. Basics of CNC Programming (4 Credits)
5. Basics of Robotics and AI (4 Credits)

[Level 5, UG Diploma] Semester III

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
1	PCC	<tbd>	Strength of Material	2	0	0	1	2	30	20	50	--	--
2	PCC	<tbd>	Theory of Machines	3	0	0	1	3	30	10	60	--	--
3	PCC	<tbd>	Manufacturing Processes	3	0	2	1	4	30	10	60	50	50
4	PCC	<tbd>	Product & Systems Graphics	0	0	2	1	1	--	--	--	CIE: 100	
5	OE	<tbd>	Open Elective-I	2	0	0	1	2	30	20	50	--	--
6	AEC - II	<tbd>	Indian language: Sanskrit / Pali	2	0	0	0	2	30	20	50	--	--
7	VEC - I	<tbd>	Constitution of India & Universal Human Values	1	0	0	0	1	CIE: 100			--	--
8	HSMC	<tbd>	Principles of Economics	2	0	0	1	2	30	20	50	---	
9	CEA	<tbd>	Community Engagement Activities/Field Project*	0	0	4	1	2	--	--	--	CIE: 100	
			Total	**15**	**0**	**8**	**7**	**19**					

- **Field Project (Social) after semester-II during summer vacation and evaluation will be done at the start of III semester.**

[Level 5, UG Diploma] Semester IV

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
1	PCC	<tbd>	Engineering Thermodynamics and Heat Transfer	2	0	2	1	3	30	20	50	50	50
2	PCC	<tbd>	Fluid Power	2	0	2	1	3	30	20	50	50	50
3	PCC	<tbd>	Design of Machine Elements	2	0	0	1	2	30	20	50	--	--
4	PCC	<tbd>	Machining Science and Technology	3	0	2	1	4	30	10	60	50	50
5	OE	<tbd>	Open Elective-II (Product Design and Manufacturing)	2	0	0	0	2	30	20	50	--	--
6	MDM	<tbd>	Multidisciplinary Minor-I (Fundamentals of Manufacturing processes)	3	0	0	1	3	30	10	60	--	--
7	VSEC-III	<tbd>	CNC Programming & Machining	0	0	4	1	2	--	--	--	50	50
8	HSMC	<tbd>	Principles of Entrepreneurship	2	0	0	1	2	30	20	50	--	--
9	VEC - II	<tbd>	Environmental Studies	1	0	0	1	1	CIE: 100			--	--
			Total	**17**	**0**	**10**	**8**	**22**					

[Level 5, UG Diploma] Semester III (wef 2024-25)
[Lateral Entry]

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
1	PCC	<tbd>	Strength of Material	2	0	0	1	2	30	20	50	--	--
2	PCC	<tbd>	Theory of Machines	3	0	0	1	3	30	10	60	--	--
3	PCC	<tbd>	Manufacturing Processes	3	0	2	1	4	30	10	60	50	50
4	PCC	<tbd>	Product & Systems Graphics	0	0	2	1	1	--	--	--	CIE: 100	
5	OE	<tbd>	Open Elective-I (Production Processes and Metrology)	2	0	0	1	2	30	20	50	--	--
6	AEC - II	<tbd>	Indian language: Sanskrit / Pali	2	0	0	0	2	30	20	50	--	--
7	VEC - I	<tbd>	Constitution of India & Universal Human Values	1	0	0	0	1	CIE: 100			--	--
8	BSC	<tbd>	Mathematics	3	0	0	1	3	30	10	60	--	--
9	HSMC	<tbd>	Principles of Economics	2	0	0	1	2	30	20	50	--	--
			Total	**18**	**0**	**4**	**7**	**20**					

- **Field Project (Social) after semester-II during summer vacation and evaluation will be done at the start of III semester.**

[Level 5, UG Diploma] Semester IV

[Lateral Entry]

Sr. No.	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme (Weightages in %)				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
1	PCC	<tbd>	Engineering Thermodynamics and Heat Transfer	2	0	2	1	3	30	20	50	50	50
2	PCC	<tbd>	Fluid Power	2	0	2	1	3	30	20	50	50	50
3	PCC	<tbd>	Design of Machine Elements	2	0	0	1	2	30	20	50	--	--
4	PCC	<tbd>	Machining Science and Technology	3	0	2	1	4	30	10	60	50	50
5	OE	<tbd>	Open Elective-II	2	0	0	0	2	30	20	50	--	--
6	MDM	<tbd>	Multidisciplinary Minor-I(Fundamentals of Manufacturing processes)	3	0	0	1	3	30	10	60	--	--
7	VSEC-III	<tbd>	CNC Programming & Machining	0	0	4	1	2	--	--	--	CIE: 100	
8	HSMC	<tbd>	Principles of Entrepreneurship	2	0	0	1	2	30	20	50	--	--
9	VEC - II	<tbd>	Environmental Studies	1	0	0	1	1	CIE: 100			--	--
10	HSMC	<tbd>	Communication Skills	1	0	2	0	2	CIE: 100			CIE: 100	
			Total	**18**	**0**	**12**	**8**	**24**					

Legends: L-Lecture, T-Tutorial, P-Practical, S-Self Study, Cr-Credits ISE-In-Semester-Evaluation, ESE-End-Semester-Evaluations-Mid-Semester-Evaluation, TA-Teachers' Assessment, CIE-Continuous-Internal-Evaluation

Exit Course options for Diploma in Manufacturing Science

Two (02) Skill based Courses:

1. Geometric Dimensioning and Tolerancing and Product Inspection (4 credit)
2. Modern Prototyping Practice (4 credit)

Department of Manufacturing & Industrial Management
Open Elective Courses

Sr. No.	Course Type	Course Name	Teaching Scheme					Credits
			L	T	P	S	Hrs	
1	OE-1	Production Process & Metrology	2	0	0	1	2	2
2	OE-2	Product Design for Manufacturing	2	0	0		2	2
3	OE-2	Production Planning and Control	2	0	0		2	2
4	OE-3	Operations Research	2	0	0		2	2
5	OE-3	Reliability Engineering	2	0	0		2	2
Total Academic Engagement and Credits			**6**	**0**	**0**	**1**	**4**	**6**

Multidisciplinary Minor

Sr. No.	Course Type	Course Name	Teaching Scheme					Credits
			L	T	P	S	Hrs	
1	MDM-I (SEM IV)	Fundamentals of Manufacturing processes	3	0	0		3	3
2	MDM-II (SEM V)	Metrology and Mechanical Measurements	3	1	0		4	4
3	MDM-III (SEM VI)	Additive Manufacturing	3	1	0		4	4
4	MDM-IV (SEM VII)	Product Design and Development	3	0	0		3	3
Total Academic Engagement and Credits			**14**	**0**	**0**		**14**	**14**

Exit Course options to qualify for certification of School of Mechanical and Materials Engineering

Any Two (02) Skill based Courses of 8 credits:

Sr. No.	Course Type	Course Name	Teaching Scheme					Credits
			L	T	P	S	Hrs	
1	SEC	Computer aided Geometric modeling	0	0	8	1	6	4
2	SEC	Additive Manufacturing	0	0	8	1	6	4
3	SEC	Metallurgical Lab Practice - I	0	0	8	1	6	4
4	SEC	Basics of CNC Programming	0	0	8	1	6	4
5	SEC	Basics of Robotics and AI	0	0	8	1	6	4

EXIT COURSES AFTER FIRST YEAR

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Course: Computer aided Geometric modelling

Course Code	SEC	**Scheme of Evaluation**	Oral & Term Work
Teaching Plan	0-0-6-1	Term Work	50
Credits	4	Oral	50

Syllabus:

Assignment	Contents	Practical
01	**Fundamentals Of Computer Graphics** Introduction to CAD, Product cycle-Design process-Computer aided design–Computer graphics– co-ordinate systems-2D and 3D transformations homogeneous coordinates–graphics primitives (point, Line drawing algorithms)	4 hrs
02	**Transformation and Projection techniques:** 2D and 3D transformation techniques - Translation, Rotation, Scaling and Reflection principles. Principle of concatenated transformation. Orthographic and Perspective Projections of Geometric Models.	8 hrs
03	**Introduction to different features of the CAD Software.** Study of Capabilities of Software for Drafting & Modeling – Co-Ordinate System, Introduction to various menus and option in software, Introduction to Dimensioning & Dimensions Styles and Annotations, technical drafting practices, procedures, and processes according to current ANSI/ISO standards, Drawing of a Title Block with necessary Text and Projection Symbol	8 hrs
04	**2-D Drafting**. Drawing of entities like Line, Circle, Rectangle, parabola, spiral etc, Drawing of front view and top view of simple solids like Cylinder, Prism, Pyramid, cone, etc,	8 hrs
05	**Constructions of Mechanical Drawings using Software Packages** Drawing Projection views of simple machine drawing using CAD software tool, Drawing front view, top view and side view of objects from the given pictorial views	8 hrs
06	**Introduction to 3D Modelling Using AutoCAD** Study of different options for 3D modelling, CAD of simple mechanical drawings using CAD software tool	8 hrs

Course outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

1) Build Computer Aided software Design and Drafting software to produce basic concepts to make 2D drafting.
2) Carryout part drawing and assembly of systems along with preparation of Bill of Material
3) Draw any Mechanical drawings using Computer Aided Software like AutoCAD with detailing.
4) Demonstrate the 3D Modelling concepts and prepare the 3D Models using Computer Aided software.

Suggested learning resources:

1. William M Neumann and Robert F.Sproul ―Principles of Computer Graphics‖, McGraw Hill Book Co. Singapore, 1989.
2. Elements of Workshop Technology Hajra & Choudhary, Media Promoters & Publisher.
3. Workshop Practice HS Bawa, Tata McGraw Hill 2nd ed. India
4. Computer-aided design: a conceptual approach, Jayanta Sarkar

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SEC: BASICS OF ADDITIVE MANUFACTURING

Course Code	SEC	**Scheme of Evaluation**	Term work
Teaching Plan	0-0-6-1	**----**	100
Credits	4	**---**	100

Unit	Contents	
01.	**Introduction to CAD, Introduction to Additive Manufacturing Technology, Introduction to .STL File, Process chain of Additive Manufacturing**	8 L
02.	**Study of different processes comes under Additive Manufacturing umbrella:** Study of Liquid based, Solid Based and Powder based AM processes	5 L
03.	**Study of pre processing techniques and Study of 3D Printing Software to understand the role of** various process parameters and its effect on printing quality, **Introduction to Post Processing techniques**	5 L
04.	**Printing of 3D components on FDM printer:** This experiment will give hands-on experience of using 3D printer to build the components	10 L
05.	**Demonstration of various technologies under Additive Manufacturing:** This experiment will cover the learning of basic Additive Manufacturing techniques and its different industrial applications	10 L
06.	**Integration of Reverse Engineering and Additive Manufacturing**	4 L

Course Outcomes:

- Interpret how CAD technology can be leveraged in the additive manufacturing process
- Compare and distinguish the difference between Solid model syntax with .STL file.
- Illustrate the concept like process chain of Rapid Prototyping and its necessity in manufacturing of real life components
- Illustrate and Classify the various additive manufacturing techniques to understand its applications in various fields like automobile, biomedical, fashion and food industry etc.
- Demonstrate the use of 3D printing software and effect of various process parameters
- Infer the printing process on 3D printers by varying the process parameters and evaluate the quality of 3d printed components

Suggested learning resources:

- Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles and Applications", World scientific 2003.
- Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
- Ali K. Kamrani, EmandAbouel Nasr, "Rapid Prototyping: Theory and Practice", Springer, 2006.
- Paul C. Bave: CAD Principles and Applications
- Understanding of Additive Manufacturing, Andreas Gebhardt, Hnaser Publishers, 2011.
- D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 20

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BASICS OF CNC PROGRAMMING

Course Code	SEC	**Scheme of Evaluation**	Term work
Teaching Plan	0-0-6-1		
Credits	1		100 marks

Objective: To use and operate the CNC controlled machines for various operations like turning, Milling etc.

Students need to carry out the following exercises:

Exercise 1	Expt 1: Identification of different parts of CNC lathe including data input Expt 2: Identification of different parts of CNC mill including data input Expt 3: Practice on CNC controller using on-screen simulation for generating different profile	10 Hrs
Exercise 2	Expt 4: Writing simple code and test on controller for CNC lathe Expt 5: Writing simple code and test on controller for CNC mill Expt 6: programming canned cycles for simple profile	11 Hrs
Exercise 3	Expt 7: Machining of programmed exercise on CNC lathe machine. Expt 8: Machining of programmed exercise on CNC milling machine. Expt 9-11: Programming for complex shape cylindrical objects with parameter selection, machining. (at least 3 exercises)	10 Hrs
Exercise 4	Expt 12-14: Programming for complex shape prismatic objects with parameter selection, machining. (at least 3 exercises) Expt 15: comparison of manual part programming and CAPP for a simple component	11 Hrs

Outcomes:

- Prepare programs, demonstrate, simulate and operate CNC lathe machines for various machining operations
- Prepare programs, demonstrate, simulate and operate CNC milling machines for various machining operations.
- Demonstrate to read the part print and select the machining operations.
- Develop the programs and simulate the program.
- Work on Modern CNC systems and carry out the various operations.

Text Books:

- *Programming of CNC machines, by Ken Evans*
- *CNC Programming Handbook by Peter Smid*
- *NC Control by Kundra Rao, Tewari*

THIRD SEMESTER REGULAR

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Course: STRENGTH OF MATERIALS

Course Code	PCC	**Scheme of Evaluation**	MSE, TA & ESE
Teaching Plan	2-0-0-1	**MSE-30**	**TA 20**
Credits	2	**ESE -50**	

Course Outcomes:
At the end of this course students will be able to
Course outcomes:

- Describe properties of engineering material, their behavior and applications.
- Explain the types of stresses and the effects of stresses in engineering applications due to different actions.
- Analyze simple problems in strength of materials and their applications in general.
- Analyze actions produced in torsion, principal stresses, thin cylinders, long columns and understand their applications in Manufacturing Engineering.

Unit	Contents	Lecture
01.	**Simple stresses and strains:** **a) Concept of stress and strain** (linear, lateral, shear and volumetric) Hooke's law. Elastic constants and their relationship, Generalized Hooke's law. **b) Axial force diagram**, stresses, strains and deformation in determinate and indeterminate homogeneous and composite bars under concentrated loads, self-weight and temperature changes	**8 hrs**
02.	**a)Shear force and bending moment diagrams** Concept and definition of shear force and Bending Moment in beams due to concentrated load, UDL, uniformly varying loads and couples in determinate beams. Relation between SF, BM and intensity of loading, SF, and BM diagrams for cantilevers, simple beams. **b) Stresses due to bending** Theory of simple bending, concept and assumptions, Derivation of Flexure formula. Bending stress distribution diagram. Moment of resistance, section modulus and design (only cross-sections, loading) of beams calculations	**7 hrs**
03.	a) **Shear stress, distribution in beams**, Shear stresses concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress and design of beams (only cross-sections, loading). b) **Torsion of circular shafts**, Theory of torsion of shafts of circular, cross section. Assumptions, Derivation of torsion formula, stresses, strains and deformation in determinate and indeterminate shafts of hollow, solid, homogeneous circular cross- sections subjected to twisting moments.	**7 hrs**

04.	**a) Principal stresses and Pressure Vessels,** Principal, Normal and Shear stresses on any oblique planes, their locations. **Pressure Vessels,** Stresses, strains, deformations and volume change in thin - walled seamless cylindrical vessels due to internal fluid pressure. **b) Axially loaded columns,** Concept of critical load and buckling, slenderness ratio, derivation of Euler's formula for buckling load with hinged ends, concept of equivalent length for various end conditions.	**7 hrs**

Textbooks:

- "Mechanics of Structure" by S. B. Junnarkar and Advi, Charotar publication.
- "Fundamental of Solid Mechanics", by ML Gambhir, PHI Publications

Reference Books

- "Mechanics of Materials" by Beer and Johnston, Mc Graw Hill publication.
- "Mechanics of Materials" by RC Hibbeler, Pearson Publications.
- "Mechanics of Materials" by James M. Gere (5th Edition) Brooks/Cole Thomson Learning.
- "Strength of Materials" by F. L. Singer and Pytel, Harper and Row publication.

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Department of Manufacturing Engineering & Industrial Management
Course: THEORY OF MACHINES

Course Code	PCC	**Scheme of Evaluation**	MSE, TA & ESE
Teaching Plan	3-0-0-1	**MSE - 30**	**TA- 10**
Credits	3	**ESE - 60**	

Syllabus:

Unit	Contents	Lecture
01.	**Fundamentals of Kinematics and mechanisms.** Kinematic Link, Kinematic Pair, Kinematic chain, Structure, mechanism, machine, Types of Constrained Motions, Degrees of Freedom, Equivalent linkage Mechanism, Inversions of Four Bar Chain, Single Slider Crank Chain.	**07 L**
02.	**Velocity and Acceleration Analysis in Mechanisms.** Relative Velocity and Relative Acceleration Polygon method for Kinematic link. Coriolis's component of Acceleration, Angular Velocity Ratio Theorem, Instantaneous Centre of Rotation (ICR), Methods of Locating ICR in a Mechanism.	**08 L**
03.	**Static and Dynamic Force Analysis** Introduction, Static Equilibrium, D'Alembert's Principle, Equivalent Dynamic System, Compound Pendulum, Correction couple, Static and Dynamic Analysis of inertia forces of Slider-Crank Mechanism by analytical and graphical method.	**07 L**
04.	**Belt Drives** Introduction, Selection of a Belt Drive, Types of Belt Drives, Materials used for Belts, Velocity Ratio of Belt Drive, Limiting tension ratio, Slip of Belt, Creep of Belt, Length of Flat Belts, Angle of Contact, Power Transmitted by a Belt, Different Tensions in belt , Design of Belt.	**07 L**
05.	**Governors** Introduction, Types of governors, Terms used in Governor, Sensitiveness, Stability and Hunting of Governor, Isochronous Governor, Governor effort and Governor power.	**07 L**
06	**Gears and gear trains** Gears, Types of gears, Terms used in gears - spur gear terminology, law of gearing, involute and cycloidal profile, minimum number of teeth, interference and under cutting. Introduction to gear trains, Types of gear trains, simple, compound and epicyclic gear train.	**07 L**

Course Outcomes:

1) To make the students conversant with commonly used mechanisms for industrial applications.
2) To develop competency in drawing velocity and acceleration diagrams for simple and complex mechanisms.
3) To develop competency in graphical and analytical methods for solving problems in static and dynamic force analysis.

4) Analyse various types of belt drives and effect of tensions on power transmission of drive.
5) Evaluate the characteristics of Governor and analyse its effect on the governor effort and governor power.
6) Evaluate gear teeth parameters as per law of gearing and analyze various gear trains.

Suggested learning resources:

Textbooks

1. R. S. Khurmi and J. K. Gupta: A Text Book of Theory of Machines: S. Chand and Company Ltd.
2. S.S. Ratan: Theory of Machines, Tata McGraw Hill.

Reference Books

1. Ulicker Jr., J.J., Penock, G.R. and Shigley, J.E. “Theory of Machines and Mechanisms”, Tata McGraw Hill.
2. John Hannah and Stephens, R.C. “Mechanics of Machines: Advance Theory and Examples” Edward Arnold London.
3. Ramamurthy, V. “Mechanics of Machines”, Narosa Publishing House.
4. Thomas Beven, “Theory of Machines”, Person Education Ltd.

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Course: MANUFACTURING PROCESES

Course Code	PCC	**Scheme of Evaluation**	MSE, TA & ESE
Teaching Plan	3-0-2-1	**MSE - 30**	**TA - 10**
Credits	3+1(Lab)	**ESE - 60**	

Syllabus:

Unit	Contents	Lecture
01.	**Casting Processes:** Sand Casting, types of pattern materials, pattern making allowances, core prints, Moulding sand-properties and testing, hand and machine Moulding, core, core boxes, Melting and pouring, Study of furnaces – cupola, fuel fired, Electric arc, Induction furnaces, Investment casting, Shell moulding, Casting techniques of cast iron, Steels and nonferrous metals of alloys, Solidification, Design of casting, Gating and riser Cleaning, Finishing and heat treatment of castings, defects in casting, Centrifugal casting, Semi-centrifugal casting, Centrifuging, Continuous casting. Basics of composite manufacturing *Self study :* Permanent Mould Casting Processes, Die-casting, Low-pressure permanent mould casting–hot and cold chamber processes, Plastic and Rubber Moulding processes, different types	**07 L**
02.	**Hot and cold working of metals:** Principles of rolling, Forging, Drop, Press, Upset, Roll forging, Extrusion, Drawing, Spinning, Effects of hot working, Cold working processes, Cold rolling, Swaging, Forging, extrusion- forward, Backward and impact roll forming, Tube drawing, Wire drawing, *Self study :* Spinning, Shot penning, High Energy Rate Forming.	**07 L**
03.	**Introduction to Manufacturing Processes** Introduction, Classification of different Manufacturing Processes **Turning, Boring, Related Processes:** Fundamentals of turning and boring, Lathe – construction, accessories, operations, Thread cutting, Different tools, Tool materials, Tool geometry, Concept of speed, feed, Depth of cut, Capstan and Turret Lathe- Construction, Working and Applications, **Introduction to CNC machines:** Definition, Types of NC Systems, working principle, Classification of NC machines, Elements of NC, CNC and DNC machines, *Self study :* Introduction to boring machines – general arrangement and nature of work done, Comparison and advantages of CNC lathes over conventional lathe machines.	**07 L**
04.	**Drilling and Milling Machines:** Fundamentals of drilling process, twist drill geometry, tool holders, Types of drilling machines, Operations performed on drilling machines, Reaming process, Milling Machines, Fundamentals of Milling process, Operations performed on milling machines, Dividing head, different methods of indexing, Gear train	**07 L**

	Self study : Types of drills, Reamers types, Geometry, Milling Cutters - types and geometry	
05.	**Abrasive Machining Processes:** Abrasive machining, abrasives - types, size and geometry, Grinding wheels, Wheel marking, Wheel selection, Wheel mountings, Types of grinding machines, Honing, Lapping, Super Finishing, Buffing. **Surface treatment processes:** Honing, lapping, Buffing, Polishing, Honing tools, lapping materials. Abrasive, Buffing, Polishing wheels and burnishing processes, *Self study :* Electroplating, Electro less plating, Plasma coating Phosphating, Galvanizing, Metal spraying, Anodizing.	**07 L**
06.	**Joining Processes:** Welding Processes: Theory, control and applications, Arc Welding – SMAW, GTAW, GMAW, FCAW, Submerged arc welding, etc, .Resistance welding – theory, Spot, Seam, Projection welding processes etc., Gas welding, Thermit welding, Friction welding, Ultrasonic welding, Electron beam and Laser welding, Defects in welding, their cause and remedy, Weldability, welding of dissimilar metals, NDT and other methods of testing welded joints, *Self study :* Soldering and Brazing applications, Use of adhesives for joining, Classification of adhesives, Types of adhesives and their applications, Surface preparation and various joints.	**07 L**

Course outcomes:

1) Summarize the basics and working of various casting and foundry techniques.
2) Interpret the various basic Manufacturing Processes and Machine Tools.
3) Learn how to select a particular production process for the given component from the available conventional as well as non-conventional manufacturing processes.
4) Interpret development and application of advanced technologies and components & processes for manufacturing.
5) Implement the knowledge of manufacturing processes in industrial environment effectively.
6) Interpret and appreciation of the breadth and depth of the field of Manufacturing Engineering.

Suggested learning resources:

1. S.K. Hajra Choudhary and S.K. Bose, “Elements of workshop Technology” Volume I, II, Asia Publishing House, 10th Edition 2000.
2. P.N. Rao, “Manufacturing Technology”, Tata McGraw-Hill Publishing Limited, 2 nd Edition, 2002.
3. Chapman W.A.J, “Workshop Technology”, Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.
4. Degarmo, Black and Kohser, “Materials and processes in Manufacturing”, Prentice Hall of India. 2nd Edition, 1998.
5. Milton Shaw, “Metal Cutting Principles”, Oxford University Press, 4th Edition, 2001.
6. O.P. Khanna and M. Lal, “Production Technology”, Vol. I,II, Dhanpatrai Publication, 5th Edition, 1999.
7. B.S. Raghuwanshi, “Workshop Technology”, Dhanpatrai Publication, 9th Edition, 1999.

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Course: MANUFACTURING PROCESSES LABORATORY

Course Code	PCC	**Scheme of Evaluation**	Oral & Term Work
Teaching Plan	0-0-2-0	Term Work	50
Credits	1	Oral	50

Syllabus:

Experiments	**Contents**	**Practical**
01	Study and demonstration of Lathe machine and Plain and Taper turning.	6 hrs
02	Forging and grinding of lathe tool with one end knife and another end vee	4 hrs
03	Making a simple solid pattern involving wood turning	4 hrs
04	Perform joining operation using Arc Welding (MIG/TIG)	4 hrs
05	Demonstration of CNC machine and completion of one job using CNC programming	4 hrs
06	Simulation and Demonstration of Sand-Casting processes	2 hrs

Journal & Demonstration:

- Demonstrations of different machine tools briefing students about the different parts of machine, working principle and operations
- Assignments on machine tools will be a questionnaire that needs to be solved in a journal. These assignments include sketches and relevant descriptions.

Course outcomes:

1) Explain the machine tools, mechanism and accessories used in various production processes.
2) Able to perform basic turning operations as well as basic Forging and grinding operations.
3) Able to perform welding using Arc welding process.
4) Demonstrate Sand Casting process.

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Course: PRODUCT & SYSTEMS GRAPHICS

Course Code	PCC	**Scheme of Evaluation**	Oral & Term Work
Teaching Plan	0-0-2-1 = 1	CIE	100
Credits	1		

Syllabus:

Assignment	Contents	Practical
01	Study of different types of drawings and conventional representation of various machine elements.	4 hrs
02	Study of basic characteristics of Production Drawings	4 hrs
03	Study of Screwed Fasteners.	4 hrs
04	Study of Pipe Joints and their symbolic representation in Pipe Layouts.	4 hrs
05	Study of Limits, Tolerance and Fits.	4 hrs
06	Study of concept of Roughness and, effect and representation of Surface Roughness in Drawings	4 hrs
07	Study of 2D Drafting Assignment using CAD tools	6 hrs
08	Study of 3D modelling Assignment using CAD tools	6 hrs

Course Outcomes:

1) Classify Engineering Drawing, Dimensioning. Represent machine components conventionally.
2) Classify various types of joints. Study constructional details of Screw Threads, different types of bolts, nuts, washers and set screws.
3) Able to Select the fits and tolerances for the designed components.
4) Illustrate Computer Aided Drafting to develop the 2D and 3D views using software tools.

Suggested learning resources:

1. A Textbook of Machine Drawing Latest Edition, by R.K. Dhawan
2. Computer-aided design: a conceptual approach, Jayanta Sarkar
3. Elements of Workshop Technology Hajra & Choudhary, Media Promoters & Publisher.
4. Workshop Practice HS Bawa, Tata McGraw Hill 2nd ed. India.

OPEN ELECTIVE-I

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Course: PRODUCTION PROCESSES AND METROLOGY (OE-I)

Course Code	OE-I	**Scheme of Evaluation**	MSE, TA & ESE
Teaching Plan	2-0-0-1	**MSE - 30**	**TA - 20**
Credits	2	**ESE - 50**	

Syllabus:

Unit	Contents	Lecture
01.	**Casting and moulding Processes**. Sand Casting, types of pattern materials, pattern making allowances, core prints, machine Moulding, core, core boxes, Melting and pouring, Investment casting, Shell moulding, Casting techniques of cast iron, Steels and nonferrous metals of alloys, Die casting, Low-pressure permanent mould casting–hot and cold chamber processes, Centrifugal casting, Semi-centrifugal casting, Centrifuging, Continuous casting. Plastic moulding processes. Basics of composite manufacturing. *Self Study- Study of furnaces – cupola, fuel fired, Electric arc, Induction furnaces,*	**06 L**
02.	**Machining Processes** Fundamentals of turning and boring, Lathe – construction, accessories, operations, Thread cutting – single and multi-start threading, Different tools, Tool materials, Tool geometry, Concept of speed, feed, Depth of cut, Drilling and Milling Machines: Fundamentals of drilling process, twist drill geometry, tool holders, Types of drilling Operations performed on drilling machines, Reaming process, Milling Machines, Fundamentals of milling process, Cutters - types and geometry, Operations performed on milling machines. Types of grinding machines, Honing, Lapping, Super Finishing, Buffing. Basics of CNC machines and operations. *Self Study*- Capstan and Turret Lathe- Construction, Working and Applications, Shaper, Planer and Slotting Machines	**06 L**
03.	**Joining Processes:** Welding Processes: Theory, control and applications, Arc Welding – SMAW, GTAW, GMAW, FCAW, Submerged arc welding, etc,. Resistance welding , Spot, Seam, Projection welding processes etc., Gas welding, Thermit welding, Friction welding, Ultrasonic welding, Electron beam and Laser welding Soldering and Brazing applications, Use of adhesives for joining, Classification of adhesives, Types of adhesives and their applications, Surface preparation and various joints. *Self Study*- Defects in welding, their cause and remedy, weldability, welding of dissimilar metals, NDT and other methods of testing welded joints	**06 L**
04.	Introduction to Metrology, Precision, Accuracy, Methods and Errors in Measurement, Calibration.	**08 L**

	Linear Measurement: Standards, Line Standards, End Standard, Wavelength Standard, Classification of Standards, Precision and Non-Precision Measuring instruments and their characteristics, Slip Gauges. Angle Measurement: Sine bars, Sine centres, Uses of sine bars, angle gauges, Auto Collimator angle dekkor, Limits, Fits and Tolerances: Meaning of Limit, Fits and Tolerance, Cost – Tolerance relationship, concept of Interchangeability, Indian Standard System.	
05.	Surface Roughness measurement method and instruments, Inspection of Geometric parameters- Straightness, Flatness, Parallelism, Concentricity, Squareness, and Circularity. Coordinate Measurement Machine working and applications.	**04 L**

Course outcomes:

1) Explain basic casting processes and their applications.
2) Aware about basic machining process and their real time applications
3) Select various joining processes for the practical applications.
4) Inspect linear and angular components and carry out measurements.
5) Evaluate the surface finish of given specimen by measuring instrument.
6) Demonstrate basic geometric parameters and their measurements.

Suggested learning resources:

1. Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002..
2. O.P. Khanna and M. Lal, "Production Technology", Vol. I,II, Dhanpatrai Publication,5th Edition, 1999.
3. "Elements of Workshop[Technology Vol-I & II" by S.K. Hajra Chaudhary, Media Promoters & Publishers.
4. B.S. Raghuwanshi, "Workshop Technology", Dhanpatrai Publication, 9th Edition
5. R. K. Jain, A Textbook of Engineering Metrology, Khanna PublicationsPvt. Ltd.18th Edition,2002
6. I.C.Gupta, A Text book of Engineering Metrology, Dhanpat Rai PublicationsPvt. Ltd.6th Edition, 2004.

FOURTH SEMESTER REGULAR

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Course: ENGINEERING THERMODYNAMICS AND HEAT TRANSFER

Course Code	PCC	**Scheme of Evaluation**	MSE, TA & ESE
Teaching Plan	2-0-2-1	**MSE- 30**	**TA - 20**
Credits	2+1(Lab)	**ESE - 50**	

Syllabus:

Unit	Contents	Lecture
01.	**Steam Generation and its properties.** Steam Generation and its properties, Measurement of dryness fraction, Ideal Rankine Cycle, Calculation of Thermal Efficiency, Specific Steam Consumption, Work ratio, Simple Impulse Turbine and Parson's Reaction Turbine, Construction and Working Principle (No numerical treatment)	**06 L**
02.	**I. C. Engines** Classifications of I C Engines, 4 Stroke and 2 Stroke IC Engines (Petrol and Diesel), Air standard Otto, Diesel cycles (Elementary Numerical treatment), Systems of I.C. engines such as fuel supply system for SI & CI engines, ignition system, cooling system, lubrication system, Performance of IC Engine: Indicated power, Brake power, Thermal efficiency, Specific fuel consumption (Elementary Numerical)	**06 L**
03.	**Conduction Heat Transfer** Introduction and Basic Concepts of Conduction, Application Areas of Heat Transfer in Manufacturing and Machine Tools. Modes and Fundamental Laws of Heat Transfer, Thermal Conductivity, Thermal Diffusivity, One Dimensional Steady State Heat Conduction in Simple and Composite Slab, Composite Cylinder, Composite Sphere, Concept of Thermal Resistance and Electrical Analogy, Overall Heat Transfer Coefficient, Critical Radius of Insulation for Cylinders and Spheres (Elementary Numerical Treatment).	**06 L**
04.	**Fundamentals of Convection and Radiation** Concept of Laminar and turbulent flow, Mechanism of natural and forced convection, local and average heat transfer coefficient, concept of velocity & thermal boundary layers. Reynold Number, Prandtl number, Grashoff number, Nusselt Number Fundamental concepts of radiation, Different Laws of radiation	**06 L**
05.	**Heat Exchangers** Introduction to heat exchangers, classification, and applications; Heat exchanger analysis – LMTD for parallel and counter flow heat	**06 L**

	exchanger, concept of effectiveness, NTU method for parallel and counter flow heat exchanger (elementary level, no numerical).	

Course outcomes:

Students who successfully complete this course will have demonstrated an ability to:

1) Apply steam tables to calculate various performance parameters of Rankine vapour power cycle.
2) Analyze I.C. engines and their various systems.
3) Estimate the Heat flow in One Dimensional Steady State Heat Conduction.
4) Quantify the Amount of Heat Conducted in Convection.
5) Calculate Heat Transfer and Evaluate Performance of Heat Exchangers.

Suggested learning resources:

Textbooks

1. R.K. Rajput,"Thermal Engineering", Laxmi Publications
2. R. S. Khurmi and Gupta,"Thermal Engineering", S. Chand Publication

Reference Books

1. Y.A. Cengel,"Thermodynamics – an Engineering approach", Tata McGraw Hill.
2. S.P. Sukhatme,"Heat Transfer", Orient Longman.
3. Eastop, A. Mc'conkey,"Applied Thermodynamics", Pearson Publishers.
4. Holman J.P.,"Heat Transfer", Tata McGraw Hill.

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Engineering Thermodynamics and Heat Transfer Laboratory

Course Code		**Scheme of Evaluation**	Term Work and Oral
Teaching Plan	0-0-2-0	**Term Work**	50
Credits	1	**Oral**	50

List of Experiments/Assignments:

Term work consists of following experiments (Any Six)

1. Determination of dryness fraction of steam.
2. Study of various systems of IC Engine.
3. Study of High-pressure Boilers.
4. Test on Diesel/Petrol engine to determine various performance parameters.
5. Determination of thermal conductivity of insulating material.
6. Determination of Emissivity of a Test Plate.
7. Determination of thermal conductivity of a composite plate.
8. Study and Demonstration of Heat Exchangers.
9. Test on parallel & counter flow Heat Exchanger.

Course Outcomes: At the end of the laboratory work, students will demonstrate the ability to:

1) Compare and Study Various Systems of IC Engine.
2) Analyze I.C. engines and determine the performance parameters.
3) Determine the thermal conductivity of insulating material.
4) Perform various test on parallel and counter flow heat exchanger.
5) Determine the Emissivity of a given plate.

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Course: Fluid Power

Course Code	PCC	**Scheme of Evaluation**	MSE, TA & ESE
Teaching Plan	2-0-2-1	**MSE - 30**	**TA - 20**
Credits	2+1(Lab)	**ESE - 50**	

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Syllabus:

Unit	Contents	Lecture
01.	**Introduction to Hydraulics and Pneumatics** Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. Properties of fluids, Fluids for hydraulic systems, governing laws. Distribution of fluid power, ISO symbols, energy losses in hydraulic systems.	**08 L**
02.	**Pumps & Power Units.** Types, classification, principle of working and constructional details of vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, characteristics curves, selection of pumps for hydraulic Power transmission. **Power units and accessories:** Types of power units, reservoir assembly, constructional details, pressure switches, temperature switches. **Accumulators:** Types, selection/ design procedure, applications of accumulators. Types of Intensifiers, Pressure switches /sensors, Temperature switches/sensors, Level sensors.	**08 L**
03.	**Hydraulic Actuators** (i) Linear and Rotary. (ii) Hydraulic motors - Types- Vane, Gear, Piston types, radial piston. (iii)Methods of control of acceleration, deceleration. (iv) Types of cylinders and mountings. (v) Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads. (vi) Design considerations for cylinders. Cushioning of cylinders. (Numerical treatment).	**08 L**
04.	***Industrial Circuits*** Simple reciprocating, Regenerative, Speed control (Meter in, Meter out and bleed off), Sequencing, Synchronization, transverse and feed, circuit for riveting machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, circuit for hydraulic press, unloading circuit (Numerical treatment), motor breaking circuit.	**08 L**
05.	**Pneumatics** Principle of Pneumatics: (i) Laws of compression, types of compressors, selection of compressors. (ii) Comparison of Pneumatics with Hydraulic power transmissions. (iii) Types of filters, regulators, lubricators, mufflers, dryers. (iv) Pressure regulating	**08 L**

	valves, (v) Direction control valves, two way, three way, four way valves. Solenoid operated valves, push button, lever control valves. (vi) Speed regulating Methods used in Pneumatics. (vii) Pneumatic actuators-rotary, reciprocating. (viii) Air motors-radial piston, vane, axial piston (ix) Basic pneumatic circuit, selection of components, (x) Application of pneumatics in low cost automation and in industrial automation. Introduction to vacuum and vacuum measurement, Vacuum pumps, types, introduction to vacuum sensors and valves. Industrial application of vacuum.	
06	**System Design** Design of hydraulic/pneumatic circuit for practical application, Selection of different components such as reservoir, various valves, actuators, filters, pumps based on design.	**05**

Course Outcomes:

1) Working principle of various components used for hydraulic & pneumatic systems.
2) Identify various components of hydraulic & pneumatic systems.
3) Ability to select appropriate components required for hydraulic and pneumatic systems.
4) Ability to design hydraulic and pneumatic system for industrial applications.
5) Ability to understand industrial applications of hydraulic and pneumatic system.
6) Troubleshooting of hydraulic & pneumatic circuits

Suggested learning resources:

Textbooks

1. Esposito, Fluid Power with application, Prentice Hall
2. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill
3. Majumdar S.R ,Pneumatics Systems Principles and Maintenance ,Tata McGraw Hill
4. H.L.Stewart, Hydraulics and Pneumatics , Taraporewala Publication GMH1`

Reference Books

1. J. J. Pipenger, Industrial Hydraulics, McGraw Hill
2. Pinches, Industrial Fluid Power, Prentice Hall
3. D. A. Pease, Basic Fluid Power, Prentice Hall
4. B. Lall, Oil Hydraulics, International Literature Association
5. Yeaple, Fluid Power Design Handbook
6. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books.
7. ISO - 1219, Fluid Systems and components, Graphic Symbols
8. Michael J, Prinches and Ashby J. G, “Power Hydraulics”, Prentice Hall.
9. Dr. R.K. Bansal, Fluid Mechanics, Laxmi Publication (P) Ltd.
10. Product Manuals and books from Vickers/ Eaton, FESTO, SMC pneumatics

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Fluid Power Laboratory

Course Code	PCC	**Scheme of Evaluation**	Oral & Term Work
Teaching Plan	0-0-2-1	Term Work	50
Credits	1	Oral	50

Minimum of 5 experiments and 3 assignments from the following;

1. Test on Gear/Vane/Piston pump and plotting of performance characteristics
2. Following experiments to be done on hydraulic trainer:
a. Regenerative circuit b. Speed control circuit
c. Sequencing circuit
3. Following experiments to be done on pneumatic trainer:
a. Automatic reciprocating circuit b. Speed control circuit
c. Pneumatic circuit involving shuttle valve/ quick exhaust valve
4. Test on filters
5. Design of accumulators and intensifiers in hydraulic system
6. Design of air distribution in pneumatic system
7. Design of simple hydraulic systems used in practice such as copy turning attachment or hydraulic clamps or jack or dumper or press etc.
8. Design of simple pneumatic systems used in practice such as braking system or vibrator etc.
9. Assignment on ISO symbols for different components of Hydraulic and Pneumatic system
10. Assignment on different types of actuators used in Pneumatic and Hydraulic system
11. Assignment on trouble shooting procedures of various hydraulic and pneumatic systems
12. Assignment on selection of circuit components for simple hydraulic and pneumatic systems

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Course: DESIGN OF MACHINE ELEMENTS

Course Code	PCC	**Scheme of Evaluation**	MSE, TA & ESE
Teaching Plan	2-0-0-1	**MSE - 30**	**TA - 20**
Credits	2	**ESE - 50**	

Syllabus:

Unit	Contents	Lecture
01.	**Fundamental aspects of design** The meaning of design, phases of design, design considerations, factor of safety, standardization, preferred series.	**04 L**
02.	**Design against static load** Stresses due to bending and torsional load, eccentric loading, Design for biaxial loading through theories of failure.	**06 L**
03.	**Design of shafts and keys** Shaft, Shaft subjected to bending and torsion, A.S.M.E code for shaft design, types of keys and their design.	**06 L**
04.	**Design of threaded Joints** Threaded Joints, I.S.O Metric screw threads profile, Coarse and fine threads, Design of bolted joints, eccentrically loaded bolted joints.	**06 L**
05.	**Design of welded joints** Types of welded joints, stresses in welded joints, eccentrically loaded welded joints and welded joints subjected to bending moment.	**06 L**

Course outcomes:
Students who successfully complete this course will be able to:

1) Outline the fundamentals of machine design to formulate the design problem and apply the appropriate procedure to get the solution.
2) Evaluate the different types of stresses induced in a machine component due to different types of static loading and design the commonly used machine elements.
3) Apply the fundamental concepts to design the shaft and keys.
4) Solve various types of bolted joint design problems.
5) Analyse various types of welded joints subjected to static loads and bending moments.

Suggested learning resources:
Textbooks

1. Shigley I.E. and Mischke C.R., "Mechanical Engineering Design", McGraw Hill Education (India) Ltd.
2. Bhandari V.B., "Design of Machine Elements", McGraw Hill Education (India) Ltd.
3. Hall A.S., Holowenko A.R. and Laughlin H.,"Theory and Practice of Machine Design", Schaumis outline series, McGraw Hill Publication.

Reference Books

1. Spotts M. F., "Design of Machine Elements", Prentice Hall International.
2. Black P.H. and Eugene Adams, "Machine Design", McGraw Hill Book Co. ltd.
3. P.S.G. College of Technology, "Design Data, Coimbatore.

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MACHINING SCIENCE AND TECHNOLOGY (MST)

Course Code	PCC	**Scheme of Evaluation**	MSE, TA & ESE
Teaching Plan	3-0-2-1	**MSE - 30**	**TA - 10**
Credits	3+1(Lab)	**ESE - 60**	

Unit	Contents	Lecture
01.	**Unit I Theory of Metal Cutting:** Cutting tools, tool geometry, Concept of speed, feed, depth of cut and cutting action and effect of these on cutting forces. Types of Chips. Merchant's circle of forces. Shear angle, Shear Strain, Mechanics of metal cutting, Theories of shear angle. Velocity vector diagram, estimation of cutting forces. Empirical Relations, Tool Force dynamometers, Measurement of cutting forces and power required. Heat Generation in Metal Cutting, Cutting Fluids. **Self-Study:Cutting Fluids**	**08 L**
02.	**Unit II :** Standards and Nomenclature of cutting tools, inserts and chip breakers Cutting Tool Materials. Heat Treatment of Tools and alloys. Machinability Tool Life and Tool Wear, New technology in metal cutting for higher productivity. Compliance test**.** **Self-Study: Cutting tool Materials**	**06 L**
03.	**Unit III Design of Cutting Tools:** Design Principles of cutting tools and tool holders. Single point tools, Tip tools, Drills, Reamers, Broaches, Milling cutters, Thread cutting tools, Gear cutting tools, Grinding Wheels, Form Tools.	**08 L**
04.	**Unit IV Gear Manufacturing:** Gear cutting process forming and generation. Gear cutting on milling. Gear hobbing. Gear shaping.Gear shaving, Lapping and Grinding. Various machines used for gear manufacturing. Self Study: Types of gears	**06L**
05.	**Unit V Thread Manufacturing:** Thread cutting internal and external, chasers, dies, thread milling, rolling, lapping and grinding. Self Study: Types of Threads	**06 L**
06	**Unit VI Non-conventional Machining Processes:** Introduction, principle, set up, operation and applications - Chemical machining, Electrochemical machining, Electric discharge machining, Electron Beam machining, Ion Beam machining, Plasma Arc machining, Laser Beam Machining, Abrasive Jet machining, Ultrasonic Machining. **Self Study: Chemical Machining**	**08 L**

Outcomes:

1) Demonstrate understanding of metal cutting principles and mechanism to solve the problems based on cutting force analysis and tool life.
2) Explain the design procedure of various tools and solve the problems based on tool design.
3) Summarize the broaching machines, tools used in the process and design methodology to solve the problems based on broach tool design.
4) Differentiate the various methods of gear manufacturing and thread manufacturing.
5) Classify the various non-conventional machining processes and learn its industrial applications.

Suggested learning resources:

1. P.N. Rao, “Manufacturing Technology”, Tata McGraw-Hill Publishing Limited, II Edition, 2002.
2. P.K.Mishra, “Non Conventional Machining”, Narosa Publishing House (January 15, 2001), ISBN: 978-81-7319-138-1, Reprint 2008.
3. Donaldson, Lecain and Goold,“Tool Design”, Tata McGraw Hill, Edition:III.
4. “Advanced Machining Processes”, Vijay K. Jain Allied Publishers Pvt. Ltd., Edition I 2007.
5. Prakash Joshi, “Cutting Tools”, Wheeler Publishing, ISBN 81-85814-53-8, Edition I 1996.
6. David A Stephenson, John S Agapiou, “Metal Cutting Theory and Practice”, CRC Press Edition II.

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MACHINING SCIENCE AND TECHNOLOGY (MST)- LABORATORY

Course Code	PCC	**Scheme of Evaluation**	Oral & Term Work
Teaching Plan	0-0-2-1	Term Work	50
Credits	1	Oral	50

Term work: Each student shall be required to complete and submit the following term work

Assignment	**Contents**	**Practical**
01	To measure the cutting force, tool temperature and shear angle during orthogonal cutting (on Lathe)	4 hrs
02	To measure the cutting force on drilling machine and milling machine.	4 hrs
03	Manufacturing of external threads using CNC lathe.	4 hrs
04	Manufacturing of spur gear using vertical milling machine.	4 hrs
05	Study of Micro EDM process and Precision gear cutting using Hybrid Micro Wire EDM machine.	4 hrs
06	Tool force dynamometer, it's working principle and construction.	4 hrs
07	Study of milling machine and CNC Lathe machine.	6 hrs
08	Study of Hybrid Micro Wire EDM machine.	6 hrs

Course Outcomes:

1) At the end of the course, students should be able to:
2) Use different Non-Conventional processes for the given applications.
3) Know about the different types of tool force dynamometers and its applications
4) evaluating forces acting on single point cutting tool, drilling tool and milling cutter.
5) To plan and create the external threads using CNC Lathe and spur gear using vertical milling machine.
6) To build the practical knowledge of Micro EDM process for precision gear cutting using Micro Wire EDM machine.

Open Elective-II

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Course: PRODUCT DESIGN AND MANUFACTURING (OE-II)

Course Code	OE-II	**Scheme of Evaluation**	MSE, TA & ESE
Teaching Plan	2-0-0-0	**MSE - 30**	**TA - 20**
Credits	2	**ESE - 50**	

Syllabus:

Unit	Contents	Lecture
01.	**Introduction To Product Design**: Asimow's Model: Definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production-consumption Cycle, The Morphology of Design (The sever phases), Primary Design Phases and flowcharting, Role of Allowance Process Capability, and Tolerance in Detailed Design and Assembly *Self Study*-– creative design, and the cultural design	**06 L**
02.	**Product Development Process Tools & Scoping Product Developments** Product development team: definition, composition, team roles, Myer-Briggs type indicator, team structure, team building, team evaluation; Product Development; phases of modern product development process; Reverse engineering and redesign product development process *Self Study*- Types of design, engineering design	**08 L**
03.	**Customer Needs Customer satisfaction:** Kano diagram, customer populations, types of customer needs, customer need models; Customer needs gathering methods: interviews, questionnaires, focus groups, be the customer need models; Customer Need Gathering Methods: Interviews, questionnaires, focus graphs, be the customer. Grouping the needs: affinity diagram method, customer sort method; cluster analysis method; *Self Study*- determining need importance; interview data method, questionnaire method	**06 L**
04.	**Product Design Practices in Industry:** Introduction, Product Strategies Time to Market, Analysis of the Product, The Three S's, Standardization Renard Series (Preferred Numbers), Simplification, The Designer and it's Role, The Designer: Myth and Reality, The Industrial Design Organization Basic Design Considerations, Problems faced by Industrial Designer. Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers, What the Designer contributes, Self Study:- Role of Aesthetics in Product Design, Functional Design Practice. Introduction to different Technology readiness levels (TRLs).	**06 L**
05.	Design for Manufacture and Assembly Design guidelines, Manufacturing cost Analysis. Design for Environment objectives, Basic design for environmental methods, life cycle assessment, techniques to reduce environmental impacts.	**06 L**

	Introduction to Safety Engineering, Design for safety, Product Architecture Design for Safety and Reliability. Cost and Price Structure, Information Need Sources, Estimating Direct and Indirect Costs, Design and Manufacturing Costs, Ways to Model Manufacturing Costs Human Engineering Considerations in Product Design	

Course outcomes:

At the end of the course, students will demonstrate the ability to

1) Demonstrate the basics of product design process and morphology of design.
2) Identify customer needs for new product development
3) Comprehend about product development process tools
4) Identify role of product development team
5) Illustrate design for safety, Environment, and Product cost.
6) Analyse different stages of product design.

Suggested learning resources:

1.Geoffrey Boothroyd, Assembly Automation and Product Design, Marcel Dekker Inc., NY, 3rd Edition, 2010.

2.Geoffrey Boothroyd, Hand Book of Product Design, Marcel Dekker Inc., NY, 1992.

3.Pravin Kumar. & M Ramaswamy, Fundamentals of design and manufacturing

4. Daniel Ling, Complete Design Thinking Guide for Successful Professionals, Kindle Edition

5. Karl Ulrich, Steven Eppinger, Product Design and Development, McGraw Hill India.

6. Seider, Seader, Lewin, Widagdo, Product and Process Design Principles: Synthesis, Analysis and Evaluation, 3ed, ISV: Synthesis, Analysis and Evaluation - ISV

Multidisciplinary Minor-I

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Course: FUNDAMENTALS OF MANUFACTURING PROCESSES (MDM-I)

Course Code		**Scheme of Evaluation**	MSE, TA & ESE
Teaching Plan	2-0-0-0 = 2	**MSE- 30**	**TA - 10**
Credits	2	**ESE - 60**	

Syllabus:

Unit	Contents	Lecture
01.	**Casting, moulding and Forming Processes** Introduction to casting processes and equipment; Special Casting Processes, plastic moulding processes. Introduction to forming processes; Bulk deformation processes; Sheet metal forming processes and equipment; Plastic Processing.	**06 L**
02.	**Joining Processes** Introduction of joining processes; fusion welding processes: gas welding, arc welding, resistance welding, high energy beam welding processes; solid-state welding processes; solid-liquid state welding: brazing, soldering; adhesive bonding; mechanical fastening.	**06 L**
03.	**Conventional Machining Processes** Introduction of material removal processes; chip removal processes: turning, milling, drilling, shaping, broaching, gear cutting; abrasion processes: polishing, grinding, honing, and lapping.	**06 L**
04.	**Introduction to Advanced Machining Processes** Introduction, chemical machining, electro chemical machining, electric discharge machining, electron beam machining, laser beam machining, abrasive jet machining, ultrasonic machining.	**06 L**
05.	**Additive Manufacturing Processes** Importance and overview of Additive Manufacturing Processes; Classification of Additive Manufacturing Processes: Vat polymerization, Powder Bed Fusion; Material Extrusion; Material Jetting; Binder Jetting; Direct energy deposition; Sheet laminations.	**04 L**

Course outcomes:

At the end of the course student should be able to:

1) Classify various basic manufacturing processes.
2) Identify various basic manufacturing processes.
3) Comprehend the process parameters associated with various basic manufacturing processes
4) Realize the industrial applications of various basic manufacturing processes.
5) Select the basic manufacturing processes based on the type of the material and process to be carried out.

Suggested learning resources:

1. Kalpakjian S. and Schmid S. R. (2021) Manufacturing processes for engineering materials. Pearson.
2. Rao P. N. (2018) Manufacturing Technology Vol. 1. Mc Graw Hill Education.
3. Mishra P. K. (2008) Non-Conventional Machining. Narosa Publishing House.
4. Jain V. K. (2009) Advanced Machining Processes. Allied Publishers, New Delhi

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CNC PROGRAMMING & MACHINING (CPM)

Course Code	VSEC	**Scheme of Evaluation**	Term work + Oral
Teaching Plan	0-0-4-1	Term Work	50
Credits	2	Oral	50

Unit	Contents	Hrs
01.	**Introduction to CNC technology** Introduction to CNC technology – CNC machines controls, History and development of CNC technology, Components of CNC system, Program of instructions, Machine Contol unit, Machine tools, Construction details of CNC machines, Machine structure, Slideways, Spindle, Drive units, Coordinate systems, Numerical Control Procedure	**06**
02.	**Drawing interpretation** Reading the machining sketches, Different Geometrical Tolerance symbols. Reading Dimensional Tolerances. Understanding the Views. Identifying feature from sketch and operation from feature.	**06**
03.	**CNC programming.** Introduction to CNC programming Introduction and demonstration of line programs, CNC programming or lathe & milling machine, CNC simulator, CNC programming for lathe and milling machines using different machining cycles on CNC simulator. Procedures Associated with part programming, cutting process parameter selection, Process planning issues and path planning, G and M Codes, Interpolations, Canned Cycles and Subprograms, Compensations.	**08**
04.	**CNC Turning** Plan and optimize programs for CNC turning operations. Calculate parameters like speed feed etc. and set a reference for the various operations. Prepare operation and operation sequence for the lathe operations like turning, grooving etc. Prepare and set CNC lathe operations and test run programmes, execute program and inspect simple geometrical forms on standard parts. Tooling for CNC turning	**08**
05.	**CNC Milling** Plan and optimize programs for CNC Milling operations. Calculate parameters like speed feed, depth of cut etc. and set a reference for the various operations. Various methods of work process like edge finding block centre etc. Prepare and set CNC Milling operations and test run programme. Execute program and inspect simple geometrical forms on standard parts. Tooling for CNC Milling	**06**
06	**Modern CNC systems** Introduction to advanced CNC systems: Computer Aided Part Programming (CAPP), application using CAM software tools. Comparison of manual part programming and CAPP for a simple component, Automatic Tool Changer, Automatic Pallet Control, Automatic Storage and Retrieval Systems.	**08**

Course Outcomes:

1) Program various CNC controlled machines and centres.
2) Prepare and understand program for various profiles
3) Identify and set parameters for various simulators and operate the CNC machines for various operations.
4) Analyze the problems with the machining operations.

Text Books:

1. *Programming of CNC machines, by Ken Evans*
2. *CNC Programming Handbook by Peter Smid*
3. *NC Control by Kundra Rao, Tewari*
4. *CNC Machines by M Adithan, B S Pabla*

Exit Course option for Diploma in Manufacturing Sciences

Two (02) Skill based courses:

Course: **Geometric Dimensioning and Tolerancing & Product Inspection (GDTPI)**

Course Code	SEC	**Scheme of Evaluation**	Term work + Oral
Teaching Plan	0-0-8-1 = 4	Term Work	50
Credits	4	Oral	50

Course Contents:

Unit No.	Topics	Teaching Hours
1	Introduction: Geometric product definition principles; verification ofposition with open setup; geometric characteristic symbols Geometric Dimensioning and Tolerancing: an explanation of tolerance zone conversion; surfaces, features, features of size, datum features, datum features of size, and datum's; tolerances; components common to geometrically dimensioned& toleranced drawing; fits & allowances, advantages of GD&T	10
2	MMC, LMC & RFS: Maximum Material Condition (meaning & use); Least Material Condition (meaning & use); Regardless of Feature Size How to read a Feature Control Frame	06
3	Size Control Form: The Taylors principle; Gauging size limits. Rules, concepts, Characteristics, and Untoleranced Dimensions: individual or related Datum's, Material Conditions; untoleranced dimensions	06
4	Datums: Datum features; oddly configured & curved surfaces as datum features; equalizing datum's; datum feature symbols; flexible parts; direct vs indirect tolerancing. MMC and its ramifications. Relations between individual features. Virtual Condition and Resultant condition Boundaries: Virtual condition (MMC concept & a functional boundary). Effect of LMC; wall thickness calculation.	05
5	Datum Feature of Size Representation: Modes of datum feature representation; angular orientation. Form Controls: flatness; straightness: circularity; free state variation; circularity Orientation Controls: orientation characteristics; angularity; perpendicularity Profile; line element controls Run out: circular & total Location: concentricity; the return of symmetry; position	05
6	A Logical Approach to part Tolerancing Dimensioning and Tolerancing Schemes Steps for the Development of a Dimensional Inspection Plan Paper Gauging and Functional Gauging	10

Course Outcomes (COs):

At the end of this course students will be able to

1. Differentiate between conventional and GD&T tolerance zones.
2. Demonstrate MMC, LMC and RFS concepts.
3. Assess the significance of selection of datum & datum features as well as showcase the form, orientation, profile, runout, and orientation controls.
4. Apply the GD and T concept for part manufacturing.

List of References:

1. James D Meadows, “Geometric Dimensioning and Tolerancing”, Marcel Dekker, Inc
2. James D Meadows, “Measurement of Geometric Tolerances in Manufacturing” Marcel Dekker, Inc
3. P S Gill, “Geometric Dimensioning and Tolerancing”, S K Kataria & sons, 2005-6

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Course: Modern Prototyping Practice

Course Code	SEC	**Scheme of Evaluation**	Oral & Term Work
Teaching Plan	0-0-8-1	Term Work	50
Credits	4	Oral	50

Assignment	**Contents**	**Practical**
01	Study and Hands on Practise on FDM 3D Printing Technologies:	4 hrs
02	Study and Hands on Practise on Liquid Resin Printing Technologies:	4 hrs
03	Demonstration of Advanced Additive Manufacturing Technologies like Metal AM.	4 hrs
04	Study and Hands on Practise on Reverse Engineering Equipment's	4 hrs
05	Study and hands on practise on Laser engraver	4 hrs
06	Study and hands on practice on CNC milling machine	4 hrs
07	Study and hands-on practice on wood router	6 hrs

Course Outcomes:
At the end of the course, students should be able to:

1) Use different FDM 3D printing processes for the given applications.
2) Know about the different types of additive manufacturing techniques and its applications
3) Evaluating key parameters of reverse engineering processes .
4) To plan and fabricate the 2D and 3D profiles using laser engraver and CNC wood router machine.

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