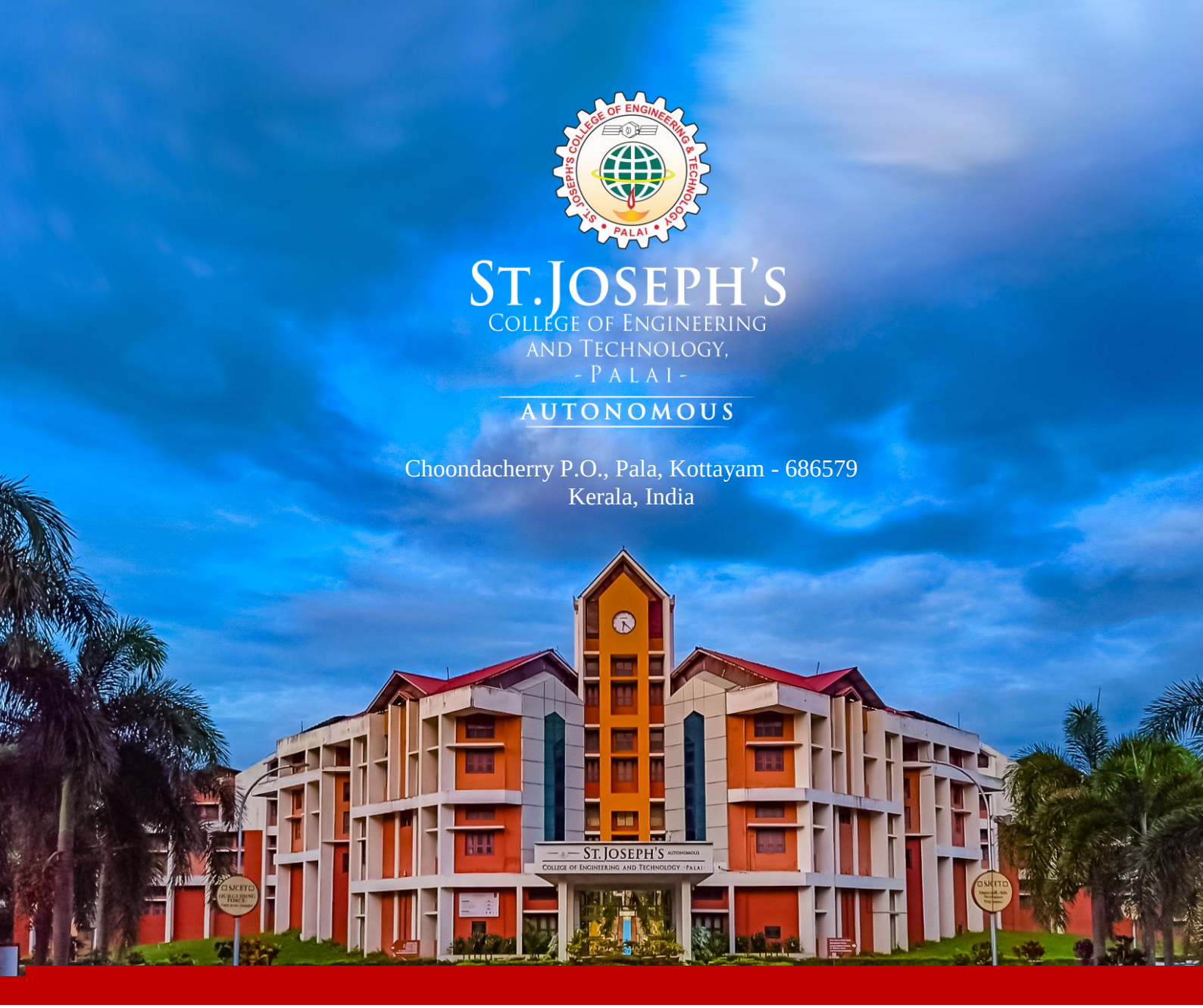

CURRICULUM & SYLLABUS

B. Tech. (Honours) *in*
MECHANICAL ENGINEERING

2024 SCHEME

CURRICULUM

B.Tech (Honours) is an enhanced version of the Bachelor of Technology degree, offering the students the opportunity to undertake additional courses within their own discipline. This pathway allows students to deepen their knowledge in emerging or advanced areas of Engineering relevant to their field of study, providing a stronger foundation for specialized career paths or further academic pursuits.

For the award of B.Tech (Honours) in Mechanical Engineering, the student shall fulfill all the curricular requirements for B.Tech in Mechanical Engineering as per SJCET B.Tech Academic Regulations 2024 and shall earn 15 additional credits by undergoing the following courses, which shall be further governed by clause R16 of the Regulations.

Sl. No	Semester	Course Code	Course Name/Type	Weekly hours				Total Marks		Credits
				L	T	P	SS	CIE	ESE	
1	4#	24SJHNMET409	Materials in Manufacturing	3	1	0	5	40	60	4
2	5	24SJHNMET509	Fluid Power Automation	3	1	0	5	40	60	4
		24SJHNMEM5XX	Approved MOOC*							
3	6	24SJHNMET609	Advanced Numerical controlled Machining	3	1	0	5	40	60	4
		24SJHNMEM6XX	Approved MOOC*							
4	7	24SJHNMET709	Precision Machining	2	1	0	4	40	60	3
		24SJHNMEM7XX	Approved MOOC*							
Total Credits										**15**

 # Students must register for theory courses in the 4th semester of the Honours curriculum

**MOOC to be approved by the Academic Council on recommendation of the Board of Studies.*

MATERIALS IN MANUFACTURING

Course Code	24SJHNMET409	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Pre-requisites (if any)	Metallurgy and Material Science	**Course Type**	Theory

Course Objectives:

- To provide fundamental knowledge of chemical bonding, crystal structures, and their influence on material properties.
- To understand the relationship between material structure and properties for high-temperature and critical manufacturing applications.
- To familiarize students with advanced material processing techniques such as triple vacuum induction melting for achieving high purity and superior performance.
- To develop an understanding of methods to enhance material strength, predict service life, and explore the characteristics and strengthening mechanisms of superalloys.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the chemical bonds, crystal structures and their relationship with the properties.	**K2**
CO2	Correlate structure and properties relationship for high temperature applications.	**K3**
CO3	Understand the attributes and purity obtainable through triple vacuum induction melting process.	**K2**
CO4	To have knowledge in improving material strength against high temperature environment and predict life time and also understand the properties of super alloys and its strengthening processes.	**K3**

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

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

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Atomic structure- chemical bonds-crystallography-miller indices - slip - dislocation – crystallization frank- reed source - Structural parameters in high-temperature deformed metals - dislocation structure - distances between dislocations in sub-boundaries - sub-boundaries as dislocation sources and obstacles -dislocations inside sub-grains - vacancy loops and helicoids - structural peculiarities of high - temperature deformation.	11	1
2	Characteristics of high-temperature materials - The super alloys as high-temperature materials- The requirement: the gas turbine engine- Larson–Miller approach for the ranking of creep performance development of the super alloys- Nickel as a high-temperature material: justification- super alloy production methods: - vacuum induction melting (VIM), vacuum arc remelting (VAR), VIM, electroslag remelting (ESR), VIM, ESR, VAR- Freckles, three rings, white spot- cleanliness.	11	2
3	Superalloys:- metallurgy, characteristics - wrought, cast superalloys, properties -crystal structures, phases in superalloys, Iron-Nickel-base superalloys, Nickel-base superalloys, Cobalt-base superalloys, - elements causing brittle phase formation, detrimental tramp elements, elements producing oxidation and hot corrosion resistance- microstructure, gamma prime, gamma double prime, Carbide and Boride phases, strengthening mechanisms- Heat treatment.	11	3
4	Single-crystal super alloys for blade applications: - solidification, heat transfer, defects – mechanical behavior, performance in creep, fatigue -Titanium: binary phase diagram - production of ingot - forgings - shear bands - pickling - Ti alloys - machining and welding of Titanium - Heat Treatment - properties of titanium aluminides - Niobium: production of niobium - niobium in steel making – niobium alloys characteristics and applications- Niobium products for the superalloy industry. Molybdenum: Ferromolybdenum - production of molybdenum – properties - effect of molybdenum alloying– applications - TZM, TZC	11	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Material Science and Engineering	Callister William. D.,	John Wiley	2014
2	Super alloys A Technical Guide	Matthew J. Donachie, Stephen J. Donachie	ASM International	Second Edition, 2002

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Structure of metals	Barrett, C. S. and Massalski, T. B.	New York, N.Y., McGraw-Hill Book Company	Third edition, 1966
2	Source book on maraging steels: A comprehensive collection of outstanding articles from the periodical and reference literature	Decker, Raymond Frank	American Society for Metals	1979
3	The Super alloys Fundamentals and Applications	Roger C. Reed	Cambridge university press	
4	High temperature strain of metals and alloys - physical fundamentals	Valim Levitin	Wiley- VCH	2006

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Atomic Structure	https://onlinecourses.nptel.ac.in/noc22_cy36/preview
2	Nickel based Super alloy	https://www.youtube.com/watch?v=mvUF9gKBXJ4
3	Cobalt based Super alloys	https://www.youtube.com/watch?v=QBkDDk69-fM
4	Titanium based alloys	https://www.youtube.com/watch?v=rWYJn0gfFbY

FLUID POWER AUTOMATON

Course Code	24SJHNMET509	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Pre-requisites (if any)	None	**Course Type**	Theory

Course Objectives:

- To provide fundamental knowledge of fluid power systems, including the principles and components of hydraulic and pneumatic power generation.
- To understand the construction and operation of key fluid power components and their control, regulation, and circuit design in automation systems.
- To introduce electrical and electro-pneumatic/hydraulic control methods used in modern automated systems.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basic concepts of fluid power automation and the working of hydraulic and pneumatic drives.	**K2**
CO2	Describe the construction, working, and control of actuators, valves, and other key elements in fluid power systems.	**K2**
CO3	Design simple fluid power circuits using ladder diagrams and logic-based methods.	**K3**
CO4	Explain the electrical control of hydraulic and pneumatic circuits using relays, timers, counters, and PLCs.	**K2**

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

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

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Need for automation – classification and comparison of hydraulic and pneumatic drives – ISO symbols for fluid power elements – selection criteria – fluid power generating elements – hydraulic pumps and motors – gear, vane and piston types – selection and specifications.	11	1
2	Drive characteristics – linear actuators – types and cushioning – power packs – accumulators – control and regulation elements – direction, flow and pressure control valves – methods of actuation – spool valves – operating characteristics – electro-hydraulic servo valves – types and performance.	11	2
3	Ladder diagrams – sequencing circuit design – combinational logic design – cascade method – Karnaugh map method.	11	3
4	Electrical control of pneumatic and hydraulic circuits- use of relays, timers, counters, interfacing with PLCs, proportional control of hydraulic systems	11	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
➢ 2 Questions from each module. ➢ Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	➢ Each question carries 9 marks. ➢ Two questions will be given from each module, out of which one question should be answered. ➢ Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books				
Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fluid Power Transmission and Control	Alavudeen A	Charotar Publishing House	2007
2	Hydraulics and Pneumatics	Jagadeesha T	I K International Publishing House	2015
3	Fluid Power System and control	Antony Esposito	Prentice-Hall	1988

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fluid Power logic circuit design	Peter Rohner	Macmillan Press	1994
2	Introduction to fluid logic	E.C. Fitchand, J.B. Surjaatmadja	McGraw Hill	1978
3	Hydraulic control systems	Herbert E. Merritt	John Wiley &Sons	1976
4	Basic Fluid Power	Dudley.A.Pease	PrenticeHall	1967

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Introduction to Oil Hydraulics and Pneumatics	https://youtu.be/VtNLMtUAxgg?si=uOuQDWa5teAt4F60
2	Directional Control Valves	https://youtu.be/JlYbKgsgrxY?si=8yUlUX7gQWwNuKd1
	Flow control valves	https://youtu.be/o2apCAU4bDk?si=CD9vz3wtZYt49kpk
3	Ladder Logic 3	https://youtu.be/MS3qJq2jvu0?si=c9hH0vf51DXcpFCv
4	Internal relays	https://youtu.be/MS3qJq2jvu0?si=XDF45nJ8f3hhTaZq
	Timers	https://youtu.be/MS3qJq2jvu0?si=nxQR4jwZb_yac82y

ADVANCED NUMERICAL CONTROLLED MACHINING

Course Code	24SJHNMET609	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Pre-requisites (if any)	None	**Course Type**	Theory

Course Objectives:

- To understand the principles, components, and peripheral requirements of numerical control (NC) and computer numerical control (CNC) systems.
- To familiarize students with various machining approaches and techniques employed in NC/CNC operations.
- To develop the ability to create, analyze, and optimize NC part programs for different machining applications.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To study the structure of numerical control and its applications	**K3**
CO2	To understand the features and control of CNC	**K2**
CO3	To write numerical part program of simple machining	**K3**
CO4	To familiarize the structure of computer assisted part programming features and to study the constructional and automated features of numerical controlled machining	**K3**

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

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

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**Principles of Numerical Control:** Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines. Historical developments and future trends. Future of NC Machines, Difference between ordinary and NC Machine tools, Machining Capabilities of a CNC Machine, Methods for improving accuracy and productivity.	11	1
2	**Control of NC Systems:** Classification of CNC control systems Open and Closed loop systems, Types of CNC Machine Tools systems devices, e.g. encoders and interpolators, Features of CNC Systems, Direct Numerical Control (DNC), Standard Controllers and General Programming features available in CNC Systems, Computer Process monitoring and Control. Adaptive control systems.	11	2
3	**NC Part Programming:** Axis identification and coordinate systems, Structure of CNC part program, Programming codes, Programming for 2 and 3 axis control systems, Manual part programming for a turning center, Programming using tool nose radius compensation, Tools offsets, Do loops, sub routines and fixed cycles. Manual Programming for simple parts. **Computer aided part programming**; Tools for computer aided part programming, Computer aided NC Programming in APT language, use of canned cycles, Generation of NC Programmes through CAD/CAM systems, Design and implementation of post processors.	12	3
4	**Constructional Details of CNC Machines:** Machine structure, Slide –ways, Motion transmission elements, Swarf removal and safety considerations, Automatic tool changers and multiple pallet systems, Sensors and feedback devices in CNC machines, Constructional detail of CNC turning center and CNC machining center. **Tooling of CNC Machines** Tooling requirements of CNC machines, Pre-set and qualified tools, Work and tool holding devices in CNC machines. Design considerations of CNC machines.	10	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Numerical Control Machines	Radhakrishnan, P	New Central Book Agencies	-
2	Automation, Production Systems and Computer Integrated Manufacturing	Mikell P. Groover	Prentice Hall.	2008

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Control of Manufacturing Systems	Yoram Koren	Tata McGraw Hill Book Co	2005
2	Mechatronics	HMT	Tata McGraw-Hill Publishing Company Limited, New Delhi	1998

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Numerical controls	https://onlinecourses.nptel.ac.in/noc19_me46/preview
2	NC part programming	https://nptel.ac.in/courses/112105211
3	CNC machines	https://nptel.ac.in/courses/112102103
4	Tooling of CNC Machines	http://digimat.in/nptel/courses/video/112105211/L01.html

PRECISION MACHINING

Course Code	24SJHNMET709	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	2:1:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Pre-requisites (if any)	None	**Course Type**	Theory

Course Objectives:

- To provide an understanding of the design principles and process parameters involved in precision machining operations.
- To familiarize students with various precision machining techniques and their industrial applications.
- To develop the ability to analyze and select appropriate precision machining processes for achieving high accuracy and surface quality.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Contrast basic premises of normal machining and precision machining	**K2**
CO2	Relate consideration of error and sources of error and role of kinematic design in establishing precision.	**K2**
CO3	Explain various sensors and AE based monitoring in precision machining environment	**K2**
CO4	Outline the basics of process planning for precision machining and also explain various precision machining processes.	**K2**

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

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

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction to precision machining: Competitive drivers for precision machining. Definition of terms accuracy, precision and resolution. Metrology and measurement- Abbe's principle. Measurement of dimension and angle- measurement of form- straightness, flatness and roundness. Measurement of surface roughness.	9	1
2	Sources of error in precision machining: Mechanical errors- errors due to machine elements, thermal errors, Error due to compliance and vibration. Error budget- error budget flow chart- (elementary idea only). Role of kinematic design in precision. Principles of design and utilisation of bearings-aerostatic bearings.	8	2
3	Sensors in precision machining: Classification of basic sensor types- overview of sensors in manufacturing- applications- AE based monitoring of grinding wheel dressing- fast AE RMS analysis of wheel condition monitoring (description only). Topographical mapping of grinding wheel. AE based monitoring of face milling	9	3
4	Process planning for precision machining: process planning basics- factors which influence precision process capability-relationship between process variability and product specification- process capability as a planning metric. Precision machining processes: Diamond turning and milling, fly cutting diamond machine configuration- features of diamond machine tool design- applications. Configuration for conical circumferential milling- applications. Typical single point diamond tool geometry. Abrasive processes-fixed and loose. Nano grinding-Chemical mechanical Planarization (CMP)- precision manufacturing applications.	10	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Precision Engineering	V.C. Venkatesh, Sudin Izman	Tata McGraw-Hill	2007

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Precision Manufacturing	David Dornfeld, Dae-Eun Lee	Springer	2008
2	Precision Machining	Michael N. Morgan, Andrew Shaw, Otar Mgaloblishvili	Transtech publications Ltd, Switzerland	2012

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Introduction to precision machining	https://youtu.be/UEcER1ar4_8?si=TumH1iPcqUM2Ke4c https://youtu.be/fo_QOB65D7k?si=Dnvn2PHaAQjCwA5L https://youtu.be/BCOU-4apOC0?si=dLF0zuHuVniikxVl https://youtu.be/FftMXCoH-Lo?si=5Hude8si4B4empFJ https://youtu.be/0tJfwMH1qTU?si=Ibrp6PApJ-J94r-E
2	Principles of design and utilization of bearings-aerostatic bearings	https://youtu.be/nMObU49i2yc?si=r1uMxfs1-MZua02N
3	Sensors in precision machining	https://www.youtube.com/watch?v=oPuk06kTJmM&t=31s
4	Precision machining processes	https://www.youtube.com/watch?v=Jg6YXvTO5FE&t=1s https://youtu.be/cghHDQrdObo?si=q023bzWR1mP4snS4