

# SYLLABUS

(Academic Year 2025 -26)

## ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ ೨೦೨೫-೨೬)

Bachelor Degree  
In  
**Mechanical Engineering**

**VII & VIII Semester**

Out Come Based Education  
With  
Choice Based Credit System

[National Education Policy Scheme]



**P.E.S. College of Engineering, Mandya - 571 401, Karnataka**

[An Autonomous Institution affiliated to VTU, Belagavi,  
Grant – in – Aid Institution (Government of Karnataka),  
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ-571 401, ಕರ್ನಾಟಕ

(ಎ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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# P.E.S. College of Engineering, Mandya

(An Autonomous Institution, Affiliated to VTU, Approved by AICTE & UGC, Aided by Govt. of Karnataka)

## Department of Mechanical Engineering

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### VISION

*“PESCE shall be a leading institution imparting quality Engineering and Management education developing creative and socially responsible professionals.”*

### MISSION

- *Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.*
- *Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.*
- *Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.*
- *Promote research, product development and industry-institution interaction.*

### QUALITY POLICY

*Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.*

### CORE VALUES

*Professionalism*

*Empathy*

*Synergy*

*Commitment*

*Ethics*



## Department of Mechanical Engineering

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### About Department of Mechanical Engineering

The Department of Mechanical Engineering was established in the year 1962 during the origination of the institute. The department was granted academic autonomy in the year 2009. The department presently offers B.E in Mechanical Engineering, M Tech in Machine Design, M.Sc., (Engg.) by research and research leading to Ph.D. The present intake capacity of the department is 120 for BE, 24 for M Tech Machine Design. The department has a faculty-student ratio of 1:20 for UG courses and 1:12 for PG courses. The department has well established laboratories to meet the academic requirements of UG and PG programmes and a skilled technical faculty to train the students. The department has its own library which has a collection of about 4600 reference books. The department is accredited with NBA for 3Years in 2019. The department regularly organizes industrial visits, technical talk by experts from industries and institutes in contemporary areas to bridge the gap between syllabi and current corporate developments. The students are encouraged to undergo industrial training as well as to take up industry oriented projects during their academic course. Mechanical Engineering Association (MEA), formed by the students and faculty of the department regularly organizes co-curricular and extracurricular activities for the students.

### Department Vision

“Be a department well recognized for its ability to develop competent mechanical engineers capable of working in global environment”

### Department Mission

The Mission of the Department of Mechanical Engineering is to:

- Provide quality education by competent faculty.
- Provide adequate infrastructure and learning ambience for the development of essential technical skills.
- Inculcate a sense of higher education and research orientation.
- Foster industry interaction.

### Program Educational Objectives (PEOs)

The Department of Mechanical Engineering has formulated the following programme educational objectives for the under-graduate program in Mechanical Engineering:

The Mechanical Engineering graduates will be able to:

**PEO1:** Use the fundamentals of basic science, mathematics and mechanical engineering, to pursue their career as engineers as well as to lead and manage teams in global organizations.

**PEO2:** Pursue advanced education, research and development and engage in the process of life-long learning.

**PEO3:** Become entrepreneurs in a responsible, professional and ethical manner to serve the society.

### Program Specific Outcomes (PSOs)

Engineering graduates should be able to:



**PSO1:** Apply conceptual knowledge with practical engagement that has real life problems by integrating different domains of mechanical engineering.

**PSO2:** Utilize the modern tools and emerging technologies with technical skills to design, develop and analyse mechanical systems through multidisciplinary approach.

### Program Outcomes (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.



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## Department of Mechanical Engineering

### Bachelor of Engineering – Mechanical Engineering (VII –Semester)

Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P22ME701	Operations Research	ME	3	-	-	3	50	50	100
2	P22ME702X	Professional Elective Course – IV	ME	3	-	-	3	50	50	100
3	P22ME703X	Professional Elective Course - V	ME	3	-	-	3	50	50	100
4	P22ME704	Theory of Machine-II	ME	3	-	2	4	50	50	100
5	P22RMI705	Research Methodology and IPR	ME	3	-	-	3	50	50	100
6.	P22ME706	Project Work Phase – I	ME	-	-	2	4	100	-	100
	P22NSS707	National Service Scheme	NSS							
	P22PED707	Physical Education (Sports and Athletics) - II	PED	-	-	2	-	50	50	100
	P22YOG707	Yoga	YOGA							
<b>Total</b>							<b>20</b>	<b>400</b>	<b>300</b>	<b>700</b>

Professional Elective Course – IV (P22ME702X)		Professional Elective Course – V (P22ME703X)	
Course Code	Course Title	Course Code	Course Title
P22ME7021	Computational Fluid Dynamics	P22ME7031	Advanced Manufacturing
P22ME7022	Condition Based Monitoring	P22ME7032	Composite Materials
P22ME7023	Hydraulics & Pneumatics	P22ME7033	Robotics & Artificial Intelligence
P22ME7024	Total Quality Management	P22ME7034	Tribology

### Bachelor of Engineering – Mechanical Engineering (VIII –Semester)

Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P22ME801	Self-Study Course	ME	-	-	-	2	100	-	100
2	P22INT802	Research / Industry Internship – III	ME	-	-	-	6	-	100	100
3	P22ME803	Project Work Phase – II	ME	-	-	2	8	100	100	200
<b>Total</b>							<b>16</b>	<b>200</b>	<b>200</b>	<b>400</b>



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## Department of Mechanical Engineering

Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Title: OPERATIONS RESEARCH		
Course Code: P22ME701	CIE Marks:50	CIE Weightage: 50%
Teaching hours/week (L:T:P): 3-0-0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy:40 hrs	Exam Hours: 3hrs	
Credits:03		
<b>Prerequisite:</b>		
Fundamental Mathematics		
<b>Course learning Objectives:</b>		
<b>CLO1:</b> Understand the basic concepts of Operations Research. <b>CLO2:</b> Identify and develop operation research models from the verbal description of real life and optimize the solutions.		
<b>Unit 1:</b>		<b>Hrs: 8</b>
<b>Introduction:</b> Definition of Operations Research (OR), scope of OR, applications of OR, phases of OR study, characteristics and limitations of OR, models used in OR, Linear Programming Problems (LPP), mathematical formulation of LPP, solutions to LPP by graphical method for maximization and minimization problems, advantages of OR.		
<b>Self-Study Content:</b> History of Operations Research. Case study related to formulation problems		
<b>Unit 2:</b>		<b>Hrs:8</b>
<b>Linear Programming Problems:</b> Simplex method, slack, surplus and artificial variables, degeneracy and procedure for resolving degeneracy. Big M method, two phase method.		
<b>Self-Study Content:</b> Dual simplex method, program of simplex problem using C.		
<b>Unit 3:</b>		<b>Hrs:8</b>
<b>Transportation and Assignment:</b> Formulation of transportation problem, initial feasible solution methods, optimality test, degeneracy in transportation problem, assignment problem, Hungarian method, travelling salesman problem.		
<b>Self-Study Content:</b> Unbalanced transportation and assignment problems.		
<b>Unit4:</b>		<b>Hrs:8</b>
<b>Network Analysis in Project Planning (PERT and CPM):</b> Project, project planning, project scheduling, project controlling, network terminologies, PERT and CPM.		
<b>Self-Study Content:</b> Crashing of networks. Case study related to network analysis in project planning problems.		
<b>Unit 5:</b>		<b>Hrs:8</b>
<b>Game Theory:</b> Formulation of games, two people-zero sum game, games with and without saddle point, graphical solution (2 x n, m x 2 game) and dominance property. Queuing Theory: Queuing system and their characteristics. The M/M/I Queuing system, steady state performance analyzing of M/M/I System.		
<b>Self-Study Content:</b> Competitive games. Case study related Game and queuing theory problems.		
<b>Suggested Learning Resources:</b>		
<b>Textbooks:</b>		



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Sl. no	Title	Author	Year & Edition (Latest)	Publisher
1	Operations Research	Taha H.A	2019 and 10 <sup>th</sup> edition	Pearson Education
2	Operations Research	Prem Kumar Gupta and D.S. Hira,S Chand	2014 and 7 <sup>th</sup> edition	Pub, NewDelhi.
<b>Reference Books:</b>				
1.	Operations Research	R Panneerselvam	2016 and 2 <sup>nd</sup> edition	PHI
2	Operations Research	S.D. Sharma	2014 and 2 <sup>nd</sup> edition	KedarnathRamnath&amp
3	Introduction to Operation Research	Frederick S. Hillier, Gerald J. Lieberman	2018 and 7 <sup>th</sup> edition	McGraw Hill, Seventh Edition

### Web links and Video Lectures ( e-resources)

- [1.https://www.youtube.com/watch](https://www.youtube.com/watch)
- [2. https://www.edx.org/course/quantitative-marketing-research](https://www.edx.org/course/quantitative-marketing-research)
- [3. https://www.edx.org/course/uconn-cybersecurity-boot-camp](https://www.edx.org/course/uconn-cybersecurity-boot-camp)
- [4. https://www.edx.org/professional-certificate](https://www.edx.org/professional-certificate)

### Active Based Learning (Suggested Activity in Class)/ Practical Based Learning( Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

### Course Articulation Matrix

Course Outcomes		Program Outcomes											PSO	
		1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	<b>Formulate</b> real world problems as a Linear programming model and demonstrate solution by graphical method and analysis technique.	3	3											
CO2	<b>Apply</b> the specific LPP like transportation and assignment and analyse the solution.	3	3											
CO3	<b>Apply</b> the different project mathematical model and analyze the solution.	3	3											
CO4	<b>Apply</b> the game and Queuing strategy with their characteristics and analyse the solutions.	3	3											



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## Department of Mechanical Engineering

### BLUE PRINT OF SEE- COURSE ASSESSMENT PLAN

Unit Name	Questions to be set for SEE					Marks weightage	% Weightage (Marks)
	R (L1)	U (L2)	A (L3)	AN (L4)	E (L5)		
Unit I	02	09	09	09	-	29	20
Unit II	02	04	14	00	-	20	20
Unit III	02	06	12	12	-	32	20
Unit IV	02	06	12	12	-	32	20
Unit V	02	09	09	09	-	29	20
Total	10	34	46	42	-	142	
% Weightage (Cognitive level)	07	31	31	31	-	-	100

**R:Remember, U:Understand, A:Application, AN:Analysis, E:Evaluate**



Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Title: COMPUTATIONAL FLUID DYNAMICS		
Course Code: P22ME7021	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P): 3:0:0	SEE Marks: 50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40 hrs	Exam Hours: 03 Hours	
Credits: 03		
<b>Prerequisite:</b>		
A solid understanding of basic thermodynamics, engineering physics, and mathematics is essential. Familiarity with fluid mechanics is also recommended.		
<b>Course learning Objectives:</b> The objectives of this course are to		
<b>CLO1:</b> Prepare students in the fundamentals of the computational approach to study fluid flow and heat transfer problems and will provide a deeper understanding of the physical models and governing equations of fluid dynamics.		
<b>CLO2:</b> Impart the knowledge of numerical techniques to the solution of fluid dynamics and heat transfer problems.		
<b>Unit 1:</b>		<b>Hrs: 08</b>
<b>Governing Equations:</b> Need of CFD as tool, role in R&D, Overview of 3-D general mass conservation, momentum and energy equations in differential form and integral form. <b>Partial Differential Equations (PDE):</b> classification of PDE, hyperbolic, parabolic and elliptic forms of equations and their physical behaviour, physical boundary conditions.		
<b>Self-Study Component:</b> Comparison of experimental, Theoretical and computational approaches, CFD Applications, Concept of material or substantial derivative or total derivative.		
<b>Unit 2:</b>		<b>Hrs: 08</b>
<b>Finite Difference Method:</b> Derivation of finite difference equations for first and second order accuracy, different numerical schemes-explicit and implicit approach-upwind, downwind, FTCS, etc., truncation error, round-off and discretization errors and analysis of stability, error propagation, application of numerical methods to selected model equations; wave equation, heat equation, Laplace equation.		
<b>Self-Study Component:</b> Stability properties of explicit and implicit methods, Numerical dissipation and numerical dispersion.		
<b>Unit 3:</b>		<b>Hrs: 08</b>
<b>Finite Volume Method for Diffusion:</b> Finite volume formulation of steady state one dimensional diffusion problems, finite volume methods for diffusion equation-one dimensional unsteady heat conduction through explicit, Crank-Nicolson and fully implicit.		
<b>Self-Study Component:</b> Properties of discretization schemes-conservativeness, Boundedness, transportive.		
<b>Unit4:</b>		<b>Hrs: 08</b>
<b>Finite Volume Method for Convection Diffusion:</b> Finite volume formulation of steady state one dimensional convection-diffusion problems- central, upwind, hybrid, power-law, QUICK differencing schemes.		
<b>Self-Study Component:</b> Properties of discretization schemes-conservativeness, Boundedness, transportive.		
<b>Unit 5:</b>		<b>Hrs: 08</b>
Overview of Ansys Workbench: (Teaching by Industry Experts)		



Introduction, mechanical overview, starting mechanical, working with units, basic analysis procedure, mechanical interface, menus, toolbars, graphics controls and selection, outline tree and details, tagging and tree filtering, graphics window, mechanical application wizard, scoping loads and supports, engineering data application. General pre-processing: Geometry, connections, co-ordinate systems, named selections, object generator, selection information. Meshing: Global, local meshing controls, mesh troubleshooting, virtual topology, submodelling.

**Self-Study Component:** Need for CFD, applications of CFD, Convergence criteria

### Suggested Learning Resources:

#### Textbooks:

Sl. No	Title	Author	Year & Edition (Latest)	Publisher
1	Computational Fluid Mechanics and Heat Transfer	John C. Tannehill, Dule A Anderson and Richard H Pletcher	3rd Edition, 2011, ISBN: 139781591690375	CRC press
2	Numerical Heat Transfer and Fluid Flow	SuhasVPatankar,	1980 ISBN: 139780891165224.	CRC press

#### Reference Books:

1	Computational Fluid Dynamics	T.J. Chung	2nd edition, 2010 ISBN: 139780521769693.	Cambridge University Press
2	Computational fluid Dynamics- The basics with applications	John D. and Anderson	Inc.1995, ISBN:139780070016859.	McGraw-Hill
3	Computational Fluid Flow and Heat Transfer	Muralidhar, K., and Sundararajan. T	2 <sup>nd</sup> edition, 2009, ISBN: 139788173195228.	Narosa Publishing House, New Delhi
4	“An Introduction to Computational Fluid Dynamics: The finite volume Method	Versteeg, H.K., and Malalasekera. W	2nd edition, 2007, ISBN: 139780131274983.	Pearson

#### Web links and Video Lectures ( e-resources)

1. <https://archive.nptel.ac.in/courses/112/103/112103289/>

#### Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)



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## Department of Mechanical Engineering

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Course Articulation Matrix														
Course Outcomes		Program Outcomes										PSO		
		1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	Formulate mathematical models and apply them with suitable boundary conditions to engineering scenarios.	2	3										2	1
CO2	Analyze the behavior of fluid flow in various systems for optimizing designs and performance.	2	3										2	1
CO3	Predict and apply discretization schemes and implement them to solve engineering problems.	3	1										2	2
CO4	Simulate and evaluate numerous design iterations quickly and cost-effectively.	3	1			2							2	2

### BLUEPRINT OF SEE- COURSE ASSESSMENT PLAN

Unit Name	Questions to be set for SEE					Marks weightage	% Weightage (Marks)
	R (L1)	U (L2)	A (L3)	AN (L4)	E (L5)		
Unit I	02	-	18	09	-	29	20
Unit II	02	-	18	09	-	29	20
Unit III	02	-	18	09	-	29	20
Unit IV	02	09	09	09	-	29	20
Unit V	02	09	09	09	-	29	20
Total	10	18	72	45	-	145	
% Weightage (Cognitive level)	07	25	50	31	-	-	100

R:Remember, U:Understand, A:Application, AN:Analysis, E:Evaluate



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## Department of Mechanical Engineering

Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Title: Condition Based Maintenance		
Course Code: P22ME7022	CIE Marks:50	CIE Weightage:50%
Teaching hours/week (L:T:P):3:0:0	SEE Marks:100	SEE Weightage:50%
Teaching hours of Pedagogy: 40	Exam Hours: 3Hrs	
Credits:03		
<b>Prerequisite:</b>		
<ul style="list-style-type: none"> <li>Fundamentals of Mechanical Engineering including machine elements, material properties, vibrations, thermodynamics, and mechanics of materials.</li> <li>Basic knowledge of maintenance practices and inspection techniques for monitoring and diagnosing mechanical systems.</li> </ul>		
<b>Course learning Objectives:</b>		
<b>CLO1:</b> To provide extensive knowledge of Condition Based Maintenance (CBM); The techniques & tools used, the diagnostics and advanced methods of CBM		
<b>CLO2:</b> To develop the ability to select and apply appropriate condition monitoring and non-destructive testing techniques for predicting and diagnosing equipment faults.		
<b>Unit 1:</b>		<b>Hrs:8</b>
<b>Condition Based Maintenance:</b> Introduction, Principles, Economics and Application; Condition Monitoring Methods. Economics of Condition Monitoring, Setting up a CM Activity, Implementation of Condition Based Maintenance, Consequences of implementation of CBM. Information System, Selection of Monitoring Methods, Assessment of monitoring techniques.		
<b>Self-Study Content:</b> Performance Trend Monitoring;Steam turbine performance parameters.		
<b>Unit 2:</b>		<b>Hrs:8</b>
<b>Non-Destructive Testing:</b> Introduction, Visual testing, Liquid Penetrant inspection and other methods, Radiographic examination, Electrostatic or Ven De Graffgenerators, Linear accelerators. Gamma-ray Radiography- Sources-Radium, Thallium 170, Iridium 192, Cobalt 62. Isotope Projectors-Geometric factors, Radiographic film, Radiograph. Safety Hazards and Government control; Cost. Sonics, Ultra Sonics, Ultra Sonic inspection and other techniques. <b>Sound Monitoring:</b> Introduction, sound frequencies, sound loudness measurement, acoustic power, sound measurement, sound level meters, sound analyzers.		
<b>Self-Study Content:</b> Sound signal data processing.		
<b>Unit 3:</b>		<b>Hrs:8</b>
<b>Specialized Techniques:</b> Acoustic imaging, Ultra sonic triangulation fault location, Acoustic Emission Technique (AET) - Instrumentation, Transducers, Pre-amplifier and filter, Main amplifier and Signal processing/ Display unit, Signals and processing, Magnetic testing Methods, Current flow Magnetisation, Induction Magnetic Flow Method, Induction Threading bar method, Induction Magnetising Coil method, Induced Current flow method, Magnetic particle Inspection Inks, Strippable Magnetic film, Eddy Current apparatus. Thermography- Thermographic Equipment, Application of Thermography.		
<b>Self-Study Content:</b> Corrosion monitoring, Need for corrosion monitoring		
<b>Unit4:</b>		<b>Hrs:8</b>
<b>Vibration Monitoring and Analysis:</b> Introduction, Machinery signatures, Selection of Transducers. Analysis Techniques, Machine failure modes, Measurement location, Vibration severity criteria, Vibration frequency analysis, Permanent Monitoring. <b>Vibration Monitoring of Ball and Roller Bearings:</b> Introduction, Shock pulse method, SPM for testing Antifriction bearings, Manual Monitoring Continuous monitoring, The Kurtosis method, Fiber optics system, Vibration signature analysis, Contact		



resistance method.

**Self-Study Content:**SPM& its Applications.

**Unit 5:**

**Hrs:8**

**Mechanical Fault Diagnosis By Wears Monitoring & Lubricant Analysis:** Introduction, Source of Contamination, Significant oil contaminants, Used oil Contamination-time trends, Changes in the carrier fluid, Ferratic wear debris. Wear process monitoring techniques- Direct debris detection methods, Debris collection methods. Lubricant sampling & analysis-Sampling, Lubricant sampling methods, Lubricant analysis methods, Interpretation of results, Indications from the amount of debris present, Indication from the size distribution of debris, Application of chemical analysis of debris, Wear detection using proximity monitors.

**Self-Study Content:**Condition Monitoring Case Studies;Failure of fan bearings- History of failures, Analysis of the failures, Solution.

**Suggested Learning Resources:**

**Textbooks:**

SI No.	Title	Author	Year & Edition	Publisher
1.	Mechanical Fault Diagnosis and Condition Monitoring	R.Collacatt	1977 & 1 <sup>st</sup> Edition	Springer Netherlands ISBN: 978-94-009-5725-1.

**Reference Books:**

1.	Failure Diagnosis and Performance Monitoring	L. F. Pau	1981 & 1 <sup>st</sup> Edition	Marcel Deker Inc. ISBN:978-0824710187.
2.	Condition Monitoring and Condition Based Maintenance	Mohammed Ben-Daya,Uday KumarandD.N. Prabhakar Murthy	2016 & 1 <sup>st</sup> Edition	JohnWiley & Sons ISBN:9781118926581.

**Web links and Video Lectures ( e-resources)**

1. <https://www.youtube.com/watch?v=f58SW0Hwcf0>
2. [https://www.youtube.com/watch?v=j\\_Xpzzo0iko](https://www.youtube.com/watch?v=j_Xpzzo0iko)

**Active Based Learning (Suggested Activity in Class)/ Practical Based Learning ( Example)**

- 1 Case study analysis on real-world machine failures using condition monitoring data.
- 2 Group activity: Design a basic condition monitoring plan for a rotating machinery system.
- 3 Demonstration and interpretation of vibration signatures and thermography images.
- 4 Practical demonstration: Identify wear debris particles from used lubricant samples.
- 5 Hands-on mini-project: Basic ultrasonic testing on test specimens to detect flaws.



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## Department of Mechanical Engineering

Course Articulation Matrix															
Course Outcomes		Program Outcomes										PSO			
		1	2	3	4	5	6	7	8	9	10	11	1	2	
CO1	Understand the fundamentals of Condition Based Maintenance & Performance Trend Monitoring.	3	2												
CO2	Analyze and Apply the principles of Non-Destructive Testing, Safety Hazards and Government control to specific applications.	2	3			2									
CO3	Assess, Compare and Select the appropriate techniques of condition monitoring for real time applications.	2		3	2										
CO4	Analyze Professional and practical skills of fault diagnosis, machinery monitoring, and maintenance scheduling.	2		3	2										

### SEE- COURSE ASSESSMENT PLAN

Unit Name	Questions to be set for SEE					Marks weightage	% Weightage (Marks)
	R (L1)	U (L2)	A (L3)	AN (L4)	E (L5)		
Unit I	02	09+09	09	-	-	29	20
Unit II	02	-	09+09	09	-	29	20
Unit III	02	09	09	09	-	29	20
Unit IV	02	09	09	09	-	29	20
Unit V	02	09	09	09	-	29	20
Total	10	45	54	36	-	145	
% Weightage (Cognitive level)	07	31	37	25	-	-	100

R:Remember, U:Understand, A:Application, AN:Analysis, E:Evaluate



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## Department of Mechanical Engineering

Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Title: Hydraulics & Pneumatics		
Course Code: P22ME7023	CIE Marks:50	CIE Weightage:50%
Teaching hours/week (L:T:P):3:0:0	SEE Marks:100	SEE Weightage:50%
Teaching hours of Pedagogy:40Hrs	Exam Hours: 03	
Credits:03		
<b>Prerequisite:</b>		
To learn hydraulics and pneumatics, students need basic knowledge of physics, mechanics and electrical controls. They should also understand circuit diagrams, technical symbols and have problem-solving skills.		
<b>Course learning Objectives:</b>		
<b>CLO1:</b> Demonstrate awareness of fluid power system applications in modern automation and manufacturing industries.		
<b>CLO2:</b> Interpret industry-standard symbols and schematics used in hydraulic and pneumatic system design.		
<b>CLO3:</b> Evaluate the environmental and energy efficiency aspects of fluid power systems in real-world scenarios.		
<b>Unit 1:</b>		<b>Hrs:8</b>
<b>Introduction to Hydraulic Power:</b> Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law. <b>The source of Hydraulic Power:</b> Pumps-classification of pumps, construction and working of Gear pumps, Vane pumps and Piston pumps, pump selection factors, hydraulic actuators- classifications, construction of double acting cylinder, hydraulic cylinder cushions, Special types of cylinders.		
<b>Self-Study Content:</b> Construction and working of Gear motor, Vane and piston motors.		
<b>Unit 2:</b>		<b>Hrs:8</b>
<b>Control Components in Hydraulic Systems:</b> Classification of control valves, Directional control valves- constructional features of check valve, pilot-operated check valve, three-way valve, four-way valve symbolic representation. Pressure control valves - simple and compound pressure relief valve pressure reducing valve and unloading valve. Flow control valves (FCV) - needle valve, non-pressure compensated FCV and pressure compensated FCV. <b>Hydraulic Circuit Design and Analysis:</b> Control of single and double acting hydraulic cylinder, regenerative circuit, double pump hydraulic system, locked cylinder using pilot check valves and cylinder synchronizing circuits using different methods.		
<b>Self-Study Content:</b> Sequence valve and Counterbalance valve.		
<b>Unit 3:</b>		<b>Hrs:8</b>
<b>Ancillary Hydraulic Devices:</b> Reservoir system-functions, types, reservoir sizing and construction, Accumulators, types, construction and applications with circuits. <b>Maintenance of Hydraulic Systems:</b> Desirable properties of hydraulic fluids, filters and strainers-types, location of filters in hydraulic circuits, wear of moving parts due to solid-particle contamination of the fluid, Problem caused by gases in hydraulic fluids, probable causes of hydraulic system problems.		
<b>Self-Study Content:</b> Types of hydraulic fluids,Beta Ratio of filters		
<b>Unit4:</b>		<b>Hrs:8</b>
<b>Introduction to pneumatic system:</b> Definition of pneumatic system, advantages, limitations, applications, choice of working medium, characteristics of compressed air, Structure of pneumatic control System. <b>Air Preparation and Components:</b> Compressors- types, production of compressed air, Fluid conditioners- dryers, filters, pressure regulators, lubricators, distribution of compressed air, piping layout.		
<b>Self-Study Content:</b> Mounting arrangements for pneumatic cylinders, Mufflers.		



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<b>Unit 5:</b>	<b>Hrs:8</b>
<b>Pneumatic Actuators and control valves:</b> Linear cylinder - types, Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application. Quick exhaust valve, time delay valve, twin pressure valve, symbols. <b>Pneumatic control circuits:</b> Direct and indirect actuation of pneumatic cylinders, speed control of cylinders - supply air throttling and exhaust air throttling.	
<b>Self-Study Content:</b> Solenoid valves, Selection criteria of D C values.	

<b>Suggested Learning Resources:</b>				
<b>Textbooks:</b>				
1.	Fluid Power with applications	Anthony Esposito	2009&7 <sup>th</sup> Edition	Pearson Prentice Hall
2.	Pneumatics and Hydraulics	Andrew Parr	2011& 3 <sup>rd</sup> Edition	Butterworth- Heinemann
<b>Reference Books:</b>				
1.	Oil Hydraulic Systems Principles and Maintenance	S. R. Majumdar	2001&1 <sup>st</sup> Edition	Tata McGraw Hill Publishing company Ltd.
2.	Industrial Hydraulics	John J. Pippenger&Tyler G. Hicks	1979&3 <sup>nd</sup> Edition	McGraw-Hill Inc.,US
3.	Hydraulics and Pneumatics	Dr. H. D. Ramachandra	2011& 2 <sup>nd</sup> Edition	Sudha Publications

<b>Web links and Video Lectures ( e-resources)</b>	
1.	<a href="https://www.youtube.com/watch?v=p7kaKmw09g">https://www.youtube.com/watch?v=p7kaKmw09g</a>
2.	<a href="https://archive.nptel.ac.in/courses/112/106/112106300/">https://archive.nptel.ac.in/courses/112/106/112106300/</a>
3.	<a href="https://www.youtube.com/watch?v=hHrPKtK-fIA">https://www.youtube.com/watch?v=hHrPKtK-fIA</a>
4.	<a href="https://www.youtube.com/watch?v=qw2CgdgocJ4">https://www.youtube.com/watch?v=qw2CgdgocJ4</a>

<b>Active Based Learning (Suggested Activity in Class)/ Practical Based Learning( Example)</b>	
1.	Design a basic hydraulic or pneumatic circuit using simulation software to analyze flow rates, pressure drops and optimize the design for efficiency.
2.	Assemble and test a hydraulic pump in a lab setup, measuring flow rates and pressure while identifying any performance issues.
3.	Build a pneumatic actuator system, adjusting pressure and load conditions, and evaluate the system's response and efficiency.
4.	Perform maintenance tasks such as replacing filters, checking seals and troubleshooting leaks in a hydraulic system, ensuring optimal performance and safety.

<b>Course Articulation Matrix</b>														
<b>Course Outcomes</b>		<b>Program Outcomes</b>										<b>PSO</b>		
		1	2	3	4	5	6	7	8	9	10	11	1	2
<b>CO1</b>	<b>Understand</b> the basic principles and components of hydraulic and pneumatic systems.	3												
<b>CO2</b>	<b>Apply</b> knowledge of hydraulic and pneumatic components to <b>design</b> and analyze circuits for controlling Hydraulic and Pneumatic systems.	3	3	2										
	<b>Illustrate</b> the ability in selecting,	3				2								



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<b>CO3</b>	operating and maintaining hydraulic and pneumatic equipment.																		
<b>CO4</b>	<b>Analyze</b> hydraulic and pneumatic systems, diagnose typical issues and develop solutions through logical reasoning and problem-solving abilities.	3	2	2															

### BLUE PRINT OF SEE- COURSE ASSESSMENT PLAN

Unit Name	Questions to be set for SEE					Marks weightage	% Weightage (Marks)
	R (L1)	U (L2)	A (L3)	AN (L4)	E (L5)		
<b>Unit I</b>	02	09+09	09	-	-	29	<b>20</b>
<b>Unit II</b>	02	09	09	09	-	29	<b>20</b>
<b>Unit III</b>	02	09	09+09	-	-	29	<b>20</b>
<b>Unit IV</b>	02	09	09+09	-	-	29	<b>20</b>
<b>Unit V</b>	02	09	09	09	-	29	<b>20</b>
Total	10	54	63	18	-	145	<b>100</b>
<b>% Weightage (Cognitive level)</b>	<b>07</b>	<b>37</b>	<b>44</b>	<b>12</b>	-	-	

**R:Remember, U:Understand, A:Application, AN:Analysis, E:Evaluate**



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Academic Year: 2025-26	Semester: VII	Scheme:22
Course Title: TOTAL QUALITY MANAGEMENT		
Course Code: P22ME7024	CIE Marks:50	CIE Weightage:50
Teaching hours/week (L:T:P) 3-0-0	SEE Marks:100	SEE Weightage:50
Teaching hours of Pedagogy: 40	Exam Hours: 3	
Credits:03		
<b>Prerequisite:</b>		
<ol style="list-style-type: none"> <li>1. Basic knowledge of manufacturing and service processes</li> <li>2. Introductory statistics (mean, standard deviation, charts, histograms)</li> <li>3. Fundamentals of management or industrial engineering</li> <li>4. Ability to interpret simple flowcharts and data sets</li> </ol>		
<b>Course learning Objectives:</b>		
<b>CLO1:</b> Understand the fundamentals and philosophy of Total Quality Management (TQM) <b>CLO2:</b> Analyze the principles of leadership and strategic planning <b>CLO3:</b> Evaluate customer satisfaction practices <b>CLO4:</b> Identify and develop appropriate tools in TQM to solve real life problems. <b>CLO5:</b> Develop skills in quality-related tools, decision-making frameworks		
<b>Unit 1:</b>		<b>Hrs: 8</b>
<b>Introduction:</b> Definition, basic approach, Gurus of Total Quality Management (TQM), awareness, defining quality, primary elements of TQM, historical review, obstacles, benefits of TQM. <b>Leadership:</b> Definitions, characteristics of quality leaders, leadership concepts, the seven habits of highly effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, quality council, core values, concepts and framework, quality statements, strategic planning, communications, decision making.		
Self-Study Content:Characteristics of successful teams.		
<b>Unit 2:</b>		<b>Hrs: 8</b>
<b>Customer Satisfaction:</b> Introduction to customer, customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, additional comments. <b>Continuous Process Improvement:</b> Introduction, process, the Juran trilogy, improvement strategies, types of problems, Plan Do Study Adjust (PDSA) cycle, Kaizen reengineering. <b>Statistical Process Control:</b> Pareto diagram, process flow diagram, cause and effect diagram check sheets, histograms.		
Self-Study Content:Objectives of performance measures.		
<b>Unit 3:</b>		<b>Hrs: 8</b>
<b>Benchmarking:</b> Introduction, benchmarking, reasons to benchmark, process, deciding what to benchmark, understanding current performance, planning, studying others, learning from the data, using the findings, pitfalls and criticisms of benchmarking. <b>Quality Management Systems:</b> Introduction, benefits of ISO registration, ISO 9000 series of standards, sector-specific standards, ISO 9001 requirements, implementation, documentation, writing the documents internal audits, registration, closing comments.		
Self-Study Content:Limitations of quality of cost, TQM exemplary organization		



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Unit4:	Hrs: 8
<b>Total Productive Maintenance (TPM):</b> Definition, types of maintenance, steps in introduction of TPM in an organization, pillars of TPM – 5S, JishuHozen, quality maintenance, planned maintenance. <b>Environmental Management Systems (EMS):</b> Definition, basic EMS, EMS under ISO 14001, costs and benefits of EMS. <b>TQM Tools and Techniques:</b> The seven traditional tools of quality, Six sigma, concepts, methodology, applications to manufacturing, service sector including IT.	
<b>Self-Study Content:</b> Applications and importance of Measurement System Analysis (MSA).	
Unit 5:	Hrs:8
<b>Quality Function Deployment (QFD):</b> Introduction, the QFD team, benefits of QFD, the voice of the customer, organization of information, house of quality, QFD process, examples and conclusion. <b>Quality by Design:</b> Introduction, rationale for implementation benefits, teams, communication models, implementation, tools, misconceptions and pitfalls.	
<b>Self-Study Content:</b> Computers and quality function (Data Collection), Kano model.	

Suggested Learning Resources:				
Textbooks:				
	Title	Author	Year & Edition (Latest)	Publisher
1	“Total Quality Management”,	Dale H. Besterfield, Besterfield Carol, Besterfield Glen H, Besterfield Mary, Urdhwareshe Hemant,	2018,	Pearson Publishers, ISBN – 13 : 9789353066314.
2	“Total Quality Management”,	V K Khanna,	2008	New Age International Publishers, ISBN – 13 : 9788122417999.
Reference Books:				
1.	“Total Quality Management”,	Dr. S Kumar,	2016	1 <sup>st</sup> Edition, Laxmi Publications, ISBN: 9789385935817.

Web links and Video Lectures ( e-resources)
1. <a href="https://archive.nptel.ac.in/courses/110/104/110104080/">https://archive.nptel.ac.in/courses/110/104/110104080/</a>
2. <a href="https://www.youtube.com/watch?v=SMOQV2CyVQo">https://www.youtube.com/watch?v=SMOQV2CyVQo</a>
3. <a href="https://asq.org/quality-resources/total-quality-management">https://asq.org/quality-resources/total-quality-management</a> .
4. <a href="https://www.iso.org/standards/popular/iso-9000-family">https://www.iso.org/standards/popular/iso-9000-family</a> .



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### Active Based Learning (Suggested Activity in Class)/ Practical Based Learning( Example)

- 1. Case Study Analysis:** Analyze real-world examples of successful/failed TQM implementations (e.g., Toyota, Motorola).
- 2. Problem Solving Workshop:** Apply tools like Pareto Chart, Fishbone Diagram, and PDCA on classroom or lab-based problems.
- 3. Mini Kaizen Event:** Perform a rapid improvement activity in a lab or campus setting.
- 4. Role Play:** Simulate quality team meetings (Quality Council, Strategic Planning) to encourage teamwork and leadership
- 5. Online Quizzes / Polls:** Use Kahoot or Google Forms for formative assessment.
- 6. Field Visits:** Visit ISO-certified or TPM-implemented organizations if feasible.

### Course Articulation Matrix

Course Outcomes		Program Outcomes										PSO		
		1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	<b>Understand</b> the concept of TQM, ethics and characteristics of TQM leaders. <b>Explain</b> customer, customer perception of quality.	3	2									2	2	
CO2	<b>Apply</b> Juran Trilogy, PDSA cycle, Kaizen re-engineering in manufacturing. <b>Illustrate</b> Benchmarking process, SPC tools and TPM.	3	3									2	3	
CO3	<b>Apply</b> ISO standards and <b>Analyze</b> its effect on QMS and EMS systems.	3	2										3	
CO4	<b>Apply</b> latest TQM Tools including Six Sigma to manufacturing and IT Sector. <b>Develop</b> a QFD team with respect to quality by design.	3	3									2	3	

### BLUE PRINT OF SEE- COURSE ASSESSMENT PLAN

Unit Name	Questions to be set for SEE					Marks weightage	% Weightage (Marks)
	R (L1)	U (L2)	A (L3)	AN (L4)	E (L5)		
Unit I	02	09+09	09		-	29	20
Unit II	02	09+09	09		-	29	20
Unit III	02	09+09	09		-	29	20
Unit IV	02	09	09	09	-	29	20
Unit V	02	09	09	09	-	29	20
Total	10	72	45	18	-	145	
% Weightage (Cognitive level)	07	49	31	13	-	-	100

R:Remember, U:Understand, A:Application, AN:Analysis, E:Evaluate



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Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Title: ADVANCED MANUFACTURING PROCESSES		
Course Code: P22ME7031	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P): 3:0:0	SEE Marks: 100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40Hrs	Exam Hours: 03	
Credits: 03		
<b>Prerequisite:</b>		
Basic knowledge of conventional machining processes and material properties. Understanding of cutting tool materials and heat generation during machining and Familiarity with CAD/CAM and manufacturing technologies.		
<b>Course learning Objectives:</b>		
CLO1: Understand the principles and applications of hard machining processes.		
CLO2: Compare machining at micro/nano scales and apply advanced manufacturing knowledge.		
CLO3: Evaluate additive manufacturing technologies and their role in product development.		
<b>Unit 1:</b>		<b>Hrs: 8</b>
<b>Machining of Hard Materials:</b> Basic Features of Hard Machining, Comparison with Grinding Operations, Technological Processes Including Hard Machining, Equipment and Tooling, Machining Using hybrid processes, characterization of Hard Machining processes, Cutting Forces, Chip, Cutting Temperature, Wear of Ceramic and PCBN Tools.		
<b>Self-Study Content :</b> Applications of Hard Machining Processes		
<b>Unit 2:</b>		<b>Hrs: 8</b>
Introduction, Amount and Cost, Health and environmental aspects, Principal Directions in the Reduction of MWF Economical. Ecological and Health impacts, Nearly Dry Machining (NDM)- How NDM Operates.		
<b>Self-Study Content:</b> Applications of NDM.		
<b>Unit 3:</b>		<b>Hrs: 8</b>
<b>Fine Finishing Processes and Hybrid Thermal Processes:</b> Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Magnetic Float Polishing (MFP), Micromachining. Electrochemical Super Finishing, Electrochemical Buffing, Hybrid Thermal Processes: Introduction, Electro erosion Dissolution Machining, Electro discharge Grinding, Abrasive Electro discharge machining.		
<b>Self-Study Content:</b> Difference between Electro discharge Grinding, Abrasive Electro discharge machining		
<b>Unit 4:</b>		<b>Hrs: 8</b>
<b>Micro and Nano-machining:</b> Introduction, Machining effects at the Micro scale, Size Effects in Micromachining, Nano-machining-Nano-metric machining, Theoretical Basis of nano-machining, Comparison of Nano-metric machining and Conventional Machining.		
<b>Self-Study Content:</b> Comparisons between micro and nano machining.		
<b>Unit 5:</b>		<b>Hrs: 8</b>
<b>Additive Manufacturing system</b> Introduction, Need for AM, Comparison of AM with Subtractive Manufacturing, Applications of AM, Development in CAD Technologies, Reverse Engineering, Generic AM Process, Development of AM technology, Classification of AM, VAT Polymerization techniques, UV curable photopolymers, Photopolymer chemistry, Resin formulations and reaction mechanism, Laser Scan photo polymerization.		
<b>Self-Study Content:</b> Roles of a Prototype		

**Suggested Learning Resources:**



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<b>Textbooks:</b>				
1.	Machining: Fundamentals and Recent Advances	J.Paulo Davim	2008 Edition	Springer Publications
2.	Advanced Machining Process	V.K.Jain	2007 & 1 <sup>st</sup> Edition	Allied Publisher
3.	Additive Manufacturing	Amit Bandyopadhyay, Susmita Bose	2016 & 1 <sup>st</sup> Edition	CRC Press

<b>Reference Books:</b>				
1.	Advanced Machining Processes: Nontraditional and Hybrid Machining Processes	Hassan Abdel-Gawad El-hofy,	2005 & 1 <sup>st</sup> Edition	McGraw-Hill Education
2.	Sculptured Surface Machining: Theory and Applications	Choi, Byoung K, Jerard, Robert B	1999 & 1 <sup>st</sup> Edition	Springer Publications
3.	Machining of Hard materials	Davim, J. Paulo	2011 & 1 <sup>st</sup> Edition	Sudha Publications

<b>Web links and Video Lectures ( e-resources)</b>				
1.	<a href="http://acl.digimat.in/nptel/courses/video/112105231/L20.html">http://acl.digimat.in/nptel/courses/video/112105231/L20.html</a> .			
2.	<a href="https://www.youtube.com/watch?v=cpFRa7D48hY">https://www.youtube.com/watch?v=cpFRa7D48hY</a> .			
3.	<a href="https://www.youtube.com/watch?v=hzJkCxoYTQg">https://www.youtube.com/watch?v=hzJkCxoYTQg</a> .			
4.	<a href="https://www.youtube.com/watch?v=6-niv4zFZWA">https://www.youtube.com/watch?v=6-niv4zFZWA</a> .			

<b>Active Based Learning (Suggested Activity in Class)/ Practical Based Learning( Example)</b>	
1.	Examine samples or images of ceramic and PCBN tools and prepare a comparison chart on tool wear, temperature resistance and applications.
2.	Demonstration using a lathe or simulation software to observe wear patterns in hard machining tools over time.
3.	Conduct a demonstration or video-based analysis showing NDM performance vs conventional lubrication.
4.	Show high-resolution videos or simulations of abrasive flow machining and EDM-hybrid processes, followed by process parameter analysis.
5.	Use a microscope or image analysis software to study micro machined surfaces and identify size effect phenomena.
6.	Design a simple model using CAD and print it using a basic FDM 3D printer to understand layer-by-layer fabrication.

<b>Course Articulation Matrix</b>														
<b>Course Outcomes</b>		<b>Program Outcomes</b>										<b>PSO</b>		
		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>1</b>	<b>2</b>
<b>CO1</b>	<b>Understand</b> the different types of hard materials for machining.	3												
<b>CO2</b>	<b>Analyze</b> Cost analysis.	3	3											
<b>CO3</b>	<b>Compare:</b> Types of fine finishing processes, Hybrid Thermal Processes.	3												
<b>CO4</b>	<b>Understand</b> the concepts of micro and nano-machining.	3												
<b>CO5</b>	<b>Apply</b> the raw materials used for AM systems	3	2			2								



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### BLUE PRINT OF SEE- COURSE ASSESSMENT PLAN

Unit Name	Questions to be set for SEE					Marks weightage	% Weightage (Marks)
	R (L1)	U (L2)	A (L3)	AN (L4)	E (L5)		
Unit I	02	09+09	09	-	-	29	20
Unit II	02	09	09	09	-	29	20
Unit III	02	09	09+09	-	-	29	20
Unit IV	02	09	09+09	-	-	29	20
Unit V	02	09	09	09	-	29	20
Total	10	54	63	18	-	145	
% Weightage (Cognitive level)	07	37	44	12	-	-	100

**R:Remember, U:Understand, A:Application, AN:Analysis, E:Evaluate**



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Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Title: COMPOSITE MATERIALS		
Course Code: P22ME7032	CIE Marks: 50	CIE Weightage: 50 %
Teaching hours/week (L:T:P) 3-0-0	SEE Marks: 100	SEE Weightage: 50 %
Teaching hours of Pedagogy:40Hrs	Exam Hours: 03	
Credits:03		
<b>Prerequisite:</b>		
1. Understanding the properties and behaviour of different materials, such as metals, polymers, and ceramics.		
2. Knowledge of stress, strain, and deformation of materials under various loads.		
3. Familiarity with mathematical concepts, such as algebra, calculus, and statistics.		
Course learning Objectives: The objectives of this course are to,		
<b>CLO1:</b> Train students on composite materials – definition, advantages and classification.		
<b>CLO2:</b> Equip students with knowledge on composite strengthening addition of components and their Production routes.		
<b>CLO3:</b> Familiarize students about the properties and response of composite structures subjected to Mechanical loading.		
<b>Unit-I</b>		<b>8 Hrs</b>
<b>Introduction:</b> Introduction and overview of composite materials and their need, Enhancement of properties, classification of composites, Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC), Application of composites.		
<b>Self-Study Component:</b> Fiber composites, laminated composites and particulate composites.		
<b>Unit-II</b>		<b>8 Hrs</b>
<b>Reinforcements Materials:</b> Metallic, Polymer, Ceramic and Composite fibers, Whiskers and Particulates, Nano-fillers used in polymer composites, Reinforcement fibers.		
<b>Types of matrix:</b> Commonly used Matrices (Metal matrix, Polymer matrix, Ceramic matrix, Intermetallic matrix, Carbon-Carbon composites), Basic Requirements in Selection of constituents.		
<b>Self-Study Component:</b> Woven fabrics and Non-woven random materials.		
<b>Unit-III</b>		<b>8 Hrs</b>
<b>Production techniques and Properties:</b> Processing of cast composites - XD process, Spray processes (Osprey Process, Rapid solidification processing), Liquid metal impregnation technique (Squeeze casting, Pressure infiltration, Lanxide process). Hand lay-up processes – Spray up processes, Compression moulding, Reinforced reaction injection moulding, Resin transfer moulding, Pultrusion, Filament winding, Injection moulding.		
<b>Self-Study Component:</b> In-Situ Dispersion Processes (Stir-casting & Compo casting, Screw extrusion).		
<b>Unit-IV</b>		<b>8 Hrs</b>
<b>Mechanics of Composite Materials:</b> Continuous fibres – iso-stress and iso-strain conditions, discontinuous fibres, Nature of stress vs. strain curves for different composite materials. Mechanical		
Properties: Mechanical testing of composites – tensile, flexure (3 point and 4 point bend tests), interfacial tests of laminates; Modes of fracture.		
<b>Self-Study Component:</b> Toughening mechanisms in composites.		



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Unit-V	8 Hrs
<b>Recent developments in Composites:</b> Self-healing composites, Molecular composites, Micro and Nano composites, Bio composites, Left handed composites, Stiffer than stiff composites, Carbon / carbon composites.	
<b>Self-Study Component:</b> Advantages and limitations of carbon matrix	

Suggested Learning Resources:				
Textbooks:				
SL. No.	Title	Author	Year & Edition	Publisher
1	“Composite materials”	Chawla K.K.	1998.	Springer
2	“Fundamentals of Composite Processing: Materials, Methods and Applications”	Dr. Ashok Kumar M S, Dr.Raghavendra S and Dr.Rudra K S	2025	Shashwat Publication, Ram Das Nagar, Bilaspur, Chhattisgarh - 495001
Reference Books:				
1	“Composite materials: Engineering and Science”,	Mathews F.L. and Rawlings R.D.	1st edition, 1994.	Chapman and Hall, London, England,
2	“Fundamentals of Composite Manufacturing”	Strong A.B.	1989.	SME
3	“Composite materials”	Sharma S.C.	2000.	Narosa Publications
4	“Composite Materials Technology: Process and Properties”	Mallick, P.K,	1990	Hanser, New York

Web links and Video Lectures ( e-resources)
1. <a href="https://archive.nptel.ac.in/courses/112/104/112104229/">https://archive.nptel.ac.in/courses/112/104/112104229/</a>
2. <a href="https://archive.nptel.ac.in/courses/112/104/112104221/">https://archive.nptel.ac.in/courses/112/104/112104221/</a>
3. <a href="https://archive.nptel.ac.in/courses/112/104/112104249/">https://archive.nptel.ac.in/courses/112/104/112104249/</a>

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning ( Example)
<ol style="list-style-type: none"> <li>1. Flip Class</li> <li>2. Seminar/ poster Presentation</li> <li>3. Individual Role play/Team Demonstration/ Collaborative Activity</li> <li>4. Case study</li> <li>5. Learn by Doing</li> </ol>



Course Articulation Matrix															
Course Outcomes		Program Outcomes											PSO		
		1	2	3	4	5	6	7	8	9	10	11	1	2	
<b>CO1</b>	Identify and understand the basic mechanical behaviour of composite materials and make sound prediction on the likely behaviour of new combinations of materials.	3													
<b>CO2</b>	Apply the choices made for using certain types of composites in certain applications with reference to composite properties.	3													
<b>CO3</b>	Demonstrate a practical understanding of composite properties and fabrication techniques, and to be able to make realistic suggestions for the evaluation of composite behaviour, where appropriate.	3		3											
<b>CO4</b>	Analyse the micromechanical properties of fibre reinforced composites.	3	2												

### BLUE PRINT OF SEE- COURSE ASSESSMENT PLAN

Unit Name	Questions to be set for SEE					Marks weightage	% Weightage (Marks)
	R (L1)	U (L2)	A (L3)	AN (L4)	E (L5)		
<b>Unit I</b>	02	09+09	09		-	29	<b>20</b>
<b>Unit II</b>	02	09+09	09		-	29	<b>20</b>
<b>Unit III</b>	02	09+09	09		-	29	<b>20</b>
<b>Unit IV</b>	02	09+09	09		-	29	<b>20</b>
<b>Unit V</b>	02	09+09	09		-	29	<b>20</b>
Total	10	90	45		-	145	
<b>% Weightage (Cognitive level)</b>	<b>07</b>	<b>62</b>	<b>31</b>		-	-	<b>100</b>

**R:Remember, U:Understand, A:Application, AN:Analysis, E:Evaluate**



# P.E.S. College of Engineering, Mandya

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## Department of Mechanical Engineering

Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Title: Robotics & Artificial Intelligence		
Course Code: P22ME7033	CIE Marks:50	CIE Weightage:50%
Teaching hours/week (L:T:P): 3:0:0	SEE Marks:100	SEE Weightage:50%
Teaching hours of Pedagogy: 40	Exam Hours: 3Hrs	
Credits:03		
<b>Prerequisite:</b>		
<ul style="list-style-type: none"><li>Fundamentals of Mechanical Engineering – understanding of mechanisms, actuators, and sensors.</li><li>Basic Programming Concepts and Electronics – logic structures, microcontrollers (like Arduino), and circuit fundamentals.</li></ul>		
<b>Course learning Objectives:</b>		
<b>CLO1:</b> Understand the basic concepts of robots & Artificial Intelligence.		
<b>CLO2:</b> Make the students familiar with various applications of robots in industry.		
<b>CLO3:</b> Understand basic principles of AI toward problem solving.		
<b>Unit 1:</b>		<b>Hrs:8</b>
<b>Introduction:</b> Automation and robotics, brief history of robotics, classifications of robots, geometrical configuration, advantages and applications of each, work volume, wrist and its motions, links and joints. End Effectors: Types of grippers and tools, resolution, accuracy and repeatability, numerical.		
<b>Self-Study Content:</b> Latest developments in robots.		
<b>Unit 2:</b>		<b>Hrs:8</b>
<b>Structure of Robotic System:</b> Robot drive system, hydraulic, electric and pneumatic drive system, advantages and disadvantages, feedback components, position and velocity sensors, types of actuators, internal state sensors, encoders, potentiometers and resolver, external state sensors, tactile sensing, proximity sensing, range sensing, and force-torque sensors. Introduction to Arduino, Types Of Arduino and its Features, Software Required For Arduino, control structure in Arduino, applications.		
<b>Self-Study Content:</b> Applications of hydraulic, electric and pneumatic drive system.		
<b>Unit 3:</b>		<b>Hrs:8</b>
<b>Autonomous Mobile Robots:</b> Locomotion, key issues for locomotion, legged mobile robots, leg-types and configurations and stability, examples of legged robot locomotion, gaits-biped, quadruped and hexaped, wheeled mobile robots, wheeled locomotion, design space.		
<b>Applications of Robots in Manufacturing:</b> Material transfer, general considerations in robot material handling pick and place, palletizing operations, machine loading and unloading; die casting, plastic moulding, forging, machining and stamping press operations.		
<b>Self-Study Content:</b> Applications of robots in processing operations.		
<b>Unit4:</b>		<b>Hrs:8</b>
<b>Introduction to Artificial Intelligence:</b> Overview, foundations, scope, problems, and approaches of AI. Intelligent agents: reactive, deliberative, goal driven, utility-driven, and learning agents, Artificial Intelligence programming techniques		
<b>Self-Study Content:</b> Applications of AI		
<b>Unit 5:</b>		<b>Hrs:8</b>



**Problem-solving through Search:** Problem – Solving Agents : Problem Definitions, Formulating Problems, Searching for solutions – measuring Problem – Solving Performance with examples. Search Strategies : Uninformed search strategies – Breadth – first Search, Uniform – Cost Search, depth –first search, depth – limited search, Iterative deepening depth – first search, bidirectional search, comparing uninformed search strategies.

**Self-Study Content:** Informed search strategies – heuristic information.

**Suggested Learning Resources:**

**Textbooks:**

SI No.	Title	Author	Year & Edition	Publisher
1.	Industrial Robots	Michell Grover, Mitchel Weiss and Roger Nagel	2012 & 2 <sup>nd</sup> Edition	McGraw Hill ISBN: 139780070265097.
2.	Robotics for Engineers	YoramnKoren	1987 & 1 <sup>st</sup> Edition	McGraw hill Intl. Book Co. ISBN: 139780070353992.
3.	Artificial Intelligence :A Modern Approach	Russell, Stuart and Norvig, Peter	2003 & 1 <sup>st</sup> Edition	Prentice Hall
4.	Introduction to Artificial Intelligence and Expert Systems	Dan.W.Patterson	2009& 1 <sup>st</sup> Edition	PHI Learning.

**Reference Books:**

1.	Robotics	K.S. Fu, R.C. Gonzales and Lee	2008 & 1 <sup>st</sup> Edition	McGraw Hill ISBN: 139780070265103.
2.	Fundamentals of Robotics	Robert J. Schilling	2011 & 1 <sup>st</sup> Edition	PHI ISBN: 139788120310476.
3.	Knowledge Representation: An approach to artificial intelligence	Bench-Capon, T. J. M	1990 & 1 <sup>st</sup> Edition	Academic Press
4.	Artificial Intelligence: A Guide to Intelligent Systems	Michael Negnevitsky	2011 & 3 <sup>rd</sup> Edition	Pearson Education Limited

**Web links and Video Lectures ( e-resources)**

1. [https://onlinecourses.nptel.ac.in/noc22\\_ge29/preview](https://onlinecourses.nptel.ac.in/noc22_ge29/preview)
2. <https://youtu.be/rYWJdZ5qg6M>



### Active Based Learning (Suggested Activity in Class)/ Practical Based Learning ( Example)

1. Modeling Exercise: Design and classify a robotic arm using physical components or simulation software (e.g., RoboDK).
2. Sensor Integration: Interface basic sensors with an Arduino board and observe their behavior (potentiometer, IR sensor, etc.).
3. Case Study: Analyze real-world use of robots in processes like pick & place or CNC loading/unloading.
4. Mini-Project: Build a basic AI agent simulation using logic-based programming (e.g., Python, Scratch, or block-based tools).

### Course Articulation Matrix

Course Outcomes		Program Outcomes										PSO			
		1	2	3	4	5	6	7	8	9	10	11	1	2	
<b>CO1</b>	<b>Understand</b> the structure and classification of robotic systems.	3		3											
<b>CO2</b>	<b>Analyze</b> the integration of sensors and actuators in robotic systems.	3	3												
<b>CO3</b>	<b>Apply</b> robot systems to practical industrial applications.			3		2									
<b>CO4</b>	<b>Analyze</b> basic problems in AI using appropriate algorithms and tools.	3			3	3									

### SEE- COURSE ASSESSMENT PLAN

Unit Name	Questions to be set for SEE					Marks weightage	% Weightage (Marks)
	R (L1)	U (L2)	A (L3)	AN (L4)	E (L5)		
<b>Unit I</b>	02	09+09	09	-	-	29	<b>20</b>
<b>Unit II</b>	02	-	09+09	09	-	29	<b>20</b>
<b>Unit III</b>	02	09	09	09	-	29	<b>20</b>
<b>Unit IV</b>	02	09	09	09	-	29	<b>20</b>
<b>Unit V</b>	02	09	09	09	-	29	<b>20</b>
Total	10	45	54	36	-	145	
<b>% Weightage (Cognitive level)</b>	<b>07</b>	<b>31</b>	<b>37</b>	<b>25</b>	<b>-</b>	<b>-</b>	<b>100</b>

**R:Remember, U:Understand, A:Application, AN:Analysis, E:Evaluate**



# P.E.S. College of Engineering, Mandya

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## Department of Mechanical Engineering

Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Title: Tribology		
Course Code:P22ME7034	CIE Marks:50	CIE Weightage:50
Teaching hours/week (L:T:P): 3:0:0	SEE Marks:100	SEE Weightage:50
Teaching hours of Pedagogy:40 Hours	Exam Hours: 3 Hours	
Credits:03		
<b>Prerequisite:</b>		
Engineering Mechanics (Statics and Dynamics): Understanding forces, motion and equilibrium. <b>Materials Science:</b> Structure and properties of materials (metals, polymers, ceramics). Knowledge of hardness, toughness, and surface treatments is essential. <b>Fluid Mechanics:</b> Basic understanding of viscosity, laminar/turbulent flow, Reynolds number. Crucial for studying lubrication regimes (boundary, mixed, hydrodynamic). <b>Thermodynamics and Heat Transfer:</b> For understanding thermal effects in friction and wear processes. <b>Mathematics (Calculus and Differential Equations):</b> For modelling contact mechanics and lubrication.		
<b>Course learning Objectives:</b>		
<b>CLO1:</b> Explain the fundamental principles of tribology, including the mechanisms of friction, wear and lubrication in engineering systems. <b>CLO2:</b> Analyse contact mechanics between surfaces under different loading and material conditions. Use experimental methods and tribometers to measure friction and wear, and analyze the results critically. <b>CLO3:</b> Identify and classify wear mechanisms (e.g., adhesive, abrasive, corrosive, fatigue) <b>CLO4:</b> Understand the impact of tribology on energy efficiency, reliability and sustainability in mechanical systems.		
<b>Unit 1:</b>		<b>Hrs: 9</b>
<b>Introduction to Tribology:</b> Introduction, friction, laws of friction, friction theories, surface contaminants and frictional heating, classification of wear, abrasive wear and adhesive wear, corrosive wear, fatigue and fretting wear, mechanisms of wear, basic wear testing methods- pin on disc wear tester and dry sand rubber wheel abrasion tester, wear resistant materials, Lubricants, types of lubricants, lubrication, types of sliding lubrication-fluid-film lubrication, boundary lubrication and extreme boundary lubrication, properties of oils and equation of flow- viscosity, effect of temperature and pressure on viscosity, viscosity index, viscosity measuring apparatus: U-tube viscometer, Saybolt universal viscometer and Redwood viscometer.		
<b>Self-Study Content:</b> Industrial importance of tribology.		
<b>Unit 2:</b>		<b>Hrs: 7</b>
<b>Lubrication:</b> Newton's law of viscous flow, Hagen-Poiseuille law, flow through capillary tube, flow between parallel stationary plates. <b>Hydrostatic Lubrication:</b> Introduction to hydrostatic lubrication, types of hydrostatic lubrication systems, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing, numerical on hydrostatic lubrication.		
<b>Self-Study Content:</b> Types of additives.		
<b>Unit 3:</b>		<b>Hrs: 8</b>
<b>Hydrodynamic Lubrication:</b> Friction forces and power loss in lightly loaded bearing, coefficient of friction for a lightly loaded bearing (Petroff's equation), limits of hydrodynamic lubrication, numerical examples of lightly loaded full-journal bearing, tower's experiments, Reynold's investigations, mechanism of pressure development in an oil film, application of converging oil film in thrust bearing, formation of a converging oil film in a partial and full journal bearings, Reynold's equation in two dimensions.		



<b>Self-Study Content:</b> Concept of Navier- Stokes				
<b>Unit4:</b>				<b>Hrs: 8</b>
<b>Idealized Hydrodynamic Bearings:</b> Definition of idealized bearings, idealized plane-slider bearing with a fixed shoe-pressure distribution, load carrying capacity, coefficient of friction, idealized slider bearing with a pivoted shoe-load carrying capacity, frictional resistance, coefficient of friction, location of the pivot point of a slider bearing with a pivot shoe, Numerical.				
<b>Self-Study Content:</b> Location of center of pressure of idealized slides bearing.				
<b>Unit 5:</b>				<b>Hrs: 8</b>
<b>Hydrodynamic Journal Bearing:</b> Idealized journal bearings- infinitely long-full journal bearing- oil film thickness, Sommerfeld substitution, pressure distribution (description only), load carrying capacity, Sommerfeld number, viscous friction, modified Sommerfeld solution. Infinitely short-full journal bearing- pressure distribution (description only), load capacity and friction force, numerical on idealized hydrodynamic journal bearing.				
<b>Nanotribology:</b> Introduction, Measurement tools, Measurements, Fabrication Techniques for MEMS/NEMS, Atomic scale simulations.				
<b>Self-Study Content:</b> Porous Bearings.				
<b>Suggested Learning Resources:</b>				
<b>Textbooks:</b>				
1.	“Fundamentals of Tribology”	Basu S K., Sengupta S. N. and Ahuja B. B	1 <sup>st</sup> Edition, 2009	PHI, ISBN: 9788120327238.
2	“Introduction to Tribology of Bearings”,	B. C. Mujumdar,	2nd Edition, 2010	S. Chand (G/L) and Company Ltd, ISBN: 9788121929875.
<b>Reference Books:</b>				
1.	“Lubrication of Bearings Theoretical Principles and Design”	E. I. Redzimoskay	1st edition, 1959	The Ronald Press Company, ASIN: B0000EGL66.
2	“Theory and Practice of Lubrication for Engineers”	Dudley D. Fuller,	2nd Edition, 1984	John Wiley and Sons, ISBN: 9780471047032.
3	“Principles and Applications of Tribology”	Desmond F. Moore	1 <sup>st</sup> Edition, 1975	Pergamaon Press, ISBN: 9780080179025
4	“Tribology in Industries”,	Sushil Kumar Srivastava	2004	S Chand and Company Limited, ISBN: 9788121920452.
5	“Engineering Tribology”	PrasantaSahoo,	8 <sup>th</sup> Edition, July 2019	PHI Learning Private Limited, ISBN: 9788120327245.
<b>Web links and Video Lectures ( e-resources)</b>				
<ol style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=U9-LOVACPCw">https://www.youtube.com/watch?v=U9-LOVACPCw</a></li> <li><a href="https://www.youtube.com/watch?v=xhtq8xqBXwE">https://www.youtube.com/watch?v=xhtq8xqBXwE</a></li> <li><a href="https://www.youtube.com/watch?v=7OY170iaGSA">https://www.youtube.com/watch?v=7OY170iaGSA</a></li> <li><a href="https://www.youtube.com/watch?v=HCPfzLH0zKA">https://www.youtube.com/watch?v=HCPfzLH0zKA</a></li> </ol>				

**Active Based Learning (Suggested Activity in Class)/ Practical Based Learning ( Example)**



This course focuses on engaging students directly in the learning process through hands-on, collaborative and inquiry-based methods;

### Laboratory Experiments

- Hands-on testing with tribometers (e.g., pin-on-disk)
- Students collect and analyze friction and wear data.

### Case Studies

- Real-world problems like engine wear or bearing failure in turbines.
- Students work in teams to diagnose issues and propose solutions.

### Problem-Based Learning (PBL)

- Pose open-ended design problems (e.g., selecting a lubricant for a high-temperature application).
- Students research materials, simulate performance, and present findings.

### Course Articulation Matrix

Course Outcomes		Program Outcomes										PSO			
		1	2	3	4	5	6	7	8	9	10	11	1	2	
CO1	Understand the fundamental concepts of friction, wear and lubrication.	3													
CO2	Examine viscosity characteristics through the utilization of diverse viscometers.		3												
CO3	Analyse lubrication regimes and various parameters in hydrodynamic lubrication for both lightly loaded partial and full journal bearings and infinitely long & short-full journal bearings			3											
CO4	Understand the fundamentals of Nano-tribology and its techniques.		2	1											

### SEE- COURSE ASSESSMENT PLAN

Unit Name	Questions to be set for SEE					Marks weightage	% Weightage (Marks)
	R (L1)	U (L2)	A (L3)	AN (L4)	E (L5)		
Unit I	2	9+9			-	20	20
Unit II	2	9	9		-	20	20
Unit III	2	9	9		-	20	20
Unit IV	2	9	9		-	20	20
Unit V	2	9	9		-	20	20
Total	10	54	36		-	100	
% Weightage (Cognitive level)	10	54	36		-	100	100

R:Remember, U:Understand, A:Application, AN:Analysis, E:Evaluate



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## Department of Mechanical Engineering

Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Title: THEORY OF MACHINE- II		
Course Code: P22ME704	CIE Marks: 50	CIE Weightage: 50 %
Teaching hours/week (L:T:P): 3:0:2	SEE Marks:100	SEE Weightage: 50 %
Teaching hours of Pedagogy: 40 Hrs. Practical: 24 Hrs	Exam Hours: 03	
Credits:04		
<b>Prerequisite:</b>		
To successfully study the Theory of Machine-11, student must have the basic knowledge of foundational understanding of Engineering Mechanics, Strength of Materials, and Kinematics of Machinery (Theory of Machine-1) is highly recommended. Additionally, a strong understanding of engineering mathematics, including calculus and differential equations, is essential for tackling complex problems related to motion and forces		
<b>Course learning Objectives: The objectives of this course are to,</b>		
<b>CLO1:</b> Apply the basic concepts of undamped and damped Free Vibrations of mechanical systems and structures.		
<b>CLO2:</b> Apply the basic concepts of forced vibrations of mechanical systems and structures.		
<b>CLO3:</b> Understand the basic concepts of dynamic force analysis of flywheel.		
<b>CLO4:</b> Understand the basic concepts of rotating and reciprocating masses under the application of external load.		
<b>CLO5:</b> Analysis of gyroscopic couple effect on Disc, Aeroplane, ship , Two and Four Wheeler.		
<b>Unit 1:</b>		<b>Hrs:08</b>
<b>Undamped Free Vibrations:</b> Introduction, types of vibration, equivalent stiffness of springs; series and parallel, single degree of freedom systems, determination of natural frequency using Newton's and Energy methods. <b>Damped Free vibrations:</b> Introduction, types of damping, free vibration with viscous damping, under-damped, over-damped and critically damped systems and logarithmic decrement.		
<b>Self-study component:</b> Determination of natural frequency using Rayleigh's method, Eddy current damping.		
<b>Unit 2:</b>		<b>Hrs:08</b>
<b>Forced Vibrations:</b> Introduction, forced vibration with constant harmonic excitation, steady state vibrations, forced vibration with rotating and reciprocating unbalance, force transmissibility, forced vibrations due to excitation of the support; absolute motion and relative motion. <b>Whirling of Shafts:</b> Introduction, critical speed of a light shaft having a single disc without damping, critical speed of a light shaft having a single disc with damping.		
<b>Self-study component:</b> vibration isolation, Frequency and Vibration measuring instruments.		
<b>Unit 3:</b>		<b>Hrs:08</b>
<b>Flywheels:</b> Introduction, turning moment diagrams, Fluctuation of Energy and speed, energy stored in a flywheel, determination of size of flywheels.		
<b>Self-study component:</b> Comparison between flywheels and Governors, and application of fly wheels.		
<b>Unit4:</b>		<b>Hrs:08</b>
<b>Balancing of rotating and reciprocating masses:</b> Introduction, Static and dynamic balancing, balancing of several masses revolving in the same and different planes. Inertia force of the reciprocating mass of a slider crank mechanism, primary balancing, secondary balancing, balancing of single cylinder engine, balancing of multi cylinder-inline engine, balancing of radial engines.		
<b>Self-study component:</b> Comparison between inline and radial engine.		



Unit 5:	Hrs:08
<b>Gyroscopes:</b> Introduction, vectorial representation of angular motion, basic definitions, gyroscopic couple, Effect of gyroscopic couple on plane disc, aero plane, ship, stability of two wheelers and four wheelers.	
<b>Self-study component:</b> Effect of gyroscopic couple on bearings (with numerical).	
<b>Practical Content</b>	<b>24</b>
<b>Hrs</b>	
<ol style="list-style-type: none"> <li>1. Determination of natural frequency of single DOF undamped spring-mass free vibration system.</li> <li>2. Determination of natural frequency of single DOF undamped equivalent spring-mass free vibration system.</li> <li>3. Study of single DOF damped torsional free vibration system.</li> <li>4. Determination of critical speed of a rotating shaft.</li> <li>5. Determination of gyroscopic torque in a Gyroscope.</li> <li>6. Determination of Fringe constant of Photo elastic material using a Circular disc subjected To diametric compression.</li> <li>7. Determination of stress concentration using Photo elasticity for a circular disk with circular hole under compression.</li> <li>8. Determination of vibration characteristics of rotor (Demonstration only).</li> <li>9. Determination of a Pressure distribution in Journal bearing (Demonstration only).</li> </ol>	

<b>Suggested Learning Resources:</b>				
<b>Textbooks:</b>				
1.	Title	Author	Year & Edition (Latest)	Publisher
1	Mechanical Vibrations	V. P. Singh	2016, ISBN: 9788177004014	DhanpatRai and Company Pvt.Ltd
2	Theory of Machines	S.S. Rattan	4 <sup>th</sup> edition, 2015, ISBN: 9789351343479.	Tata McGraw-Hill, New Delhi
3	Theory of Machines	V.P. Singh	3rd Edition, 2013, ISBN: 9788177000528.	DhanpatRai& Co
<b>Reference Books:</b>				
1.	Mechanical Vibrations	Singiresu S Rao	4th Edition, 2003, ISBN: 978-8177588743	Pearson Education India
2.	Theory of Machines and Mechanisms	John J. Uicker, Jr., Gordon R. Pennock and Joseph E. Shigley	4 <sup>th</sup> Edition, 2014, ISBN: 9780199454167	Oxford University Press
3.	Theory of Machines and Mechanisms	P. L. Ballaney	25th Edition, 2003, ISBN: 978-8174091222	Khanna Publishers
4.	Kinematics & Dynamics of Machinery	Robert L. Norton	1st Edition, 2009, ISBN: 9780071278522.	Tata McGraw Hill
5.	Theory of Machines	Khurmi R S and Gupta J K	Edition Re print 2015,ISBN978-81-219-2524-X.	S Chand & Company Pvt..Ltd



### Web links and Video Lectures ( e-resources)

1. <https://archive.nptel.ac.in/courses/112/107/112107212/>
2. <https://archive.nptel.ac.in/courses/112/103/112103112/>
3. [https://onlinecourses.nptel.ac.in/noc22\\_me76/preview](https://onlinecourses.nptel.ac.in/noc22_me76/preview)
4. <https://www.youtube.com/watch?v=swgvKwyOnYk>
5. <https://www.youtube.com/watch?v=YoZgk1xIIW4>
6. <https://www.youtube.com/watch?v=aRulDXMuNDc>
7. <https://www.youtube.com/watch?v=FydJu1A1oeM>
8. <https://www.youtube.com/watch?v=oMxLYKtxhGE>

### Active Based Learning (Suggested Activity in Class)/ Practical Based Learning ( Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

### Course Articulation Matrix

Course Outcomes		Program Outcomes											PSO			
		1	2	3	4	5	6	7	8	9	10	11	1	2		
CO1	<b>Understand</b> the dynamic forces of flywheel, rotating and reciprocating masses and <b>analyze</b> the performance of flywheel, reciprocating and rotating mechanical components.	3	2												2	
CO2	<b>Apply</b> the principle of gyroscopic effect to <b>analyze</b> the stability of aeroplane, ship, two wheeler and four wheeler.	3	2													
CO3	<b>Apply</b> the basic concepts of undamped, damped free vibrations and forced vibrations to <b>analyze</b> the resonance condition of mechanical systems and structures.	2	2													
CO4	<b>Make use of</b> experimental data for writing a report as an individual or as a team member to communicate effectively.	3	2													



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## Department of Mechanical Engineering

### BLUE PRINT OF SEE- COURSE ASSESSMENT PLAN

Unit Name	Questions to be set for SEE					Marks weightage	% Weightage (Marks)
	R (L1)	U (L2)	A (L3)	AN (L4)	E (L5)		
Unit I	02	09	09	09	-	29	20
Unit II	02	09	09	09	-	29	20
Unit III	02	09	09	09	-	29	20
Unit IV	02	09	09	09	-	29	20
Unit V	02	09	09	09	-	29	20
Total	10	45	45	45	-	145	
% Weightage (Cognitive level)	07	31	31	31	-	-	100

**R:Remember, U:Understand, A:Application, AN:Analysis, E:Evaluate**



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## Department of Mechanical Engineering

<b>Course Title: Research Methodology and IPR</b>		
Academic Year: 2025-26	Semester: VII	Scheme: P22
Course Code: P22RMI705	CIE Marks:50	CIE Weightage: 50%
Teaching hours/week (L:T:P): 3:0:0	SEE Marks: 100	SEE Weightage: 50%
Teaching hours of Pedagogy:40	Exam Hours: 3	
Credits:03		
<b>Course learning Objectives:</b>		
<b>CLO1:</b> Gain comprehensive understanding of research methodology & IPR importance		
<b>CLO2:</b> Create a framework for literature review and data sample collection		
<b>CLO3:</b> Interpret and write research reports		
<b>CLO4:</b> Understand the life cycle of IPR and its related legal aspects		
<b>Unit 1:</b>		<b>Hrs:8</b>
<b>Research Methodology:</b> Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.		
<b>Research Problem:</b> Introduction, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.		
<b>Self-Study Content:</b> Case study to define research problem in the area of your interest.		
<b>Unit 2:</b>		<b>Hrs:8</b>
<b>Reviewing the literature:</b> Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.		
<b>Research Design:</b> Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs: principles of replication, randomization and local control		
<b>Self-Study Content:</b> Important Experimental Designs		
<b>Unit 3:</b>		<b>Hrs:8</b>
<b>Design of Sampling:</b> Introduction, Steps in Sample Design, Criteria of Selecting a Sampling Procedure, Characteristics of Good Sample Design.		
<b>Measurement Technique:</b> Introduction, Measurement Scales, Sources of Error in Measurement, Technique of Developing Measurement Tools.		
<b>Data Collection:</b> Collection of Primary Data, Difference between Questionnaires and Schedules, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.		



<b>Self-Study Content:</b> Case Study on Method of data collection	
<b>Unit4:</b>	<b>Hrs:8</b>
<b>Interpretation and Report Writing:</b> Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	
<b>Intellectual Property:</b> Introduction, Intellectual Property Regime in India, Copyrights, Trademarks, Patents, Designs, Trade Secrets, Geographical Indications and their Salient Features, Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Issues Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS.	
<b>Self-Study Content:</b> Berne and Paris Conventions	
<b>Unit 5:</b>	<b>Hrs:8</b>
<b>Indian Patent Law:</b> Introduction to patent law, Patents Act 1970, Amendments to the Patent Act 1970, Elements of Patentability, Non- Patentable Subject Matter, Duration of Patents - Law and Policy Consideration, Procedure for Filing Patent applications and Types of Applications.	
<b>Self-Study Content:</b> Ownership and Maintenance of Patents	

### Course Outcomes (COs)

CO1: Explain the fundamental concepts of research methodology, types of research, and techniques for defining research problems.

CO2: Apply appropriate methods for literature review, research design, data collection, and sampling to address research objectives.

CO3: Analyze collected data to derive valid conclusions and prepare structured research reports in accordance with academic and professional standards.

CO4: Identify the protection of intellectual property under Indian laws and international agreements, including patents, copyrights, and trademarks.



### Project Work Phase – I

[As per Choice Based Credit System (CBCS) & OBE Scheme]

### SEMESTER – VII

<b>Course Code:</b>	<b>P22ME706</b>	<b>Credits:</b>	<b>04</b>
<b>Teaching Hours/Week (L:T:P):</b>	<b>0:0:0</b>	<b>CIE Marks:</b>	<b>100</b>
<b>Total Number of Teaching Hours:</b>	<b>-</b>	<b>SEE Marks:</b>	<b>-</b>

Project Work: The Project Work (Phase I + Phase II) carries 12 credits (4 credits+8 credits) and spreads over TWO semesters, i.e. during 7th and 8th semesters.

- I. Project Phase – I and Project seminar Comprises of Literature Survey, Problem identification, Objectives and Methodology. CIE marks shall be based on the report covering Literature Survey, Problem identification, Objectives and Methodology and seminar presentation skill.
- II. The Assessment marks (CIE) in the case of Project Work - Phase I, shall be based on the evaluation at the end of the 7th semester by a committee consisting of Head of the concerned department, two senior faculty members of the department, one of them may be the internal guide. The work may be evaluated by the committee for award of Assessment marks (CIE) based on a Report [comprising of synopsis, Introduction, Literature survey, Objective and Methodology], presentation and viva voce.
- III. The project work shall be carried out by candidate(s) independently/in a group (maximum of four) during the seventh and eighth semester under the guidance of one of the faculty members of the Department of study. If the project work is of inter- disciplinary nature, a co-guide shall be taken from the same or any other relevant Department. If a project work has to be carried out in any industry / factory / organization, outside the campus, the permission for the same and the name of co- guide at any of these organizations shall be intimated to the authorities at the beginning of seventh semester by the Head of the Department.



### National Service Scheme

[As per Choice Based Credit System (CBCS) & OBE Scheme]

### SEMESTER - VII

<b>Course Code:</b>	<b>P22NSS707</b>	<b>Credits:</b>	<b>00</b>
<b>Teaching Hours/Week (L:T:P):</b>	<b>0:0:2</b>	<b>CIE Marks:</b>	<b>50</b>
<b>Total Number of Teaching Hours:</b>	<b>20-24 Hrs</b>	<b>SEE Marks:</b>	<b>50</b>

#### Course Outcomes (COs):

Upon successful completion of this course, students will be able to:

**CO1: Implement plantation programs:** Plan and execute plantation projects and manage plant adoption programs promoting environmental stewardship.

**CO2: Organize social harmony events:** Design and organize events promoting national integration and social harmony.

**CO3: Address school infrastructure needs:** Assess and address infrastructure needs in government schools, considering budget, feasibility, and community.

**CO4: Apply engineering to community projects:** Integrate engineering knowledge to develop solutions for environmental projects, infrastructure improvements, and event logistics.

**CO5: Demonstrate community engagement:** Demonstrate commitment to community engagement and social responsibility through project work.

**Course Description:** This course focuses on practical strategies for community engagement and positive social impact, covering environmental initiatives like plantation and plant adoption, promoting national integration and social harmony, and supporting educational infrastructure development in government schools. It emphasizes project planning, implementation, and community collaboration.

#### Course Content:

- Plantation and adoption of plants, including learning about different plant species.
- Organizing national integration and social harmony events/workshops/seminars (minimum 2 programs).
- Supporting government school rejuvenation and infrastructure improvement.



<b>Physical Education (Sports &amp; Athletics) – II</b> [As per Choice Based Credit System (CBCS) & OBE Scheme] <b>SEMESTER - VII</b>			
<b>Course Code:</b>	<b>P22PED707</b>	<b>Credits:</b>	<b>00</b>
<b>Teaching Hours/Week (L:T:P):</b>	<b>0:0:2</b>	<b>CIE Marks:</b>	<b>50</b>
<b>Total Number of Teaching Hours:</b>	<b>20-24 Hrs</b>	<b>SEE Marks:</b>	<b>50</b>
<b>Course Outcomes:</b> At the end of the course, the student will be able to			
1. Understand the Postural deformities and Stress management in sports and athletics			
2. Participate in the competition at regional/state / national / international levels.			
3. Understand and practice of specific games and athletic Jumping events.			
4. Understand and practice of Aerobics.			
<b>Module I: Orientation</b>			4 Hours
1. Postural deformities			
2. Stress management			
<b>Module II: Specific games (Any one to be selected by the student)</b>			16 Hours
1. Throw ball			
2. Table Tennis			
3. Athletics (Field Events- Jumps) – Any event as per availability of Ground.			
<b>Module III: Aerobics</b>			4 Hours



### Yoga

[As per Choice Based Credit System (CBCS) & OBE Scheme]

### SEMESTER - VII

<b>Course Code:</b>	<b>P22YOG707</b>	<b>Credits:</b>	<b>00</b>
<b>Teaching Hours/Week (L:T:P):</b>	<b>0:0:2</b>	<b>CIE Marks:</b>	<b>50</b>
<b>Total Number of Teaching Hours:</b>	<b>20-24 Hrs</b>	<b>SEE Marks:</b>	<b>50</b>

#### Course Outcomes (COs):

Upon successful completion of this course, students will be able to:

**CO1: Understand advanced Ashtanga Yoga:** Explain Dharana, Dhyana, and Samadhi within Patanjali's framework and their relevance to personal growth.

**CO2: Perform advanced Yoga practices safely:** Execute advanced Suryanamaskar, Asanas, kapalabhati, and Pranayama with precision, control, and safety awareness.

**CO3: Analyze advanced Yoga's effects:** Describe the benefits and risks of advanced techniques and their impact on body, mind, and higher cognitive functions.

**CO4: Apply advanced Yoga for well-being and performance:** Integrate advanced techniques for enhanced self-awareness, stress resilience, and peak mental performance.

**CO5: Understand the holistic nature of Yoga:** Articulate the connection between Asanas, Pranayama, concentration, meditation, and deeper states of consciousness.

**Course Description:** This course builds upon foundational Yoga principles and practices, exploring advanced techniques for enhancing physical, mental, and spiritual well-being. It delves into the latter stages of Ashtanga Yoga, including Dharana (concentration), Dhyana (meditation), and an introduction to Samadhi. Practical training includes advanced variations of Suryanamaskar, challenging Asanas focusing on strength, balance, and flexibility, advanced Kapalabhati practice, and specific Pranayama techniques. The course aims to equip students with tools for deep relaxation, enhanced focus, improved self-awareness, and a greater understanding of the mind-body connection.

#### Course Content:

- **Ashtanga Yoga:** Dharana, Dhyana, Samadhi (brief introduction)
- **Suryanamaskar:** 12 counts, 8 rounds (revision and advanced variations)
- **Asanas:**
  - Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana, Yogamudra in Vajrasana
  - Standing: Vatayanasana, Garudasana
  - Balancing: Veerabhadrasana (likely meant as a balancing pose within the series), Sheershasana
- **Kapalabhati:** 80 strokes/min, 3 rounds (revision and advanced practice)
- **Pranayama:** Bhastrika, Bhramari  
Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama



<b>Self-Study Course</b> [As per Choice Based Credit System (CBCS) & OBE Scheme] <b>SEMESTER – VIII</b>			
<b>Course Code:</b>	<b>P22ME801</b>	<b>Credits:</b>	<b>02</b>
<b>Total Number of Teaching Hours:</b>	-	<b>CIE Marks:</b>	<b>100</b>
		<b>SEE Marks:</b>	-
<p>The student has to choose and study the course related to the program discipline with her / his own efforts under the guidance of Course Instructor / Project guide, using study materials available in Open Sources i.e., Massive Open Online Courses (MOOCs) – NPTEL Courses. The intention of the course is to encourage the habit of self-learning. In this regard, the department has to release the pool of courses from the list of available 8 weeks NPTEL online courses according to NPTEL calendar of events. The student has to register for the course from the available pool during VII / VIII Semester and the same will be reflected in the Grade Card of VIII Semester. The 100 marks CIE assessment is based on the final NPTEL score (i.e. Online assignments: 25% + Proctored exam: 75%). The NPTEL score will be mapped directly to the CIE marks as per the calculation below only if he /she has completed the NPTEL course (i.e. Certification).</p> <p><b>CIE = (NPTEL Score X 1.5) = [Maximum CIE should be 100 Marks] [Ex. – 1: If NPTEL Score is 52 then the CIE will be = 52 X 1.5 = 78</b></p> <p><b>Ex. – 2: If NPTEL Score is 80 then the CIE will be = 80 X 1.5 = 100 (Subjected to a Maximum CIE Marks of 100)]</b></p> <p>If the student fails to complete the NPTEL course at the end of the VIII Semester, then the department has to constitute a committee consisting of the Head of the department, two senior faculty members of the department, one of them may be the internal guide. The evaluation is based on a Report, Presentation, and Viva-Voce of the NPTEL chosen topic and the assessment is a relative evaluation in context to the student's completed NPTEL course Certification (i.e. the CIE Score should be less than the score of the student who cleared the NPTEL Course).</p> <p><b>Note: The student who fails to enroll and appear for the proctored exam in NPTEL is considered to have failed.</b></p>			



### Research / Industry Internship - III

[As per Choice Based Credit System (CBCS) & OBE Scheme]

### SEMESTER – VIII

Course Code:	P22INT802	Credits:	06
Teaching Hours/Week (L:T:P):	0:0:0	CIE Marks:	-
Total Number of Teaching Hours:	-	SEE Marks:	100

#### Guidelines for Internship:

- I. Internship is of minimum Fifteen weeks duration and to be completed between the vacation period of VI & VII semester and VII & VIII semester.
- II. The internship can be carried out in any industry/ R & D Organization/ Research/ Institute/ Educational institute of repute/ Internshala (ACITE MoU Internship).
- III. The Department/college shall nominate staff member/s to facilitate, guide and supervise students under internship.
- IV. The Internal Guide has to visit place of internship at least once during the student's internship.
- V. The students shall report the progress of the internship to the guide in regular intervals and seek his/her advice.
- VI. After the completion of Internship, students shall submit a report with completion and attendance certificates to the Head of the Department with the approval of both internal and external guides.
- VII. There will be 100 marks for Viva Voce conducted during Semester End Examination (SEE) of VIII Semester. For the conduction of Internship Semester End Examination following instructions are issued:
  - a. The Semester End Examination (SEE) for 100 marks shall be conducted similar to final semester project work / lab examination.
  - b. Internal & External Examiners shall be appointed by the BoE – Chairperson in consultation with HoD and approval of the same by the Principal & Controller of Examination.
  - c. External Examiner may be from the Industry. If the external examiner from the industry is not available, alternative arrangement shall be made by the BoE - Chairperson by appointing a faculty from out of the available faculty in the department, wherein the student is studying.
- VIII. The students are permitted to carry out the internship anywhere in India or abroad. The Institution will not provide any kind of financial assistance to any student for carrying out the Internship.
- IX. Failing to undergo Internship: Internship is one of the head for obtaining degree, therefore completion of internship is mandatory.



### Project Work Phase – II

[As per Choice Based Credit System (CBCS) & OBE Scheme]

### SEMESTER – VIII

<b>Course Code:</b>	<b>P22ME803</b>	<b>Credits:</b>	<b>08</b>
<b>Teaching Hours/Week (L:T:P):</b>	<b>0:0:0</b>	<b>CIE Marks:</b>	<b>100</b>
<b>Total Number of Teaching Hours:</b>	<b>-</b>	<b>SEE Marks:</b>	<b>100</b>

Project Work: The Project Work (Phase I + Phase II) carries 12 credits (4 credits+8 credits) and spreads over TWO semesters, i.e. during 7th and 8th semesters.

- I. Project Phase – I and Project seminar Comprises of Literature Survey, Problem identification, Objectives and Methodology. CIE marks shall be based on the report covering Literature Survey, Problem identification, Objectives and Methodology and seminar presentation skill.
- II. The Assessment marks (CIE) in the case of Project Work - Phase I, shall be based on the evaluation at the end of the 7th semester by a committee consisting of Head of the concerned department, two senior faculty members of the department, one of them may be the internal guide. The work may be evaluated by the committee for award of Assessment marks (CIE) based on a Report [comprising of synopsis, Introduction, Literature survey, Objective and Methodology], presentation and viva voce.
- III. The project work shall be carried out by candidate(s) independently/in a group (maximum of four) during the seventh and eighth semester under the guidance of one of the faculty members of the Department of study. If the project work is of inter- disciplinary nature, a co-guide shall be taken from the same or any other relevant Department. If a project work has to be carried out in any industry / factory / organization, outside the campus, the permission for the same and the name of co- guide at any of these organizations shall be intimated to the authorities at the beginning of seventh semester by the Head of the Department.
- IV. The weekly progress of the Project work shall be monitored and reviewed by the Project Guide assigned by DUGC. The method of evaluation, including intermediate assessment shall be evolved by the pertinent DUGC.
- V. A candidate shall submit N+3 (No. of candidates+3) copies of the Report of the Project Work to Head, DUGC on or before the specified date. The report shall be in the format prescribed by the Institute. The candidate shall submit a report of the project work (dissertation) duly approved by the guide and co-guide. The project report shall be countersigned by the guide, co-guide (if any) and the Head of the Department
- VI. The last date for the submission of Report shall be Two weeks before the closure of the semester in which the project work credits have been registered for and is expected to be completed or as announced by the COE. The date of submission of the dissertation may be extended up to a maximum of eight academic years, from the date of commencement of the first semester in which the candidate has taken admission to the course.
- VII. The final evaluation (CIE & SEE) for Project Work - Phase II is done by a Project Work Evaluation Committee (PWEC) constituted by the pertinent DUGC. There shall be an open seminar followed by a viva – voce examination as part of the final evaluation. After the final evaluation, appropriate letter grade is awarded.
- VIII. If in the opinion of the PWEC, the Project Report is acceptable with minor modifications for the minimum passing grade 'E' (Fair) in the case of project, the PWEC shall value and instruct the candidate suitably to incorporate the necessary modifications and to resubmit it to the Chairman, PWEC. After such resubmission, the Chairman, PWEC will certify that the necessary modification has been incorporated.
- IX. The Assessment marks in case of Project Work - Phase II and seminar shall be based on the evaluation, as per the guidelines, at the end of the 8th semester by a committee consisting of Head



of the concerned department, two senior faculty members of the department (one of them may be the internal guide).

- X. The Assessment marks sheet shall bear the signature of all those concerned, along with the date and seal of the Principal.