APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

(A State Government University)

B. Tech, 2024

Minor Degree in

Intelligent Systems Design and Manufacturing

Offered By: (Mechanical Engineering)

CURRICULUM

Minor(Intelligent Systems Design and Manufacturing)											
Sl.No:	Semester	Course Code	Course Title (Course Name)	Credit Structure			SS	Total Marks		Credits	Hrs./ Week
				L	T	P		CIA	ESE		
1	3	MNMET309	Introduction to product design and Associated Development Tools * /MOOC#	3	0	2&	5.5	40	60	4	5
2	4	MNMET409	Introduction to Computational Methods* /MOOC#	3	0	2&	5.5	40	60	4	5
3	5	MNMET509	Intelligent Design Practices and Smart Manufacturing /MOOC	3	1	0	5	40	60	4	4
4	6	MNMET609	Mechatronics and robotics /MOOC	3	0	0	4.5	40	60	3	3
Total							**21**			**15**	**17**

**Students must register for theory courses listed in the 3rd and 4th semesters of the Minor curriculum.*

#Students who fail a theory course listed in the Minor curriculum are permitted to register for an alternate MOOC course specified in the Minor curriculum.

&The courses offered in the third and fourth semesters can be structured as either theory-based courses or a combination of theory and lab-based courses

SYLLABUS

SEMESTER 3

SEMESTER 3

INTRODUCTION TO PRODUCT DESIGN AND ASSOCIATED DEVELOPMENT TOOLS

Course Code	**MNMET309**	**CIE Marks**	40
Teaching Hours/Week (L:T:P)	3:0:2	ESE Marks	60
Credits	4	Exam Hours	2Hrs. 30 Min.
Prerequisites (if any)	NIL	Course Type	**Theory + Lab**

Course Objectives:

1. To establish fundamental knowledge of product development process
2. Apply knowledge of robust industrial design and conceptual design in product development
3. To acquaint with the basic concepts of design for manufacturing and assembly in product design.
4. To understand the concept of ergonomics and rapid prototyping in product development
5. To acquaint with 2d drawing and 3d modelling software.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction: Classification/ Specifications of Products, Product life cycle, product mix. Introduction to product design, Modern product development process Design by evolution, Design by innovation, Morphology of design	**11**
2	Creativity Techniques: Creative thinking, conceptualization, brain storming, primary design, drawing, simulation, detail design. Conceptual Design: Generation, selection & embodiment of concept, Product architecture. Industrial design: process, need.	**11**
3	Manufacturing and Assembly: Methods of designing for Manufacturing and Assembly. Design for Maintenance. Design for Environment.	**11**

	Ergonomics in product design. Aesthetics in product design. Concepts of size and texture colour.	
4	Concurrent Engineering -Elements of concurrent engineering, Benefits Rapid prototyping: concepts, processes and advantages. Reverse engineering: steps in reverse engineering	**11**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	**5**	**10**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the tools for product development process	***K3***
CO2	Conduct study on the use of robust industrial design and conceptual design in product development	***K5***
CO3	Assess concepts of design for manufacturing and assembly in product design.	***K5***
CO4	Analysing the concept of ergonomics and rapid prototyping	***K4***

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

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Product Design & Development	Karl T Ulrich, Steven D Eppinger	Tata McGraw Hill,	**2003.**
2	The Mechanical Design Process.	David G Ullman,	McGraw Hill Inc Singapore	**1992**
3	Machine Drawing	N. D. Bhatt and V.M. Pancha	Charotar Publishing House.	**2016**
4	Machine Drawing	P I Varghese & K C John	PHI Learning Private Limited	**2009**

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Designing for Production	Baldwin E N & Neibel B W	Edwin Homewood Illinois	1974
2	"Handbook of Product Design for Manufacture,	Bralla J G (Ed.)	McGraw Hill, NewYork,	1986

3	Rapid Manufacturing-The Technologies and Applications of Rapid Prototyping and Rapid Tooling,	D. T. Pham, S.S. Dimov,	Springer – Verlag, London,	2001.
4	Successful Product Design	Hollins B & Pugh S	Butter worths London,	1990
5	Design Methods. Seeds of Human Futures.	Jones J C	John Willey,	1970
6	Product Design: Techniques in Reverse Engineering and new Product Development.	Kevin Otto & Kristin Wood	Pearson Education New Delhi	2000
7	Product Design Fundamentals and Methods	N J M Roozenberg , J Ekels , N F M Roozenberg	John Willey & Sons	1995
8	Rapid Prototyping	Andreas Gebhardt	Carl Hanser – Verlag, Munich	2003

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1-4	https://www.youtube.com/watch?v=HN9GtL21rb4

1. Continuous Assessment (5 Marks)

i. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

ii. Conduct of Experiments (3 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

Final Marks Averaging: *The final marks for preparationand conduct of experiments are the average of all the specified experiments in the syllabus.*

2. Evaluation Pattern for Internal Lab Examination (10 Marks)

1. Procedure/Preliminary Work/Conduct of Experiments (3 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task

2. **Result (5 Marks)**
    - Accuracy of Results: Precision and correctness of the obtained results.
3. **Viva Voce (2 Marks)**
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

Experiment List

(Minimum 8 Experiments)

Experiment No.	Experiment
1-5	Understand the basics of machine drawing using any 2D drawing software. Study types of lines, dimensioning, scales of drawing, sectional views, Practice simple 2D sketches to familiarize with these concepts. (Minimum 4). simple sketches are required
6-10	Creating 3D machine components using any 3d modelling software (Minimum 4).

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNMET309

Course Name: Introduction to product design

Max. Marks: 60 | Duration: 2 Hours 30 Minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		What is product mix?	1	(3)
2		Explain morphology of design.	1	(3)
3		What is the role of simulation in product design?	2	(3)
4		Why drawing is important in product design?	2	(3)
5		What is design for assembly?	3	(3)
6		What is the role of Ergonomics in product design?	3	(3)
7		What are the benefits of Concurrent Engineering?	4	(3)
8		What is Reverse engineering	4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

		Module 1		
9	a)	Explain product life cycle with an example.	1	(6)
	b)	Explain Design by evolution.	1	(3)
10	a)	What are the classifications of a product? Explain.	1	(5)
	b)	Explain Morphology of design	1	(4)
		Module 2		
11	a)	What is Creative thinking? Explain with an example.	2	(5)
	b)	Explain Product architecture.	2	(4)
12	a)	What are the steps to design a concept	2	(5)
	b)	What is primary design?	2	(4)
		Module 3		
13	a)	What is design for manufacturing? Explain with an example.	3	(5)
	b)	Explain Design for Maintenance.	3	(4)

14	a)	What are the concepts of size and texture colour in product design?	3	(5)
	b)	Explain Design for Environment.	3	(4)
		Module 4		
15	a)	What are the elements of concurrent engineering? Explain	4	(5)
	b)	What are the advantages of rapid prototyping?	4	(4)
16	a)	Explain the steps in reverse engineering.	4	(5)
	b)	What is Concurrent Engineering?	4	(4)
		*****		

SEMESTER 4

SEMESTER 4

INTRODUCTION TO COMPUTATIONAL METHODS

Course Code	MNMET409	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	ESE Marks	60
Credits	4	Exam Hours	2Hrs. 30 Min.
Prerequisites (if any)	NIL	Course Type	Theory + Lab

Course Objectives:

1. To establish fundamental knowledge of basic fluid mechanics and simulation using FVM.
2. Apply heat transfer principles to solve engineering problems and simulations using FEM and FVM.
3. To acquaint with the basic concepts of stress and deformation in solids and simulations using FEM.
4. To understand the kinematics of different mechanism and simulations of different mechanisms.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to fluid mechanics - Types of fluids, Newton's law of viscosity. Dynamic and Kinematic Viscosity. Fluid kinematics: Description of fluid motion – Types of flows, Continuity equation, and Momentum equation (Derivation is not required). Laminar and turbulent flows, Reynolds number. Introduction to Computational Fluid Dynamics. Discretization-converting derivatives to their finite difference forms. Boundary and Initial conditions.	11
2	Modes of heat transfer - General heat conduction equation in three dimensions through plane (Derivation is not required, Simple problems only). –initial and boundary conditions.	11

	Natural convection and forced convection. (Basic concepts only) Basic laws of radiation heat transfer – Black, gray, diffuse and real surfaces.	
3	Introduction to analysis of deformable bodies. Hooke's law - Stress-Strain diagrams. Deformation in axially loaded bars (uniform cross section). Pure Bending – Flexure formula for beams (Derivation is not required, Simple problems only). Torsion: Shafts - torsion theory of elastic circular bars (Derivation is not required, Simple problems only). Introduction to FEM, Governing Equations (Derivation is not required). Formulation of stiffness matrix- one dimensional spring element.	**11**
4	Concepts of Kinematics and Dynamics, Mechanisms and Machines, Degrees of Freedom. Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Inversions of Four bar chain and Slider Crank Mechanisms.	**11**

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

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	**5**	**10**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply CAD, FEA and FVM tools to design and simulate mechanical systems.	***K3***
CO2	Conduct thermal and stress analysis on mechanical components under different loading conditions.	***K5***
CO3	Assessing Fluid flow using Computational Fluid Dynamics (CFD) software.	***K5***
CO4	Analysing linkage motions in different mechanisms	***K4***

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

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fluid Mechanics and Hydraulic Machines	Bansal R. K	Laxmi Publications	**2005**
2	Computational Fluid Dynamics	John D Anderson Jr	McGraw-Hill Book Company	**2012**
3	Fundamentals of engineering heat and mass transfer	R. C. Sachdeva	New Age International Publishers	6th edition, 2022
4	Mechanics of Solids	R.K.Bansal	Laxmi Publications	2012
5	Finite Element Analysis	S SBhavikatti	New Age Publisher	Third edition,2008
6	Theory of Machines	S. S. Rattan	Tata McGraw Hill	2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fluid Mechanics	White F.M.	Tata McGraw Hill	2003
2	Introduction to computational fluid dynamics	Anil W. Date	Cambridge University Press	2005
3	A text book on heat transfer	S.P. Sukhatme	Universities Press	4th edition, 2005
4	Mechanics of Solids	S. S. Bhavikatti	New Age International	2013
5	An introduction to Finite Element Method	J N Reddy	McGrawHill Education	Third Edition, 2009
6	Theory of Machines and Mechanisms	Ballaney P. L.	Khanna Publishers	2005

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://www.youtube.com/watch?v=rY7bvZn75Do&list=PLwdnzlV3ogoWrAmpEcsPXayfsXnFfYY1O&index=4 https://www.youtube.com/watch?v=rY7bvZn75Do&list=PLwdnzlV3ogoWrAmpEcsPXayfsXnFfYY1O&index=4 https://nptel.ac.in/courses/112105045
2	https://archive.nptel.ac.in/courses/112/105/112105124/ https://onlinecourses.nptel.ac.in/noc20_me64/preview
3	https://onlinecourses.nptel.ac.in/noc22_ce46/preview https://nptel.ac.in/courses/112106135
4	https://archive.nptel.ac.in/courses/112/105/112105268/

1. Continuous Assessment (5 Marks)

i. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

ii. Conduct of Experiments (3 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

Final Marks Averaging: *The final marks for preparation and conduct of experiments are the average of all the specified experiments in the syllabus.*

2. Evaluation Pattern for Internal Lab Examination (10 Marks)

1. Procedure/Preliminary Work/Conduct of Experiments (3 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Setup and Execution: Proper setup and accurate execution of the experiment or programming task

2. Result (5Marks)

- Accuracy of Results: Precision and correctness of the obtained results.

3. Viva Voce (2 Marks)

- Proficiency in answering questions related to theoretical and practical aspects of the subject.

Experiment List

(Minimum 8 Experiments)

Experiment No.	Experiment
	Simulations using **Finite Volume Method**
1.1	Laminar flow through pipe
1.2	Turbulent flow through pipe
1.3	Simulation of fluid flow and heat transfer in a mixing elbow
1.4	Drag and lift forces in an aerofoil
	Simulations using **Finite Element Method**
2.1	Truss analysis
2.2	Analysis of beams
2.3	Plane stress analysis
2.4	Steady state thermal analysis
	Simulation of Mechanisms
3.1	Dynamic simulation of a four-bar mechanism.
3.2	Simulation of a Whitworth Quick Return Mechanism

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNMET409

Course Name: Introduction to Computational Methods

Max. Marks: 60 | Duration: 2 hours 30 minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		How fluids are classified?	1	(3)
2		What is Reynolds number?	1	(3)
3		What is boundary condition?	2	(3)
4		What is Natural convection?	2	(3)
5		Write and explain the terms in Flexure formula for beams.	3	(3)
6		Explain Hooke's law.	3	(3)
7		What is a Mechanism?	4	(3)
8		What is a Kinematic Pair?	4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

		Module 1		
9	a)	Explain the difference between Laminar and turbulent flows.	1	(3)
	b)	What are the steps in Computational Fluid Dynamics Analysis?	1	(6)
10	a)	Explain the terms in Continuity equation and Momentum equation.	1	(6)
	b)	What is Discretization?	1	(3)
		Module 2		
11	a)	Explain the general heat conduction equation in three dimensions through plane.	2	(6)
	b)	What is initial condition?	2	(3)
12	a)	The air in a room is at 25° C and outside temperature is 0° C. The window of the room has an area of 2 m2 and thickness 2 mm. Calculate the rate of loss of heat by conduction through window? Thermal conductivity for glass is 1 W/m-K.	2	(6)
	b)	Explain Stefan-Boltzman Law.	2	(3)
		Module 3		

13	a)	Explain Stress-Strain diagram.	3	(3)
	b)	A steel plate of width 120 mm and of thickness 20mm is bent into a circular arc of radius 10 m. Determine the maximum stress induced and the bending moment which will provide the maximum stress. Take E = 2x105 N/mm2.	3	(6)
14	a)	A solid shaft of 150 mm diameter is used to transmit torque. Find the maximum torque transmitted to the shaft if the maximum shear stress induced to the shaft is 45 N/mm2.	3	(4)
	b)	What are the steps in FEA.	3	(5)
		Module 4		
15	a)	Explain Inversions of Four bar chain.	4	(5)
	b)	What is Degree of Freedom?	4	(4)
16	a)	Explain Inversions of Slider Crank Mechanism.	4	(5)
	b)	Explain Kinematic Chains.	4	(4)
		*****		

SEMESTER 5

SEMESTER 5

INTELLIGENT DESIGN PRACTICES AND SMART MANUFACTURING

Course Code	MNMET509	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:1:0	ESE Marks	60
Credits	4	Exam Hours	2Hrs. 30 Min.
Prerequisites (if any)	NIL	Course Type	Theory

Course Objectives:

1. To equip students with a comprehensive understanding of structured design methodologies
2. To impart knowledge on advanced manufacturing technologies, including Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and Computer-Aided Engineering (CAE), along with CNC systems, programming methods, and modern additive manufacturing techniques.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Concept Generation -Structured Design - Axiomatic Design, Algorithmic Design -- Intuitive Bias, Synectics and Systematic Search - Product Detailing Material Selection for Mechanical and Aesthetic Design - Embodiment Design - Placement of sensors and actuators - Design Inspired by Nature Inspirations in the Functional and Evolution Domain.	11
2	Computer Aided Drawing (CAD) and Computer Aided Manufacturing (CAM): Introduction, Role of CAD in design and development of new products, Advantages of CAD and CAM. Computer-Aided Engineering (CAE) -Analysis, Simulation, Optimization, and Manufacturing process improvement. Computer Aided Process Planning (CAPP) - automation and optimization.	11
3	CNC: systems – Principle of operation, components of CNC system, coordinate systems, classification of CNC systems - incremental and	11

	absolute programming methods, open loop and closed loop systems, feedback devices. Interpolators: liner and circular interpolator. Manual part programming - Computer aided part programming.	
4	Material addition processes: - Stereo-lithography, Selective laser sintering, Fused deposition modeling, Laminated object manufacturing, Powder bed fusion, 3D Printing, GTAW/GMAW process extension to derive basic metal additive manufacturing techniques. Available MAM Systems and Modern Developments.	**11**

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

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the different aspects of Design Practice with an emphasis on Product Design	*K2*
CO2	Understand the theory of CAD and CAM and Sketch simple drawings and solids using appropriate cad tools.	*K2 K3*
CO3	CNC programming, select appropriate tooling and parameters.	*K3*
CO4	Explain the processes used in additive manufacturing for a range of materials and applications.	*K2*

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

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Universal Principles of Design,	Lidwell, Holden and Butler	Rockport Publishers	2010
2	Computer control of manufacturing systems	Yoram Koren	TMH	2017
3	Machine Tool Design & Numerical Control	N K Mehta	McGrawhill Education	2020
4	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing	Ian Gibson, David Rosen, Brent Stucker	Springer Nature	2nd ed. 2015

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer-Aided Design and Manufacturing	M.P. Groover, E.M. Zimmers, Jr.	Prentice Hall of India	1987
2	Programmable logic controllers	Petruzella Frank.D.	McGraw Hill	2016
3	Developments in high-speed metal forming	Davies K and Austin E.R	The Machinery Publishing Co	1970
4	Advanced Machining Processes	Jain V.K.	Narosa publishers	2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc25_de10/unit?unit=42&lesson=44
2	https://onlinecourses.swayam2.ac.in/nou25_me04/preview
3	https://onlinecourses.nptel.ac.in/noc25_me49/preview
4	https://www.youtube.com/playlist?list=PLgMDNELGJ1CZlDT0ysOjbpR_6QTFmvIv7

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNMET509

Course Name: Intelligent Design Practices and Smart Manufacturing

Max. Marks: 60		Duration: 2 hours 30 minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		What is Structured Design?	1	(3)
2		What is actuator?	1	(3)
3		What is Computer Aided Manufacturing?	2	(3)
4		Discuss the importance of process planning in product development.	2	(3)
5		What is the difference between incremental and absolute programming methods?	3	(3)
6		What are G codes and M codes?	3	(3)
7		Explain the working of Fused deposition modelling.	4	(3)
8		What is 3D Printing?	4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

		Module 1		
9	a)	How the Material is selected for Mechanical and Aesthetic Design?	1	(6)
	b)	What is the importance of Evolution Domain in product design?	1	(3)
10	a)	What are the factors to be considered while placement of sensors and actuators?	1	(5)
	b)	What is Design Inspired by Nature?	1	(4)
		Module 2		
11	a)	Explain the steps in Computer Aided Process Planning.	2	(5)
	b)	How CAD helps to optimise the design of a product?	2	(4)
12	a)	Explain Computer Aided Manufacturing.	2	(4)
	b)	What is the role of CAD in design and development of new product?	2	(5)
		Module 3		
13	a)	What are the main parts of the CNC machine?	3	(5)
	b)	What is the difference between open loop and closed loop systems?	3	(4)

14	a)	Explain the circular interpolator.	3	(5)
	b)	Explain the following NC Part Program Codes: N001 G21 G90 G92 X0 Y-0.50.0 Z030.0; N002 G00 X0.70.0 Y030.0;	3	(4)
		Module 4		
15	a)	Explain the steps involved in Selective laser sintering.	4	(4)
	b)	Explain Laminated object manufacturing with diagrams.	4	(5)
16	a)	What are the Modern Developments in additive manufacturing?	4	(4)
	b)	Explain the steps in Powder bed fusion.	4	(5)
		*****		

SEMESTER 6

SEMESTER 6

MECHATRONICS AND ROBOTICS

Course Code	MNMET609	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	ESE Marks	60
Credits	3	Exam Hours	2Hrs. 30 Min.
Prerequisites (if any)	NIL	Course Type	Theory

Course Objectives:

1. To understand behaviour of sensors and actuators.
2. To understand different controllers for mechatronic systems
3. To understand the basics of robotics and trajectory planning
4. To understand the application of mechatronics in robotics

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Sensors and Actuators:** Introduction to Mechatronics: Structure of Mechatronics system. Sensors - Characteristics -Temperature, flow, pressure sensors. Displacement, position and proximity sensing by magnetic, optical, ultrasonic, inductive, capacitive and eddy current methods. Encoders, Piezoelectric sensors. Acoustic Emission sensors. Principle and types of vibration sensors. Actuators: Mechanical actuators, electrical actuators, hydraulic and pneumatic actuators.	9
2	**Control of mechanical systems**: System modeling - Mathematical models and basic building blocks of general mechanical, electrical, fluid and thermal systems (Concepts only). Programmable Logic Controllers (PLC) –Basic structure, input/ output processing. Development of simple ladder programs. Mechatronics in automobiles. EMS, Sensors, ECU, ABS, Cruise control.	9
3	**Robotics** - Definitions- Robots, Types of Robots- Manipulators, Mobile Robots-wheeled & Legged Robots, Aerial Robots; Anatomy of a robotic manipulator-links, joints, actuators, sensors, controller; open kinematic	9

	vs closed kinematic chain; Classification of End effectors.	
4	Mechatronics in Robotics-Electrical drives: DC, AC, brushless, servo and stepper motors (working only). Robotic vision system - Image acquisition: Vidicon, charge coupled device (CCD) and charge injection device (CID) cameras. Image processing techniques: histogram processing: sliding, stretching, equalization and thresholding.	**9**

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

Continuous Internal Evaluation Marks (CIE):

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

End Semester Examination Marks (ESE)

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

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To understand behaviour of sensors and actuators.	*K2*
CO2	To understand different controllers for mechatronic systems	*K2*
CO3	To understand the basics of robotics and trajectory planning	*K2*
CO4	To understand the application of mechatronics in robotics	*K2*

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

CO-PO Mapping Table:

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

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering	W. Bolton	Pearson	7th
2	Mechatronics: Principles and Applications	Godfrey C. Onwubolu	Elsevier	
3	Mechatronics System Design	Devdas Shetty, Richard Kolk	PWS Pub	
4	Fundamentals of Robotics – Analysis and Control	Robert. J. Schilling	Prentice Hall of India	1996
5	Introduction to Robotics (Mechanics and Control)	John. J. Craig	Pearson Education Asia	2002
6	Introduction to Robotics	S K Saha,	McGraw Hill Education	
7	Robotics and Control	R K Mittal	Tata McGraw Hill, New Delhi	2003

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	A Text Book of Mechatronics	R.K. Rajput	S. Chanth	First edition 2007
2	Handbook of Robotics	Siciliano, Khatib	Springer	First edition

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/112/107/112107298/
2-3	https://archive.nptel.ac.in/courses/112/105/112105249/
4	https://archive.nptel.ac.in/courses/112/107/112107298/

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B. TECH MINOR DEGREE EXAMINATION, MONTH AND YEAR

Course Code: MNMET609

Course Name: Mechatronics and robotics

Max. Marks: 60 | Duration: 2 hours 30 minutes

PART A

		Answer all questions. Each question carries 3 marks	CO	Marks
1		Explain with a neat sketch, the working of a pressure sensor.	1	(3)
2		How electrical actuators works?	1	(3)
3		What is a ladder diagram?	2	(3)
4		What is Cruise control?	2	(3)
5		What is an Aerial Robot?	3	(3)
6		What is the difference between open kinematic and closed kinematic chain?	3	(3)
7		Explain the working of BLDC motor.	4	(3)
8		What is sliding in histogram processing?	4	(3)

PART B

Answer any one full question from each module. Each question carries 9 marks

		Module 1		
9	a)	Explain the working of an Encoder with a neat sketch.	1	(3)
	b)	Explain the working of any two displacement sensors.	1	(6)
10	a)	Explain the working of proximity sensing by magnetic and optical methods?	1	(6)
	b)	What is the principle behind vibration sensors?	1	(3)
		Module 2		
11	a)	Explain the mathematical models and basic building blocks of general mechanical systems.	2	(5)
	b)	Explain the basic structure of PLC.	2	(4)
12	a)	How the fluid and thermal systems are modelled?	2	(5)
	b)	Explain the working of ABS.	2	(4)
		Module 3		
13	a)	What are the different types of robots?	3	(6)

	b)	What is the need of controller in robots?	3	(3)
14	a)	How End effectors are classified? Explain.	3	(5)
	b)	Explain the working of any two robotic sensory devices.	3	(4)
		Module 4		
15	a)	Explain the working of CCD with a neat sketch.	4	(5)
	b)	Describe the working of stepper motors.	4	(4)
16	a)	Explain the working of CID with a neat sketch.	4	(5)
	b)	Explain the working of servo motors.	4	(4)
		*****		