SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE
(AUTONOMOUS)
(Approved by AICTE, New Delhi, Affiliated to JNTUK, Kakinada)
Accredited by NAAC with 'A+' Grade
Recognised as Scientific and Industrial Research Organisation
SRKR MARG, CHINA AMIRAM, BHIMAVARAM – 534204 W.G.Dt., A.P., INDIA

Regulation: R23	

MECHANICAL ENGINEERING (Honors)

COURSE STRUCTURE
(With effect from 2023-24 admitted Batch onwards)

Course Code	Course Name	Year/ Sem	Cr	L	T	P	C.I.E	S.E.E	Total Marks
B23MEH101	Product Design and Development	III-I	3	3	0	0	30	70	100
B23MEH201	Industrial Robotics & Automation	III-II	3	3	0	0	30	70	100
B23MEH301	Advanced CAD	IV-I	3	3	0	0	30	70	100
B23MEH401	*MOOCS-I	III-I to IV-I	3	--	--	--	--	--	100
B23MEH501	*MOOCS-II	III-I to IV-I	3	--	--	--	--	--	100
B23MEH601	*MOOCS-III	III-I to IV-I	3	--	--	--	--	--	100
	TOTAL		**18**	**12**	**0**	**0**	**120**	**280**	**600**

*Three MOOCS courses of any **MECHANICAL ENGINEERING** related Program Core Courses from NPTEL/SWAYAM with a minimum duration of 12 weeks (3 Credits) courses other than the courses offered need to be takenby prior information to the concern. These courses should be completed between III Year I Semester to IV Year I Semester

Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23MEH101	**Honor**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

PRODUCT DESIGN AND DEVELOPMENT

(Honors Degree Course in ME)

Course Objectives:

1.	To impart the process of product design and Development
2.	To expose the various factors influencing product design.

Course Outcomes

S.No	Outcome	Knowledge Level
1.	**Apply** the product design and development process to solve engineering problems	**K3**
2.	**Demonstrate** concept generation, selection and robust design using design morphology.	**K3**
3.	**Use** product planning methods to convert needs into specifications.	**K3**
4.	**Use** creative thinking to generate, select and test product concepts.	**K3**
5.	**Apply** DFX principles to optimize designs, ensuring cost, legal and ethical compliance.	**K3**

SYLLABUS

UNIT-I (10Hrs)	**Introduction**: Classification/Specifications of Products, Product life cycle. Product mix, Introduction to product design, Modern product development process, Innovative thinking.
UNIT-II (10 Hrs)	**Morphology of design:** Conceptual Design: Generation, selection & embodiment of concept. Product architecture, Industrial design: process, need, Robust Design development economics quantitative and qualitative analysis
UNIT-III (10 Hrs)	**Product planning:** Identify opportunities, prioritize projects, allocate resources, project planning, Identify customer needs, product specifications, target specifications and final specifications, concept generation and selection
UNIT-IV (10 Hrs)	**Creativity Techniques:** Creative thinking, concept generation: clarify the problem search external and internal explorer systematically, concept selection & testing, concurrent engineering, rapid prototyping, 3D printing and 3D scanning
UNIT-V (10 Hrs)	**Design for X(DFX):** Design for Manufacturing (DFM) & Assembly (DFA), Designs for Maintainability, Designs for Environment, Product costing, Legal factors, Engineering ethics and issues of society related to design of products, Forms of intellectual property and steps involved in patent filing.

Textbooks:	
1.	Karl T Ulrich, Steven D Eppinger, “Product Design & Development.” Tata McGrawhill New Delhi 2003.
2.	David G Ullman, “The Mechanical Design Process.” McGrawhill Inc Singapore 1992.
Reference Books:	
1.	Hollins B & Pugh S “Successful Product Design.” Butter worth London.
2.	Jones J C “Design Methods.” Seeds of Human Futures. John Willey New York.
3.	Bralla J G “Handbook of Product Design for Manufacture, McGrawhill NewYork.
4.	N J M Roozenberg, J Ekels, N F M Roozenberg “Product Design Fundamentals and Methods”
e-Resources	
1.	https://nptel.ac.in/courses/112107217
2.	https://onlinecourses.nptel.ac.in/noc21_me66/preview

Course Code: B23MEH101					
SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (A)					**R23**
III B.Tech. I Semester MODEL QUESTION PAPER					
PRODUCT DESIGN AND DEVELOPMENT					
(Honors Degree Course in ME)					
Time: 3 Hrs.					**Max. Marks: 70 M**
Answer Question No.1 compulsorily					
Answer **ONE Question** from **EACH UNIT**					
Assume suitable data if necessary					
					10 x 2 = 20 Marks
			CO	**KL**	**M**
1.	**a).**	List out the stages involved in product life cycle.	**1**	**1**	**2**
	b).	Differentiate between product design and product development.	**1**	**2**	**2**
	c).	Define morphology of design. What are its key stages?	**2**	**1**	**2**
	d).	Differentiate between quantitative and qualitative analysis in development economics.	**2**	**2**	**2**
	e).	Name any two tools used for concept selection.	**3**	**1**	**2**
	f).	Define the term 'opportunity identification' in product planning.	**3**	**1**	**2**
	g).	Define rapid prototyping.	**4**	**1**	**2**
	h).	State the importance of problem clarification in the design process.	**4**	**1**	**2**
	i).	Name any two forms of intellectual property relevant to product design.	**5**	**1**	**2**
	j).	What is the purpose of patenting a product?	**5**	**1**	**2**
					5 x 10 = 50 Marks
		UNIT-1			
2.		What are the different classifications and specifications of products? Discuss in detail with suitable examples.	**1**	**3**	**10**
		OR			
3.		Elucidate the stages involved in the modern product development process to launch new products to market.	**1**	**3**	**10**
		UNIT-2			
4.		Elaborate the stages involved in robust design and how each stage contributes to minimizing variation in product performance.	**2**	**3**	**10**
		OR			
5.		Discuss the implications of architecture in product development.	**2**	**3**	**10**
		UNIT-3			
6.		Discuss how customer needs are translated into target and final product specifications with a suitable example.	**3**	**3**	**10**
		OR			
7.		Develop a process for identifying and prioritizing customer needs.	**3**	**3**	**10**
		UNIT-4			
8.		Illustrate the steps involved in internal and external search strategies	**4**	**3**	**10**

		during concept generation.			
		OR			
9.		Apply the concept of concurrent engineering in product development and explain its advantages.	**4**	**3**	**10**
		UNIT-5			
10.		Apply the principles of Design for Manufacturing (DFM) and Design for Assembly (DFA) to improve the efficiency of a product design.	**5**	**3**	**10**
		OR			
11.		Discuss the steps involved in preparing a disclosure for patent filing in product development.	**5**	**3**	**10**

CO-COURSE OUTCOME **KL-KNOWLEDGE LEVEL** **M-MARKS**

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks

Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23MEH201	**Honor**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

INDUSTRIAL ROBOTICS AND AUTOMATION

(Honors Degree Course in ME)

Course Objectives:

1.	Student will understand the fundamental concepts and components of industrial robots and automation systems.
2.	Student can analyze robot kinematics, control systems, and sensor integration for effective motion planning.
3.	Student will understand the design of robotic work cells, end effectors, and machine vision systems.
4.	Student will learn programming techniques and robot languages used in industrial applications.
5.	Student will acquire knowledge about robot cell design and the real-world applications of industrial robots aligned smart manufacturing.

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

S.No	Outcome	Knowledge Level
1.	**Understand** the structure, configuration, and motion control of industrial robots.	**K3**
2.	**Apply** kinematic equations and control strategies to model robot motion and dynamics.	**K3**
3.	**Analyze** the functionality of end effectors, and machine vision in robotics.	**K4**
4.	**Evaluate** and write basic programs for robot motion and task control using different programming types.	**K4**
5.	**Design** robot cells and assess automation solutions for industrial applications.	**K4**

SYLLABUS

UNIT-I (10Hrs)	**Introduction:** Automation and Robotics, Robot anatomy, robot configuration, motions joint notation scheme, work volume, robot drive systems, control systems and dynamic performance, precision of movement. **Control System and Components:** basic concepts and motion controllers, control system analysis, robot actuation and feedback components. **Sensors**: Desirable features, tactile, proximity and range sensors, uses sensors in robotics. Positions sensors, velocity sensors, actuators, power transmission systems
UNIT-II (10 Hrs)	**Motion Analysis and Control:** position representation, forward and inverse transformations, homogeneous transformations, manipulator path control, robot arm dynamics, configuration of a robot controller. Robot joint control design. **Manipulator kinematics:** Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – basic problems.

UNIT-III (10 Hrs)	**End Effectors:** Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design**.** **Machine Vision:** Functions, Sensing and Digitizing-imaging devices, Lighting techniques, Analog to digital single conversion
UNIT-IV (10 Hrs)	**Robot Programming:** Lead through programming, Robot program as a path in space, Motion interpolation, Branching, capabilities and Limitations of lead through methods. **Robot Languages:** Textual robot Languages, Robot language structures, Elements and function.
UNIT-V (10 Hrs)	**Robot Cell Design and Control:** Robot cell Layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Interlocks, Error detection, Work cell controller. Emphasize human-robot interaction (HRI) and safety protocols in automated environments. **Robot Applications:** Material transfer, Machine loading/unloading, Processing operation, Assembly and Inspection, Future Application.

Textbooks:	
1.	Industrial Robotics /Groover M P /Pearson Edu.
2.	Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.
Reference Books:	
1.	Robotics / Fu K S/ McGraw Hill.
2.	Robotic Engineering / Richard D. Klafter, Prentice Hall.
3.	Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
4.	Introduction to Robotics by SK Saha, The McGrah Hill Company, 6th, 2012.
5.	Robotics and Control / Mittal R K &Nagrath I J / TMH.
e-Resources	
1.	https://youtube.com/playlist?list=PLXDsvE7qtfNdt9oYEhJ_LMXDUGu6bH-L6&si=1NCCkMEjClE5rXHg
2.	https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/syllabus

				Course Code: B23MEH201	
		SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (A)			**R23**
		III B.Tech. II Semester MODEL QUESTION PAPER			
		INDUSTRIAL ROBOTICS AND AUTOMATION			
		(Honors Degree Course in ME)			
Time: 3 Hrs.				**Max. Marks: 70 M**	
		Answer Question No.1 compulsorily			
		Answer **ONE Question** from **EACH UNIT**			
		Assume suitable data if necessary			
				10 x 2 = 20 Marks	
			CO	**KL**	**M**
1.	**a).**	Define a robot. How is it different from automation?	**1**	**2**	**2**
	b).	List any two types of robot drive systems.	**1**	**2**	**2**
	c).	What is a homogeneous transformation matrix?	**2**	**2**	**2**
	d).	Define Denavit–Hartenberg (D-H) notation.	**2**	**2**	**2**
	e).	Mention two important considerations in gripper selection.	**3**	**2**	**2**
	f).	List two common types of sensors used in robotics.	**3**	**2**	**2**
	g).	Define trajectory planning in robotics.	**4**	**2**	**2**
	h).	What are the key elements and functions of textual robot languages?	**4**	**2**	**2**
	i).	Explain about Robot cell design.	**5**	**2**	**2**
	j).	List two applications of industrial robots.	**5**	**2**	**2**
				5 x 10 = 50 Marks	
		UNIT-1			
2.		Differentiate between various robot configurations with suitable sketches.	**1**	**3**	**10**
		OR			
3.		Explain the basic concepts of motion controllers used in robotics.	**1**	**3**	**10**
		UNIT-2			
4.		Derive the homogeneous transformation matrix for a simple rotation and translation.	**2**	**3**	**10**
		OR			
5.		Describe manipulator path control techniques.	**2**	**3**	**10**
		UNIT-3			
6.		Discuss various types of grippers and their operating mechanisms.	**3**	**3**	**10**
		OR			
7.		Explain the image digitization process in machine vision.	**3**	**3**	**10**
		UNIT-4			
8.		Describe motion interpolation and branching in robot programming with suitable examples.	**4**	**3**	**10**
		OR			

9.	Explain the structure of textual robot languages and explain the key elements and functions of robot programming languages.	**4**	**3**	**10**
	UNIT-5			
10.	Discuss the importance of human-robot interaction (HRI) and safety protocols in modern automated environments with example.	**5**	**3**	**10**
	OR			
11.	Explain robotic applications in machine loading/unloading and inspection.	**5**	**3**	**10**

CO-COURSE OUTCOME **KL-KNOWLEDGE LEVEL** **M-MARKS**

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks

Code	Category	L	T	P	C	I.M	E.M	Exam
B23MEH301	**Honors**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

ADVANCED CAD

(Honors Degree Course in ME)

Course Objectives: The objective of this course is to:

1.	Master geometric modeling by applying Bézier, B-spline, and NURBS techniques to 2D/3D design challenges
2.	Implement computational methods for cubic splines and solid modeling in CAD systems
3.	Analyze industrial applications of surface modeling through Gaussian curvature and continuity evaluation
4.	Integrate CAD modeling techniques with industry standards for automotive and aerospace applications

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

S.No	Outcome	Knowledge Level
1.	**Apply** 2D/3D coordinate transformations to modify geometric primitives in CAD systems	**K3**
2.	**Use** blending functions and reparametrization techniques to construct cubic spline curves for geometric modelling	**K3**
3.	**Analyze** Bézier and B-spline curves using Bernstein basis functions and derivative properties	**K4**
4.	**Apply** surface modelling techniques (bicubic, ruled, sweep) to create manufacturable CAD geometries.	**K3**
5.	**Apply** solid modelling concepts to create manufacturable solid models from 2D designs	**K3**

SYLLABUS

UNIT-I (10 Hrs)	**INTRODUCTION:** Definition & Scope of CAD systems, Explicit and implicit equations, parametric equations
UNIT-II (10 Hrs)	**Cubic Splines-1:** Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve, blending functions, four-point form, reparametrization, truncating and subdividing of curves. Graphic construction and interpretation, composite pc curves
UNIT-III (10 Hrs)	**Bezier Curves**: Bernstein basis, equations of Bezier curves, properties, derivatives, Applications
UNIT-IV (10 Hrs)	**Surfaces:** Bicubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature.

UNIT-V (10 Hrs)	**Solids: Tricubic solid, Algebraic and geometric form.** Solid modelling concepts: Wire frames, Boundary representation, Half space modeling, spatial cell, cell decomposition, classification problem.

Textbooks:	
1.	Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc., 1992.
2.	Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education –2003.
3.	David F Rogers & J Alan Adams "Mathematical Elements For Computer Graphics"
Reference Books:	
1.	Ibrahim Zeid Mastering CAD/CAM – McGraw Hill, International Edition, 2007.
2.	William M Neumann and Robert F.Sproul "Principles of Computer Graphics", Mc Graw Hill Book Co. Singapore, 1989.
e-Resources :	
1	https://nptel.ac.in/courses/112104031
2	https://nptel.ac.in/courses/112102101

				Course Code: B23MEH301	
		SAGI RAMA RISHNAM RAJU ENGINEERING COLLEGE (A)			**R23**
		IV B.Tech. I Semester MODEL QUESTION PAPER			
		ADVANCED CAD			
		(Honors Degree Course in ME)			
Time: 3 Hrs.					**Max. Mars: 70 M**
		Answer Question No.1 compulsorily			
		Answer **ONE Question** from **EACH UNIT**			
		Assume suitable data if necessary			
					10 x 2 = 20 Marks
			CO	**KL**	**M**
1.	**(a)**	Define CAD	**1**	**1**	**2**
	(b)	Explain the scope of CAD systems	**1**	**1**	**2**
	(c)	What is reparametrization?	**2**	**1**	**2**
	(d)	State the four-point form of a cubic spline	**2**	**1**	**2**
	(e)	Define Bézier curves.	**3**	**1**	**2**
	(f)	Explain industrial applications of Bézier curves	**3**	**1**	**2**
	(g)	Explain why B-spline surfaces are preferred over Bézier surfaces in automotive design	**4**	**2**	**2**
	(h)	Define Gaussian curvature in surface modeling	**4**	**1**	**2**
	(i)	List the three primary components of boundary representation	**5**	**1**	**2**
	(j)	Define solid modelling.	**5**	**1**	**2**
					5 x 10 = 50 Marks
		UNIT-1	**CO**	**KL**	**M**
2.		Differentiate explicit and parametric equations	**1**	**3**	**10**
		OR			
3.		Convert the implicit equation of a circle ($x^2+y^2=r^2$) into parametric form	**1**	**3**	**10**
		UNIT-2			
4.		Derive the mathematical formulation of a cubic spline's blending functions	**2**	**3**	**10**
		OR			
5.		Compare algebraic and geometric forms of cubic splines	**2**	**3**	**10**
		UNIT-3			
6.		Explain the properties of Bézier curves derived from the Bernstein basis	**3**	**3**	**10**
		OR			
7.		Explain the limitations of Bézier curves for high-precision applications	**3**	**3**	**10**
		UNIT-4			
8.		Differentiate ruled and sweep surfaces with suitable examples	**4**	**3**	**10**
		OR			
9.		Construct the parametric equations for a bilinear surface.	**4**	**3**	**10**

		UNIT-5			
10.		Classify the given solid models as either CSG or B-rep	**5**	**3**	**10**
		OR			
11.		Compare wireframe and B-rep models for virtual reality-based engineering applications	**5**	**3**	**10**

CO-COURSE OUTCOME **KL-KNOWLEDGE LEVEL** **M-MARKS**

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks