INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICALENGINEERING

COURSE DESCRIPTOR

Course Title	**FLEXIBLE MANUFACTURING SYSTEMS**				
Course Code	BCCB23				
Programme	M.Tech				
Semester	III				
Course Type	Professional Elective-V				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Course Coordinator	Ms. B. Vijaya Krishna, Assistant Professor, ME				
Course Faculty	MS. B. Vijaya Krishna, Assistant Professor, ME				

I. COURSEOVERVIEW:

Flexible Manufacturing is a sub discipline of mechanical engineering, and optical engineering concerned with designing machines, fixtures, and other structures that have exceptionally low tolerances, are repeatable, and are stable over time. These approaches have applications in machine tools. allowed a different approach to engine design. The reduced cost of machining has made possible integrated structural configurations, with more functions assigned to the same piece of metal.

II. COURSEPRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	-	-	Production Technology	-

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Flexible manufacturing system	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	LCD / PPT	✔	Seminars	✔	Videos	✔	MOOCs
✘	Open Ended Experiments						

V. EVALUATIONMETHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the Concept.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Technical Seminar and Term Paper	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):
Two CIE exams shall be conducted at the end of the 9^{th} and 17^{th} week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration, consisting of 5 one mark compulsory questions in part-A and 4 questions in part-B. The student has to answer any 4 questions out of five questions, each carrying 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Technical Seminar and Term Paper:
Two seminar presentations and the term paper with overview of topic are conducted during II semester. The evaluation of Technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

VI. HOW PROGRAM OUTCOMES AREASSESSED:

Program Outcomes (POs)		Strength	Proficiency Assessed by
PO 1	Apply advanced level knowledge, techniques, skills and modern tools in the field of computer aided engineering to critically assess the emerging technological issues.	3	Seminar
PO 2	Have abilities and capabilities in developing and applying Computer software and hardware to mechanical design and manufacturing fields.	2	Term Papers
PO 4	Function on multidisciplinary environments by working cooperatively, creatively and responsibly as a member of a team.	2	Seminar
PO 6	Independently carry out research/investigation and development work to solve practical problems	2	Term Papers

3 = High; 2 = Medium; 1 = Low

VII. COURSE OBJECTIVES(COs):

The course should enable the students to:	
I	Understanding of modern trends in design and manufacturing using CAD/CAM.
II	Apply performance analysis techniques.
III	Understand preventive maintenance procedures in manufacturing

VIII. COURSE OUTCOMES:

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Expose the student to the different types of manufacturing available today such as the Special Manufacturing System, the Manufacturing Cell, and the Flexible Manufacturing System	CLO 1	Understand the basic concepts of FMS
		CLO 2	Apply the concept of system design procedures to different levels of production.
		CLO 3	Identify the system modeling issues and control them
CO 2	To learn the fundamentals of computer assisted numerical control programming and programming languages	CLO 4	Apply the concept of scheduling
		CLO 5	Understand and Apply system modeling techniques
		CLO 6	Distinguish between continuous and discrete modeling techniques
CO 3	Understanding the modelling, design and simulation of complex systems	CLO 7	Design models of manufacturing systems
		CLO 8	Analysis of performance of manufacturing system
		CLO 9	Understand the preventative maintenance
CO 4	The common CAD/CAM data base organized to serve both design and manufacturing	CLO 10	Understand the basic concepts of FMS
		CLO 11	Apply the concept of system design procedures to different levels of production.
		CLO 12	Identify the system modeling issues and control them
CO 5	To practice the PLC control devices and CNC operation skills.	CLO 13	Understand and Apply system modeling techniques
		CLO 14	Distinguish between continuous and discrete modeling techniques
		CLO 15	Design models of manufacturing systems

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
BCCB23.01	CLO 1	Understand the basic concepts of Flexible Manufacturing system	PO 1	3
BCCB23.02	CLO 2	Apply the concept of system design procedures to different levels of production.	PO 1	2
BCCB23.03	CLO 3	Identify the system modeling issues and control them	PO 1	3
BCCB23.04	CLO 4	Apply the concept of scheduling	PO 2	2
BCCB23.05	CLO 5	Understand and Apply system modeling techniques	PO 2	2
BCCB23.06	CLO 6	Distinguish between continuous and discrete modeling techniques	PO 2	3
BCCB23.07	CLO 7	Design models of manufacturing systems	PO 3	1
BCCB23.08	CLO 8	Analysis of performance of manufacturing system	PO 4	2
BCCB23.09	CLO 9	Understand the preventative maintenance	PO 5	2
BCCB23.10	CLO 10	Understand the basic concepts of FMS	PO 5	2
BCCB23.11	CLO 11	Apply the concept of system design procedures to different levels of production.	PO 6	3
BCCB23.12	CLO 12	Identify the system modeling issues and control them	PO 6	3
BCCB23.13	CLO 13	Understand and Apply system modeling techniques	PO 3	3
BCCB23.14	CLO 14	Distinguish between continuous and discrete modeling techniques	PO 5	3
BCCB23.15	CLO 15	Design models of manufacturing systems	PO 7	2

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (PO)					
	PO 1	PO 2	PO 3	PO 5	PO 6	PO 7
CO 1	1					
CO 2		2				
CO 3		1	3			
CO 4				2		
CO 5					2	2

XI. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Learning Outcomes (CLOs)	Program Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO 1	3						
CLO 2	2						
CLO 3	3						
CLO 4		2					
CLO 5		2					
CLO 6		3					
CLO 7			1				
CLO 8				2			
CLO 9					2		
CLO 10					2		
CLO 11						3	
CLO 12				1		3	
CLO 13			3				
CLO 14					3		
CLO 15							2

3 = High; 2 = Medium; 1 = Low

XII. ASSESSMENTMETHODOLOGIES–DIRECT

CIE Exams	PO 1, PO2, PO 3, PO4,	SEE Exams	PO 1, PO2, PO 3, PO4,	Term Paper	PO 5,PO 6
Viva	-	Mini Project	-	Laboratory Practices	-

XIII. ASSESSMENTMETHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIV. SYLLABUS

UNIT-I	FLEXIBLE MANUFACTURING SYSTEM	Classes:09
Introduction: Definitions of manufacturing with input-output model, definition of system, basic problemsconcerningsystemsandsystemdesignprocedure,modesofmanufacturing–job/batch/flow and multi- product, small batch manufacturing.		
UNIT-II	**SYSTEM MODELLING ISSUES**	**Classes: 09**
System modeling issues: Centralized versus distributed control; Real-time vs discrete event control; Forward vs. backward scheduling approaches with finite/infinite capacity loading; Modeling of absorbing states and deadlocks; Conflicts; Concurrency, and synchronization.		
UNIT-III	**SYSTEM MODELLING TOOLS AND TECHNIQUES**	**Classes: 09**
System Modeling Tools and Techniques: Introduction to mathematical modeling, optimization, and simulation; issues related with deterministic and stochastic models. Continuous and discrete mathematical modeling methods -discrete event, monte carlo method; Basic concepts of Markov chains and processes; The M/M/1 and M/M/m queue; Models of manufacturing systems including transfer lines and flexible manufacturing systems, introduction to Petri nets		
UNIT-IV	**PERFORMANCE ANALYSIS**	**Classes: 09**
Performance Analysis: Transient analysis of manufacturing systems, analysis.		
UNIT-V	**PREVENTATIVE MATAINANCE**	**Classes: 09**
Preventive maintenance, Kanban system, implementation issues.		
Text Books:		
1. N. K. Jha, "Hand Book of Flexible Manufacturing Systems", Academic Press, 1st Edition, 2013. 2. Talichi Ohno, "Production System beyond Large Scale Production", Toyota Productivity Press India Pvt. Ltd, 1st Edition, 2010. 3. H KShivanand, "Flexible Manufacturing Systems", New Age International, 1st Edition, 2006.		
Reference Books:		
1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, 2nd Edition, 2004. 2. P. Radha Krishnan, "CAD/ CAM/ CIM", New Age International, 4th Edition, 2016.		

XIV COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No	Topic Outcomes	Topic/s to be covered	Reference
1 – 3	**Understand** the basic concepts of Flexible Manufacturing system	Introduction: Definitions of manufacturing with input-output model, definition of system, basic problems concerning systems.	T1,T2, R1
4 – 6	**Apply** the concept of system design procedures to different levels of production.	system design procedure, modes of manufacturing– job/batch/flow and multiproduct, small batch manufacturing	T1,T2
7 – 9	**Identify** the system modeling issues and control them	System modeling issues: Centralized versus distributed control; Real-time vs discrete event control.	T2,T3
10 – 13	**Apply** the concept of scheduling	Forward vs. backward scheduling approaches with finite/infinite capacity loading; Modeling of absorbing states and deadlocks; Conflicts; Concurrency, and synchronization.	T1,T2
14 – 16	**Understand and Apply** system modeling techniques	System Modeling Tools and Techniques: Introduction to mathematical modeling, optimization, and simulation; issues related with deterministic and stochastic models.	T1, R1
17 – 20	**Distinguish** between continuous and discrete modeling techniques	Continuous and discrete mathematical modeling methods-discrete event, monte carlo method; Basic concepts of Markov chains and processes; The M/M/1 and M/M/m queue.	T1
21 – 22	**Design** models of manufacturing systems	Models of manufacturing systems including transfer lines and flexible manufacturing systems, introduction to Petri nets.	T1
23 – 25	**Analysis** of performance of manufacturing system	Performance Analysis: Transient analysis of manufacturing systems, analysis.	T1,T2
29 – 35	Understand the preventative maintenance	Preventive maintenance, Karban system, implementation issues.	T1,T2

XIV: GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSIONREQUIREMENTS:

S No	Description	Proposed Actions	Relevance with POs
1	Advances in manufacturing processes	Seminars /Guest Lectures / NPTEL	PO 1, PO 2, PO 3
2	Interaction of materials and manufacturing processes	Seminars / Guest Lectures / NPTEL	PO 2, PO 5
3	Recommended practices in casting, welding, and forming	Assignments / Laboratory Practices	PO 1, PO 3, PO 6

Prepared by:

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