Paper Code: ARA 206	L	T/P	Credits
Subject: Fundamentals of Automation	4	-	4

Marking Scheme
Teachers Continuous Evaluation: As per university examination norms from time to time.
End Term Theory Examination: As per university examination norms from time to time.

INSTRUCTIONS TO PAPER SETTERS: Maximum Marks: As per University Norms

- There should be 9 questions in the end term examination question paper
- Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 15 marks.
- Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 15 marks.
- The questions are to be framed keeping in view the learning outcomes of course/paper. The standard/ level of the questions to be asked should be at the level of the prescribed textbooks.
- The requirement of (scientific) calculators/ log-tables/ data-tables may be specified if required

Course Outcomes [Bloom's Knowledge Level (KL)]:

CO1:	Ability of students to identify suitable automation hardware for the given application. **[K1,K2]**
CO2:	Ability of students to identify potential areas of automation and material handling systems**. [K1,K2,K3]**
CO3:	Ability of students to utilize understanding of Manufacturing systems and Mathematical models of production lines. **[K1,K2,K3**]
CO4:	Ability of students to practically implement knowledge of Industrial Automated production lines, work part transfer mechanism and buffer storage analysis for setup of future automated factory. **[K3,K4]**

CO/PO	**PO01**	**PO02**	**PO03**	**PO04**	**PO05**	**PO06**	**PO07**	**PO08**	**PO09**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	2	2	1	1	1	3	3
CO2	3	3	3	3	2	2	2	1	1	1	3	3
CO3	3	3	3	3	2	2	2	1	1	1	3	3
CO4	3	3	3	3	2	2	2	1	1	1	3	3

Course Content	**No of lectures**
Unit I **Concept and scope of automation:** Definition of automation, Socio economic impacts of automation, Types of Automation, Low Cost Automation and Automation Strategies, Types of	[10]

production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models **Fixed Automation:** Automated Flow lines, Methods of Workpart Transport, Transfer Mechanism - Continuous transfer, intermittent transfer and Indexing mechanism, Operator-Paced Free Transfer Machine, Buffer Storage, Control Functions and Automation for Machining Operations, Design and Fabrication Considerations **Automation Application:** Home, Library, Electronics Assembly, Mechanical Assembly, Material Removal, Quality Control and Inspection, Material Handling and Storage, Laboratory Automation	
Unit II **Automated Materials Handling:** The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. **Automated Storage Systems:** Storage System Performance, Automated Storage/Retrieval Systems, Carousel Storage Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing **Automated Manufacturing Systems-**Components, Classification and overview of manufacturing systems, Cellular manufacturing, Flexible manufacturing system (FMS), FMS and its planning and implementation, automated assembly system – design and types of automated assembly systems, Analysis of multi station and single station assembly machine.	[10]
Unit III **Analysis of Automated Flow Lines**: General Terminology and Analysis, Analysis of Transfer Lines without Storage, Partial Automation, Automated Flow Lines with Storage Buffers. **Automated Assembly Systems:** Design for Automated Assembly, Types of Automated Assembly Systems, Vibratory bowl feeder and Non vibratory bowl feeder, Part Orienting Systems, Feed tracks, Escapements and part placing mechanism, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine	[10]
Unit IV **Modeling Automated Manufacturing Systems:** Role of Performance Modeling, Performance Measures, **Performance Modeling Tools**: Simulation Models, Analytical Models. **The Future Automated Factory:** Trends in Manufacturing, The Future Automated Factory, Human Workers in the Future Automated Factory, The social impact	[10]

Text Books:

[T1] Groover, M. P. (2016). *Automation, production systems, and computer-integrated manufacturing*. Pearson Education India.

[T2] Asfahl, R. (1992). *Robots and Manufacturing Automation*, John Wiley&Son.

[T3] Chang, Y. W., Zhu, K., Wu, G. M., Wong, D. F., & Wong, C. K. (1985). An Introduction to Automated. In *Process Planning, Prentice-Hall International Series in Industrial and Systems Engineering*.

Reference Books:

[R1] Viswanadham, N., & Narahari, Y. (2015). *Performance modeling of automated systems*. PHI Learning Pvt. Ltd.

[R2] Stephen J. Derby, (2004) *Design of Automatic Machinery*, Special Indian Edition, Marcel Decker, New York, Yesdee publishing Pvt. Ltd, Chennai.