

DR. A. P. J. ABDUL KALAM TECHNICAL UNIVERSITY
LUCKNOW, UTTAR PRADESH



COURSE STRUCTURE/ EVALUATION SCHEME

FOR

B.TECH. 4thYEAR

**PRODUCTION ENGINEERING/
INDUSTRIAL PRODUCTION ENGINEERING**

[Effective from Session: 2025-26]

B. Tech.
Production Engineering/Industrial Production Engineering
Evaluation Scheme
[Effective from Session: 2025-26]

SEMESTER- VII														
S. No.	Code	Subject	Learning Mode	Periods			Evaluation Scheme				End Semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BME 701	Measurement & Metrology	Offline	3	-	-	20	10	30	-	70	-	100	3
2		Departmental Elective-IV	Offline	3	-	-	20	10	30	-	70	-	100	3
3	BOEM**	Open Elective-II	Offline/MOOCs	3	0	0	20	10	30	-	70	-	100	3
4	BME751	Measurement & Metrology Lab	Offline	0	0	2	-	-	-	50	-	50	100	1
5	BPI 751	Mini Project or Internship Assessment*		0	0	4	-	-	-	100	-	-	100	2
6	BPI 752	Project-1		0	0	10	-	-	-	150	-	-	150	5
7	BPI 753	Startup and Entrepreneurial Activity Assessment#		0	0	4	-	-	-	100	-	-	100	2
		Total		9	0	20							750	19
*The Mini Project or internship (5-6 weeks) conducted during summer break after VI semester and will be assessed during VII semester. # The Startup and Entrepreneurial Activity Assessment will be done in 7 th semester under which a student will have to undergo a startup/entrepreneurship activity of at least 60 hours till 6 th semester.														

SEMESTER- VIII														
S. No	Code	Subject	Learning Mode	Periods			Evaluation Scheme				End Semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BOEM**	Open Elective-III	MOOCs	3	0	0	20	10	30	-	70	-	100	3
2	BOEM**	Open Elective-IV	MOOCs	3	0	0	20	10	30	-	70	-	100	3
3	BPI 851	Project-II		0	0	18				100		350	450	10
		Total		6	0	18	24						650	16

The Internal Assessment of MOOCs will be done by the respective institute and the external Assessment (End Semester Examination) will be done by the University)

Departmental Electives

		Specialization-1	Specialization-2
Semester	Specialization	Industrial Automation	Industrial Management
VII	Departmental Elective-IV	BME 071	BPI 062
		Additive Manufacturing	Total Quality Management

Subject Code: BME 701	Measurement and Metrology	L T P : 3 0 0	Credits: 3
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Course Outcome: Student will be able to		Bloom Taxonomy
CO 1	Explain the basics knowledge of measurements. and also develop competence in sensors, transducers	K2
CO 2	Understand and able to use various devices for measuring strain, Pressure and time related equipment.	K2
CO 3	Understand and able to use various devices for measuring Flow, Temperature, Force & Torque.	K2
CO 4	Explain the basics knowledge of metrology & Inspection.	K2
CO 5	Understand the fundamentals of various methods for the measurements of surface roughness parameters and working of optical measuring instruments.	K2

UNIT I

Mechanical Measurements: Introduction to measurement and measuring instruments. General concept– Generalized measurement system and its elements-Unit sand standards- measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response- repeatability-systematic, Source of error, statistical analysis of error and random errors- correction, calibration. Dimensional and geometric tolerance

Sensors and Transducers: Types of sensors, types of transducers and their characteristics.

UNIT II

Time Related Measurements: Stroboscope, frequency measurement by direct comparison. Measurement of displacement

Measurement of Pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures (high vacuum).

Strain Measurement: Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration.

UNIT III

Flow Measurement: Hot Wire Anemometry, Laser Doppler Velocimetry, Rotameter.

Temperature Measurement: Thermometers, bimetallic thermocouples, thermistors and pyrometers.

Measurements of Force & Torque: Different types of load cells, elastic transducers, pneumatic & hydraulic systems. Seismic instruments.

UNIT IV

Metrology and Inspection: Standards of linear measurement, line and end standards. Interchange ability and standardization. Linear and angular measurements devices and systems

Comparators: Sigma, Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design.

UNIT-V

Limits, Fits &Tolerance and Surface roughness: Introduction to Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness. Measurement of geometric forms like straightness, flatness, roundness. Tool makers microscope, profile projector, autocollimator.

Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears. Surface texture: quantitative evaluation of surface roughness and its measurement.

Books and References:

1. Experimental Methods for Engineers by Holman, MCGRAW HILL INDIA
2. Mechanical Measurements by Beckwith, Pearson
3. Principles of Measurement Systems by Bentley, Pearson
4. Metrology of Measurements by Bewoor and Kulkarni, MCGRAW HILL INDIA
5. Measurement Systems, Application Design by Doeblein, MCGRAW HILL INDIA
6. Hume KJ, "Engineering Metrology", MacDonald and Co
7. Jain, RK, "Engineering Metrology" Khanna Publishers
8. Jain, R.K., "Mechanical Measurement" Khanna Publishers
9. Gupta SC, Engineering Metrology, Dhanpat Rai Publications

Departmental Elective – IV

Subject Code: BME 071	Additive manufacturing	L T P : 3 0 0	Credits: 3
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Course Outcome: Student will be able to			Bloom Taxonomy
CO 1	Understanding the basics of additive manufacturing/rapid prototyping and its advantages and disadvantages		K2
CO 2	Understanding the role of additive manufacturing in the design process and the implications for design.		K2
CO 3	Understanding the processes used in additive manufacturing for a range of materials and applications		K2
CO 4	Understand the various software tools, processes and techniques that enable advanced/additive manufacturing and personal fabrication.		K2
CO 5	Apply knowledge of additive manufacturing for various real-life applications		K3

UNIT I

Introduction

History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing and CNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines, Direct and Indirect Processes; Prototyping, Manufacturing and Tooling.

Layer Manufacturing Processes: Polymerization, Sintering and Melting, Extrusion, Powder Binder Bonding, Layer Laminate Manufacturing, Other Processes; Aerosol printing and Bio plotter.

UNIT II

Development of Additive Manufacturing Technology

Computer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems.

Generalized Additive Manufacturing Process Chain; The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

UNIT III

Additive Manufacturing Processes

Vat Photo polymerization; Materials, Reaction Rates, Photo polymerization Process Modelling, Scan Patterns

Powder Bed Fusion Processes; Material, Powder Fusion Mechanism, Process Parameters and Modeling, powder Handling

Extrusion Based System; Basic principles, plotting and Path Control, Other Systems

Material Jetting; Materials, Material Processing Fundamentals, Material Jetting Machines

Directed Energy Deposition Processes; General DED Process Description, Material Delivery, DED systems, Process Parameters, Processing-Structure-Properties Relationships

UNIT IV: Design & Software Issues

Additive Manufacturing Design and Strategies; Potentials and Resulting Perspectives, AM based New Strategies, Material Design and Quality Aspects for Additive Manufacturing; Material for AM, Engineering Design Rules for AM.

Software Issue for Additive Manufacturing; Introduction, Preparation of CAD Models: The STL file, Problem with STL file, STL files Manipulation, Beyond the STL file, Additional Software to Assist AM

UNIT V

Material Design & Quality Aspects

Machines for Additive Manufacturing, Printers, Secondary Rapid Prototyping processes, Intellectual Property, Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing, Business Opportunities

Applications

Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewellery, Toys, Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.

Books and References:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, by- Ian Gibson , DSavid W. Rosen , Brent Stucker, Springer.
2. Understanding Additive Manufacturing, by- Andreas Gebhardt, Hanser.
3. Additive Manufacturing, by- AmitBandyopadhyay, Susmita Bose, CRC Press.
4. Rapid Prototyping: Principles and Applications, by -Chee Kai Chua, Kah Fai Leong, Chu Sing Lim.

Departmental Elective – IV

Subject Code: BPI 062	Total Quality Management	L T P: 3 0 0	Credits: 3
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Course Outcome: Student will be able to		Bloom Taxonomy
CO1	Understand the basics of the quality management.	K2
CO2	Understand the types of tools and techniques for the quality management.	K2
CO3	Understand the various defects, diagnosis and prevention useful for quality management.	K2
CO4	Understand the different types of control charts.	K3
CO5	Understand the ISO and its concept for quality management.	K3

UNIT-I

Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design.

Control on Purchased Product:

Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality:

Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

UNIT II

Quality Management:

Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

TQM Principles:

Leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT III

Tools and Techniques:

Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flow chart).

Control Charts:

Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts, P-charts and C-charts.

UNIT IV

Defects Diagnosis and Prevention:

Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

UNIT V

ISO and its concept of Quality Management:

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

Text Books:

1. Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
2. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
3. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
4. Total Quality Management by Mukherjee, P.N.
5. TQM in New Product manufacturing, H. G. Menon, McGraw Hill.

Reference Books:

1. Beyond Total Quality Management, Greg Bounds, McGraw Hill.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.

Subject Code: BME 751	Measurement & Metrology Lab	L T P : 0 0 2	Credits: 1
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Course Outcome (CO): The Students will be able to		Bloom Taxonomy
CO1	Understand the basic principles of instrumentation for measurement of surface finish, strain, temperature, pressure and flow.	K2
CO2	Understand the principle and operation of Coordinate Measuring Machine (CMM).	K2
CO3	Apply Sine Bar, Slip Gauges, Bevel Protractor, Stroboscope, Dial Indicator etc. for measurement of different attributes.	K3
CO4	Apply the basic concepts of limits, fits & tolerances for selective assembly.	K3

List of Experiments

Minimum 08 experiments out of following (or such experiment) are to be performed:

1. Measurement of effective diameter of a screw thread using 3 wire method.
2. Measurement of angle using sine bar & slip gauges.
3. Study of limit gauges.
4. Study & angular measurement using Bevel protector.
5. Study of different types of Comparators.
6. Study of important parameters of surface finish.
7. Study of principle and operation of coordinate-measuring machine (CMM).
8. Use of dial indicator and V Block to check the circularity and plot the polar Graph.
9. Study and understanding of limits, fits & tolerances in assembly of machine components.
10. Study and understanding of different methods of measurement of pressure.
11. Study and understanding of different methods of measurement of temperature.
12. Study and understanding of measurement of strain using strain gauges.
13. Study and understanding of different methods of measurement of flow.
14. Study and understanding of different methods of measurement of vibration/power.
15. Study and understanding of measurement of displacement using LVDT.