MSME TECHNOLOGY CENTRE, KANPUR

(GOVERNMENT OF INDIA)

Syllabus for Diploma Course

(FOR II AND III YEARS)

Tool & Die Making Under Mechanical Engineering

(UNDER AFFILLIATION OF BOARD OF TECHNICAL EDUCATION, LUCKNOW U.P.)

CURRICULUM OF DIPLOMA IN TOOL & DIE MAKING UNDER MECHANICAL ENGINEERING

MSME TECHNOLOGY CENTRE,

KANPUR w.e.f. 2026-27

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Third semester

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PREFACE

An important issue generally debated amongst the planners and educator's world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization have created an environment for free flow of information and technology through fast and efficient means. This has led to shrinking of the world, bringing people from different culture and environment together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and opens economy in the last few decades. To cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources, in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives are being taken by the State Board of Technical Education, UP to revise the existing curricula as per the needs of the industry and make NSQF compliant.

In order to meet the requirements of future technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of diploma programmes. The curricula for diploma programmes have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of diploma programme.

The real success of the diploma programme depends upon its effective implementation. However best the curriculum document is designed, if that is not implemented properly, the output will not be as expected. In addition to acquisition of appropriate physical resources, the availability of motivated, competent and qualified faculty is essential for effective implementation of the curricula.

It is expected of the polytechnics to carry out job market research on a continuous basis to identify the new skill requirements, reduce or remove out dated and redundant courses, develop innovative methods of course offering and thereby infuse the much-needed dynamism in the system.

F.R. Khan
Director
Institute of Research Development & Training

1. ACKNOWLEDGEMENTS

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2. Sh. F. R. Khan Director I.R.D.T. Kanpur continually motivating, guiding and taking keen interest in the review of the curriculum.

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2. SALIENT FEATURES

1. Name of the Programme	Diploma in Tool & Die Making Under Mechanical Engineering.
2. Duration of the Programme	➢ Three years (Six Semesters)
3. Entry Qualification	➢ Matriculation or equivalent NEP-2020/NSQF Level 5 as Prescribed by State Board of Technical Education, U.P.
4. Pattern of the Programme	➢ Semester System
5. Ratio between theory and Practice	➢ 40% (Theory) / 60% (Practical)

1) Industrial Training/Internship:

Four and six weeks of industrial training is made mandatory after the II and IV semesters during summer vacation.Total marks allotted to industrial training will be respectively 50 & 100.

In the last (6^{th} Semester) we have made the one semester Industrial training/Internship as optional along with usual classroom training.

2) Audit & Pathways:

As per AICTE and NEP-2020 directives, Essence of Indian Knowledge & Tradition, Indian Constitution, Entrepreneurship & Startup, subjects on Environmental Studies have been incorporated in the curriculum.

3) Student Centered Activities:

A provision of 4-8 hrs. per week has been made for organizing Student Centered Activities for overall personality development of students. Such activities will comprise co– curricular activities such as expert lectures, classroom seminars, games, hobby club like photography, painting, singing etc. declamation contests, field visits, NCC, NSS and other cultural activities, etc.

4) Project work:

Micro/Mini/Major project work has been included in the curriculum to enable the student to get familiarized with the practices and procedures being followed in the industries and provide an opportunity to work on some live projects in the industry.

3. **EMPLOYMENT OPPORTUNITIES OF DIPLOMA HOLDERS IN TOOL & DIE MAKING UNDER MECHANICAL ENGINEERING**

Diploma holders in Tool & Die Making under Mechanical Engineering have wide employment opportunities in manufacturing, automobile, aerospace, plastics, electronics, automation, and precision engineering industries. Their skills are highly demanded in industries involving production, tooling, moulds, dies, CNC machining, and maintenance.

Major Employment Areas

1. **Tool Rooms and Die Manufacturing Industries**
    - Design and manufacture of press tools, dies, moulds, jigs, and fixtures.
    - Maintenance and repair of production tools.
2. **Automobile Industries**
    - Manufacturing of vehicle body components, sheet metal parts, and engine components.
    - Tool maintenance and production supervision.
3. **Plastic and Injection Moulding Industries**
    - Design and maintenance of plastic moulds and moulding tools.
    - Production planning and quality inspection.
4. **CNC and Precision Machining Industries**
    - CNC programming, machining, and tool setup operations.
    - Precision component manufacturing.
5. **Aerospace and Defense Industries**
    - Manufacturing of precision dies, moulds, and aerospace components.
    - Quality assurance and inspection work.
6. **Manufacturing and Assembly Industries**
    - Production supervision, process planning, and quality control activities.
    - Inventory and shop floor management.

SELF-EMPLOYMENT

Diploma holders can also become entrepreneurs by starting:

- Tool room workshops
- CNC machining centers
- Die and mould manufacturing units
- Fabrication workshops
- CAD/CAM design services
- Repair and maintenance workshops
- Precision component manufacturing units

Employment Scope and Career Growth

Tool & Die Making is considered a specialized and high-skill area in manufacturing industries. Skilled diploma holders can grow into:

- Senior Tool Designer
- Production Manager
- Quality Manager
- Tool Room Manager
- Design Engineer
- Manufacturing Engineer
- Plant Supervisor

Experienced professionals are highly valued because industries require precision tooling and manufacturing expertise.

4. (A) PROGRAM OUTCOMES (POS) for Diploma in Tool and Die Making Under Mechanical Engineering

PO1: Basic and Discipline-Specific Knowledge
Apply knowledge of basic mathematics, science, engineering fundamentals, and the specialization of Tool and Die Making to solve well-defined engineering problems.

PO2: Problem Analysis
Identify, analyze, and solve engineering problems in tool and die manufacturing using appropriate technical knowledge, engineering standards, and systematic approaches.

PO3: Design/Development of Solutions
Design, manufacture, assemble, inspect, and maintain press tools, moulds, dies, jigs, fixtures, gauges, and precision components using conventional and CNC manufacturing processes..

PO4: Engineering Tools, Experimentation, and Testing
Select and apply modern engineering tools such as CAD/CAM software, CNC programming, CMM, precision measuring instruments, simulation software, and manufacturing technologies effectively with an understanding of their limitations.

PO5: Engineering Practices for Society, Sustainability, and Environment
Apply appropriate technology in the context of society, sustainability, environment, and ethical engineering practices.

PO6: Project Management and Communication
Use engineering management principles as an individual, a team member, or a leader to manage projects and communicate effectively about well-defined engineering activities.

PO7: Life-long Learning
Recognize the need for continuous learning, skill up gradation, innovation, and adaptation to emerging technologies such as Industry 4.0, CAD/CAM/CAE, additive manufacturing, automation, and smart manufacturing for professional growth.

4. (B) LEARNING OUTCOMES OF THE PROGRAM

After undergoing this program, students will be able to:	
1.	Identify and operate milling, grinding, CNC, and workshop machines safely.
2.	Perform basic and advanced milling operations with accuracy.
3.	Perform surface, cylindrical, and tool grinding operations.
4.	Select suitable cutting tools, grinding wheels, and machining parameters.
5.	Apply workshop safety rules and machine maintenance practices.
6.	Explain the principles and applications of jigs and fixtures.
7.	Select locating, clamping, and indexing devices for manufacturing operations.
8.	Design jigs and fixtures for machining and production processes.
9.	Prepare assembly and detail drawings of jigs, fixtures, moulds, and press tools.

10.	Explain properties, classifications, and applications of plastic materials.
11.	Select suitable engineering materials for tooling and mould applications.
12.	Explain heat treatment processes and phase transformation concepts.
13.	Select suitable heat treatment methods for engineering components.
14.	Explain the principles and operations of press working processes.
15.	Calculate cutting force, clearance, strip layout, and press capacity.
16.	Design simple, compound, progressive, and combination press tools.
17.	Explain moulding processes, mould terminology, and mould components.
18.	Design injection moulds, compression moulds, and advanced mould systems.
19.	Design runner, gating, cooling, and ejection systems for moulds and dies.
20.	Explain forging processes, forging equipment, and die design concepts.
21.	Identify forging defects and apply corrective measures.
22.	Explain hydraulic and pneumatic principles, components, and circuits.
23.	Analyze hydraulic and pneumatic systems used in automation.
24.	Explain basic electrical and electronics engineering concepts and applications.
25.	Use electrical measuring instruments and follow electrical safety practices.
26.	Develop CNC programs using G-codes, M-codes, and CAM software.
27.	Simulate and optimize CNC machining programs for production.
28.	Apply quality control tools, TQM concepts, and industrial quality standards.
29.	Demonstrate entrepreneurship skills, business planning, and start-up awareness.
30.	Plan, execute, document, and present engineering projects effectively.
31.	Apply cumulative knowledge and skills to solve real-world problems or industry-based projects.
32.	Plan and execute minor projects related to tool and die work innovation.

5. ABSTRACT OF CURRICULUM AREAS

PROGRAM CORE COURSES

- WORKSHOP TECHNOLOGY-III (MILLING)
- JIGS & FIXTURE THEORY
- MECHANICAL ENGINEERING MATERIAL (PLASTIC)
- HEAT TREATMENT
- PRESS TOOL THEORY
- GENERAL WORKSHOP PRACTICE-II (BASIC MILLING & GRINDING)
- WORKSHOP TECHNOLOGY-IV (GRINDING)
- PRESS TOOL DESIGN-I
- MOULD THEORY
- FUNDAMENTAL APPLICATIONS OF ELECTRICAL & ELECTRONICS ENGINEERING
- JIGS & FIXTURE DESIGN
- WORKSHOP PRACTICE (ADVANCE MILLING & GRINDING, CNC MACHINING)
- FORGING THEORY & DESIGN
- HYDRAULICS & PNEUMATICS
- MOULD DESIGN-I
- PRESS TOOL DESIGN-II
- CNC & CAM PROGRAMMING
- DIE CASTING THEORY & DESIGN
- ENTREPRENEURSHIP & START-UPS
- QUALITY MANAGEMENT
- MOULD DESIGN-II
- IN HOUSE PROJECT

ADVANCE SKILL DEVELOPMENT (OPEN ELECTIVE-I)

- ENGINEERING ECONOMICS & ACCOUNTANCY
- DISASTER MANAGEMENT

ADVANCE SKILL DEVELOPMENT (OPEN ELECTIVE-II)

- ECONOMIC POLICIES IN INDIA
- PROJECT MANAGEMENT

ADVANCE SKILL DEVELOPMENT (OPEN ELECTIVE-III)

- RENEWABLE ENERGY TECHNOLOGIES
- ARTIFICIAL INTELLIGENCE

INDUSTRIAL TRAINING

1. SUMMER INTERNSHIP (4 WEEKS)
2. SUMMER INTERNSHIP (6 WEEKS)

PROGRAM ELECTIVE COURSES

PROGRAM ELECTIVE-I

1. MECHANICS & MATERIAL STRENGTH
2. THERMAL ENGINEERING

PROGRAM ELECTIVE-II

1. ADVANCE MANUFACTURING PROCESS CNC
2. MANUFACTURING ENGINEERING

PROGRAM ELECTIVE-III

1. PRODUCTION PLANNING, CONTROL & COST ESTIMATION
2. MECHATRONICS

PROJECT WORK, SEMINAR & INTERNSHIP IN INDUSTRY

INTERNSHIP / IN-HOUSE PROJECT

AUDIT COURSES

ESSENCE OF INDIAN KNOWLEDGE AND TRADITION
INDIAN CONSTITUTION

6. STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN TOOL & DIE MAKING UNDER MECHANICAL ENGINEERING THIRD SEMESTER

S. No	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME Hrs./Week			CREDIT (C)	MARKS IN EVALUATION SCHEME								
							INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					TOTAL MARKS OF INT. & EXT.
			L	T	P		Th	Pr	Total	Th	Hrs.	Pr	Hrs.	Total	
3.1	Workshop Technology – III (Milling)	Program Core (Theory)	1	-	-	1	40	-	40	60	3	-	-	60	**100**
3.2	Jigs & Fixture Theory	Program Core (Theory)	2	-	-	2	40	-	40	60	3	-	-	60	**100**
3.3	Mechanical Engineering Material (Plastic)	Program Core (Theory)	2	-	-	2	40	-	40	60	3	-	-	60	**100**
3.4	Heat Treatment	Program Core (Theory)	2	-	-	2	40	-	40	60	3	-	-	60	**100**
3.5	Program Elective-I 1.Mechanics & Material Strength 2.Thermal Engineering	Program Core (Theory)	2	-	-	2	40	-	40	60	3	-	-	60	**100**
3.6	Press tool Theory	Program Core (Theory)	2	-	-	2	40	-	40	60	3	-	-	60	**100**
3.7	General Workshop Practice-II (Basic Milling & Grinding) & Auto CAD Practical	Program Core (Practical)	-	-	14	7	-	180	180	-	-	120	8	120	**300**
3.8	Summer internship (4 weeks)	Practical	-	-	-	2	-	50	50	-	-	-	-	-	**50**
# Student Centered Activities (SCA)			-	-	11	-	-	50	50	-	-	-	-	-	**50**
Total			**11**		**25**	**20**	**240**	**280**	**520**	**360**		**120**		**480**	**1000**

NOTE: -

1. # Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, library, Cultural Activities and self-study etc.
2. (Q) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.
3. Advance skill development mention at the table provides the scope of selecting the course as per choice from the elective list provided in the syllabus conducted by various agencies of repute of duration not less than 20 Hrs (Offline/Online).

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN TOOL & DIE MAKING UNDER MECHANICAL ENGINEERING FOURTH SEMESTER

S. No	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME Hrs./Week			Credit (C)	Marks in Evaluation Scheme								
							Internal Assessment			External Assessment					Total Marks of Int. & Ext.
			L	T	P		Th	Pr	Total	Th	Hrs.	Pr	Hrs.	Total	
4.1	Workshop Technology – IV (Grinding)	Program Core (Theory)	1	-	-	1	40	-	40	60	3	-	-	60	100
4.2	Program Elective-II 1.Advance Manufacturing Process CNC 2.Manufacturing Engineering	Program Core (Practicum)	2	-	3	3	40	-	40	60	3	-	-	60	100
4.3	Press tool Design - I	Program Core (Practicum)	1	-	2	2	-	60	60	-	-	40	6	40	100
4.4	Mould Theory	Program Core (Theory)	3	-	-	3	40	-	40	60	3	-	-	60	100
4.5	Fundamental Applications of electrical & electronics	Program Core (Theory)	2	-	-	2	40	-	40	60	3	-	-	60	100
4.6	Jigs & Fixture Design	Program Core (Practicum)	2	-	2	3	-	60	60	-	-	40	8	40	100
4.7	Workshop Practice (Advance Milling, Grinding, CNC Machining) practical	Program Core (Practical)	-	-	8	4	-	210	210	-	-	140	8	140	350
4.8	Advance skill development (open elective-I)	(Q) Open Elective-I (Theory)	2		-	2	50		50*	-					N/A
4.9	(Q) Essence of Indian knowledge and Tradition.	(Audit Course)	2		-	-	50		50*	-					N/A
# Student Centered Activities (SCA)			-	-	6	-	-	50	50	-	-	-	-	-	50
Total			**15**		**21**	**20**	**160**	**380**	**540**	**240**		**220**		**460**	**1000**

NOTE: -

1. # Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, library, Cultural Activities and self-study etc.
2. (Q) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.
3. Advance skill development mention at the table provides the scope of selecting the course as per choice from the elective list provided in the syllabus conducted by various agencies of repute of duration not less than 20 Hrs (Offline/Online).

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN TOOL & DIE MAKING UNDER MECHANICAL ENGINEERING FIFTH SEMESTER

S. No	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME Hrs./Week			Credit (C)	Marks in Evaluation Scheme								
							Internal Assessment			External Assessment					Total Marks of Int. & Ext.
			L	T	P		Th	Pr	Total	Th	Hrs.	Pr	Hrs.	Total	
5.1	Forging Theory & Design	Program Core (Theory)	2	-	-	2	40	-	40	60	3	-	-	60	100
5.2	Hydraulics & Pneumatics	Program Core (Theory)	2	-	-	2	40	-	40	60	3	-	-	60	100
5.3	Mould Design-I	Program Core (Practicum)	1	-	2	2	-	60	60	-	-	40	3	40	100
5.4	Press tool Design - II	Program Core (Practicum)	2	-	8	6	-	210	210	-	-	140	3	140	350
5.5	CNC & CAM Programming	Program Core (Practicum)	1	-	2	2	-	60	60	-	-	40	3	40	100
5.6	Program Elective-III 1.Production Planning, Control & Cost Estimation 2.Mechatronics	Program Core (Theory)	2	-	-	2	40	-	40	60	3	-	-	60	100
5.7	Advance skill development	(Q) Open Elective-II (Theory)	2	-	-	2	50*		50*						N/A
5.8	(Q) Indian constitution	(Audit Course)	2	-	-	-	50*	-	-	-	-	-	-	-	N/A
5.9	Summer internship (6 weeks)	Practical	-	-	-	2	-	60	60			40	3	40	100
	# Student Centered Activities (SCA)		-	-	10	-	-	50	50	-	-	-	-	-	50
Total			**14**		**22**	**20**	**120**	**440**	**560**	**180**		**260**		**440**	**1000**

NOTE: -

1. # Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, library, Cultural Activities and self-study etc.
2. (Q) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.
3. Advance skill development mention at the table provides the scope of selecting the course as per choice from the elective list provided in the syllabus conducted by various agencies of repute of duration not less than 20 Hrs (Offline/Online).

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN TOOL & DIE MAKING UNDER MECHANICAL ENGINEERING
SIXTH SEMESTER

S. No	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME Hrs./Week			Credit (C)	Marks in Evaluation Scheme								
							Internal Assessment			External Assessment					Total Marks of Int. & Ext.
			L	T	P		Th	Pr	Total	Th	Hrs.	Pr	Hrs.	Total	
6.1	Die casting theory & design	Program Core (Theory & Practical)	1	-	2	2	40	60	100	60	3	40	3	100	200
6.2	Entrepreneurship & start-ups	Program Core (Theory)	2	-	-	2	40	-	40	60	3	-	-	60	100
6.3	Quality Management	Program Core (Theory)	1	-	-	1	40	-	40	60	3	-	-	60	100
6.4	Mould design-II	Program Core (Practical)	-	-	2	1	-	60	60	-	-	40	3	40	100
6.5	In house project	Program Core (Practical)	4	-	16	12	-	270	270	-	-	180	8	180	450
6.6	Advance skill development	(Q) Open Elective-III (Theory)	2	-	-	2	50	-	50*	-	-	-	-	-	N/A
# Student Centered Activities (SCA)			-	-	6	-	-	50	50	-	-	-	-	-	50
Total			**10**		**26**	**20**	**120**	**440**	**560**	**180**		**220**		**440**	**1000**

NOTE: -

1. # Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, library, Cultural Activities and self-study etc.
2. (Q) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.
3. Advance skill development mention at the table provides the scope of selecting the course as per choice from the elective list provided in the syllabus conducted by various agencies of repute of duration not less than 20 Hrs (Offline/Online).

OPEN ELECTIVE-I

Sr. No.	(Q) THEORY COURSES NAME
1.	ENGINEERING ECONOMICS & ACCOUNTANCY (Course offered by Polytechnic Institute)
2.	DISASTER MANAGEMENT (Course offered by Polytechnic Institute)

OPEN ELECTIVE-II

Sr. No.	(Q) THEORY COURSES NAME
1.	ECONOMIC POLICIES IN INDIA (Course offered by Polytechnic Institute)
2.	PROJECT MANAGEMENT (Course offered by Polytechnic Institute)

OPEN ELECTIVE-III

Sr. No.	(Q) THEORY COURSES NAME
1.	RENEWABLE ENERGY TECHNOLOGIES (Course offered by Polytechnic Institute)
2.	ARTIFICIAL INTELLIGENCE (Course offered by Polytechnic Institute)

PROGRAME ELECTIVE-I

Sr. No.	SUBJECT NAME
1.	MECHANICS & MATERIAL STRENGTH
2.	THERMAL ENGINEERING

PROGRAME ELECTIVE-II

Sr. No.	SUBJECT NAME
1.	ADVANCE MANUFACTURING PROCESS CNC
2.	MANUFACTURING ENGINEERING

PROGRAME ELECTIVE-III

Sr. No.	SUBJECT NAME
1.	PRODUCTION PLANNING, CONTROL & COST ESTIMATION
2.	MECHATRONICS

1. DETAILED CONTENTS OF VARIOUS SUBJECTS

THEORY	3.1 WORKSHOP TECHNOLOGY – III (MILLING)	L	T	P
		1	-	-

COURSE OBJECTIVES

After studying this subject, the diploma students will be able to:

1. Understand the construction, specification, working principle and classification of milling machines used in manufacturing industries.
2. Identify the main parts, accessories, attachments and work holding devices used in milling machines and understand their applications.
3. Develop knowledge of different milling cutters, milling methods and various milling operations used in machining processes.
4. Select appropriate cutting parameters such as cutting speed, feed and depth of cut for efficient milling operations.
5. Understand the construction and applications of dividing heads and perform different indexing methods used in milling operations.
6. Develop practical skills related to milling machine setup, tooling selection and machining operations for industrial applications.

COURSE OUTCOMES

After successful completion of this course, the students will be able to:

CO1: Explain the specification, working principle, classification and applications of different milling machines.

CO2: Identify and describe the constructional features and functions of various parts of column and knee type milling machines.

CO3: Select suitable milling machine accessories, attachments, cutters and work holding devices for different machining applications. Determine and apply appropriate cutting parameters including cutting speed, feed and depth of cut during milling operations.

CO4: Understand the construction and working of plain and universal dividing heads and perform different indexing methods such as direct, simple, compound, differential and angular indexing.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	1	-	1	*	*
CO2	3	2	1	2	-	-	1	*	*
CO3	3	3	3	3	1	2	1	*	*
CO4	2	3	2	3	-	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT

UNIT–I: Introduction to Milling Machine (3 Periods)

Milling Machine: Definition and importance of milling machine, Specification of milling machine, working principle of milling machine.

Classification of Milling Machines: Classification of milling machines, Brief description of different types of milling machines, Applications of milling machines in manufacturing industries.

Main Parts of Milling Machine: Constructional features of column and knee type milling machine and Functions of main parts: Base, Column, Knee, Saddle, Table, Spindle, Arbor support, Overarm.

UNIT–II: Milling Machine Accessories and Attachments (3 Periods)

Milling Machine Accessories: Arbors, Adaptors, Collets, Machine vices, Circular table, Work mandrels.

Milling Machine Attachments: Indexing head and tail stock, Vertical milling attachment, Slotting attachment.

Work Holding Devices: Types of work holding devices, Application and selection of work holding devices.

Milling Cutters: Identification of different milling cutters and Types and applications of milling cutters.

UNIT–III: Milling Operations and Methods (4 Periods)

Milling Methods: Up milling, Down milling, Comparison between up milling and down milling.

Milling Operations: Face milling, Angular milling, Form milling, Straddle milling, Gang milling

Cutting Parameters: Cutting speed, Feed, Depth of cut, Selection of cutting parameters

UNIT–IV: Indexing and Dividing Heads (4 Periods)

Dividing Heads: Plain dividing head, Universal dividing head, Construction and applications of dividing heads.

Indexing Methods: Direct indexing, Plain or simple indexing, Compound indexing, Differential indexing, Angular indexing.

INSTRUCTIONAL STRATEGY

The content should be taught using a combination of lecture-cum-discussion, demonstration, practical exposure, and activity-based learning methods. Introduction to milling machines, their specifications, classifications, and applications may be explained through charts, presentations, industrial examples, and machine demonstrations. Main parts, accessories, attachments, and work holding devices should be taught through hands-on identification and practical demonstration on actual milling machines. Milling operations and methods should be explained using machining demonstrations, industrial videos, and comparison-based discussions. Cutting parameters and indexing methods should be taught through numerical problem-solving, practical exercises, and workshop activities. Audio-visual aids, real machine components, industrial case studies, and workshop practice should be used to enhance understanding and skill development.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS:

1. Production Technology HMT Production Technology 1st 2000 Tata McGraw Hill, New Delhi
2. Manufacturing Technology P.N. Rao Manufacturing Technology Vol. II 3rd 2013 Tata McGraw Hill, New Delhi
3. Machine Tools R.K. Jain and S.C. Gupta Machine Tools 1st 2009 Khanna Publishers, New Delhi

4. Workshop Technology B.S. Raghuwanshi Workshop Technology Vol. II 9th 2007 Dhanpat Rai Publications, New Delhi
5. Elements of Workshop Technology S.K. Hajra Choudhury, A.K. Hajra Choudhury and Nirjhar Roy Elements of Workshop Technology Vol. II 14th 2008 Media Promoters & Publishers Pvt. Ltd., Mumbai
6. Theory of Metal Cutting and Machine Tools A. Bhattacharya Theory of Metal Cutting and Machine Tools 2nd 2014 New Central Book Agency, Kolkata

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs.)	Marks Allotted (%)
1	3	20
2	3	20
3	4	30
4	4	30
Total:	**14**	**100%**

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

THEORY	3.2 JIGS & FIXTURE THEORY	L	T	P
		2	-	-

COURSE OBJECTIVES

1. To develop understanding of the concepts, principles, and applications of jigs, fixtures, and gauges used in manufacturing industries.
2. To impart knowledge of locating, supporting, clamping, and tool guiding elements used in jig and fixture design.
3. To enable students to identify, select, and apply different types of jigs, fixtures, clamps, locators, and drill bushes for machining operations.
4. To develop the ability to understand the design characteristics and working principles of drilling, milling, welding, boring, grinding, and inspection fixtures.
5. To provide knowledge of gauges, gauging systems, Taylor's principle, and design of limit gauges used for quality control and inspection.
6. To develop practical skills for designing and applying jigs, fixtures, and gauges for improving productivity, accuracy, interchangeability, and manufacturing efficiency.

COURSE OUTCOMES (COS)

After completing this course, students will be able to:

CO1: Explain the fundamentals of jigs and fixtures, principles of locating and supporting, degrees of freedom, and different locator systems used in manufacturing applications.

CO2: Describe and apply various clamping methods, power clamping systems, vises, and tool guiding elements including drill bushes and liners used in jig and fixture design.

CO3: Analyze the principles and requirements of drill jig design and differentiate between various types of jigs used in production engineering.

CO4: Identify and explain the constructional features, applications, and design characteristics of different types of fixtures used in machining, assembly, inspection, and welding operations.

CO5: Understand the principles of gauges, Taylor's principle, gauge tolerances, wear allowance, and design and application of different types of gauges used in quality control and inspection.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	-	-	1	*	*
CO2	3	2	2	2	-	-	1	*	*
CO3	3	3	2	2	-	1	1	*	*
CO4	3	2	3	2	1	1	1	*	*
CO5	3	2	2	3	1	-	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT

UNIT 1: Introduction: (6 Periods)

Introduction & Definition of Jigs and Fixtures, Difference between Jigs and Fixtures –Advantages of Jigs and Fixtures. Locating and supporting principles - Location types, 12 Degrees of freedom, Location methods - 6 points location principle (or) 3-2-1 principle of location.

Concentric and Radial methods – Basic rules, position and number of locators, Redundant locators, Locational Tolerances, Fool proofing(poka/yoka). Locator Types: External – Fixed locators, Integral locators, Commercial pin, Assembled locators, Pins, V Type, locating nests.

UNIT 2: Clamping And Tool Guiding Elements: (5 Periods)

CLAMPING: Clamping principles – Tool forces, clamping forces, positioning clamps, types of Clamps – Strap clamp, screw clamp, cam action clamps, Toggle action clamps, wedge action clamps, latch clamps, rack and pinion clamps.

VISES – Special jaws, independent jaws, Non-Mechanical Clamping – Magnetic chucks, vacuum chucking, Electrostatic chuck, Power Clamping – Hydraulic and Pneumatic clamping.

TOOL GUIDING ELEMENTS: Drill jig bushings and liners – Selection, Bushing / liner installation, interference fit, chip clearance, accuracy and life, bush material.

BUSHES: Types of bushes – Introduction and explanation of guiding the tools, explain the use and application of Drill bushes

UNIT 3: Principles Of Jig Design (6 Periods)

Introduction & requirements of Drill jigs, types of JIGS – Diameter jig, Ring Jig, Template drill jigs, Plate jigs, Universal jigs, Leaf jig, Channel and Tumble box jigs, Indexing Jigs, Boring jigs, – Post jig – Pot jig. Miscellaneous drill jigs – Wooden drill jigs, Polymer Drill Jigs, modified vises, collet fixtures, self-centering vises.

UNIT 4: Characteristics Of Fixture Design (5 Periods)

Introduction & Basic Design Characteristics of Types of fixtures-: Milling fixture, Lathe fixture, Grinding fixture, Broaching fixture, Assemble fixture, Inspection fixture, Boring fixture, Indexing fixture, Welding fixture and Sawing fixture.

UNIT 5: Gauges (6 Periods)

Introduction: Taylor's principle, Limit gauge – Application of limit gauges, Allocation of Gauge Tolerance – Bilateral system, Uni-lateral system.Gauge wear allowance, Gauge materials, Gauging policy.Types of Gauges -Screw pitch gauges, plug gauges, Ring gauges, Snap gauges, Flush pin gauges– IS specifications for gauges – Design of plug and Snap gauges.

INSTRUCTIONAL STRATEGY

The course should be delivered through a combination of lecture-cum-discussion, demonstration, practical exposure, and activity-based learning methods. Concepts of jigs, fixtures, locating principles, and degrees of freedom should be taught using charts, models, animations, and industrial examples. Clamping devices, vises, drill bushes, and tool guiding elements should be explained through hands-on demonstrations and identification of actual components. Different types of jigs and fixtures should be taught using case studies, industrial applications, specimen observation, and drawing interpretation. Gauge design, tolerances, and gauging systems should be taught through numerical exercises, practical demonstrations, and inspection activities. Audio-visual aids, workshop practice, group discussions, and problem-solving exercises should be used to improve conceptual understanding and practical skills.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments

- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Cyril Donaldson, Tool Design, Special Indian Edition, 2012, Tata Mc Graw Hill
2. P.C.Sharma, A Text Book of Production Engineering, 2013, S.Chand & Co
3. P.H.Joshi, Jigs & Fixtures
4. G.K.Vijayaraghavan, Design of Jigs,Fixtures and Press Tools, Suchitra publications

References:-

1. Edward Hoffman, Jig & Fixture design
2. Roop Lal, Jig & Fixtures design
3. W boyes, Handbook of Jig & Fixture Design
4. Elanchezhian C, Design of Jigs, Fixtures & Press tool

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (hrs.)	Marks Allotted (%)
1	6	20
2	5	20
3	6	20
4	5	20
5	6	20
Total:	**28**	**100%**

THEORY	3.3 MECHANICAL ENGINEERING MATERIALS (PLASTIC)	L	T	P
		2	-	-

COURSE OBJECTIVES

1. To develop fundamental knowledge of engineering materials with emphasis on polymers and plastics used in modern industries.
2. To impart understanding of polymer structure, classification, properties, and behavior of thermoplastics and thermosetting plastics.
3. To enable students to understand the effect of additives, fillers, reinforcements, and modifiers on the performance and applications of plastics.
4. To provide knowledge of basic plastic processing methods such as injection moulding, extrusion, blow moulding, compression moulding, and thermoforming.
5. To develop understanding of engineering plastics, commodity plastics, and their industrial applications in automotive, packaging, medical, electrical, and construction sectors.
6. To create awareness about sustainable plastics, recycling methods, biodegradable polymers, and environmental aspects related to plastic materials.

COURSE OUTCOMES (COS)

After completing this course, students will be able to:

CO1: Explain the classification of engineering materials, fundamentals of polymers, plastics, and their industrial importance.

CO2: Differentiate between thermoplastics and thermosetting plastics, amorphous and crystalline polymers, and identify commonly used polymer blends and plastic materials.

CO3: Describe the mechanical, thermal, electrical, chemical, and optical properties of plastics and relate them to engineering applications.

CO4: Explain the role of additives, fillers, plasticizers, stabilizers, reinforcements, and other modifiers in improving the properties of plastics.

CO5: Describe the basic working principles and applications of different plastic processing methods such as injection moulding, extrusion, blow moulding, compression moulding, and thermoforming.

CO6: Identify engineering and commodity plastics and explain their applications in automotive, packaging, medical, electrical, electronics, and construction industries.

CO7: Explain sustainable plastic practices, recycling methods, biodegradable plastics, and the concept of circular economy in plastic industries.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	1	-	-	1	-	1	*	*
CO2	3	2	1	-	1	-	1	*	*
CO3	3	2	2	1	1	-	1	*	*
CO4	3	2	2	1	1	-	1	*	*
CO5	3	2	2	2	1	1	1	*	*
CO6	3	2	2	1	2	1	1	*	*
CO7	2	1	1	-	3	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Introduction To Engineering Materials (Plastics) (3 Periods)
Classification of engineering materials, Introduction to polymers and plastics, Comparison: Metals vs Plastics vs Ceramics, Advantages & limitations of plastics, Current scenario of plastics in industries.

UNIT 2: Polymer Structure & Classification (3 Periods)
Basic concepts of polymers, Thermoplastics vs Thermosetting plastics, Amorphous vs Crystalline polymers, Polymer blendes: PP-EPDM, ABS-PC, PBT-PC and PA-EPDM.
Examples: PE, PP, PVC, Nylon, ABS, Polycarbonate,

UNIT 3: Properties Of Plastics (3 Periods)
Mechanical properties (strength, hardness, toughness), Thermal properties (melting point, heat resistance), Electrical properties (insulation), Chemical resistance, Optical properties
Application-based understanding (e.g., insulation in electronics)

UNIT 4: Plastic Additives & Modification (5 Periods)
Fillers, plasticizers, stabilizers, Reinforcements (glass fiber, carbon fiber), Colorants & flame retardants, Effect of additives on properties, Compositions and properties of in-organic and organic fillers, plasticizers, stabilizers, colorants, antioxidants, blowing agents, flame retardant, antistatic agents, slip and ant- block additives, lubricants, heat and light stabilizer, flow modifiers, and U-V absorbers

UNIT 5: Processing Methods (Basic Overview) (5 Periods)
Injection moulding, Extrusion moulding, Blow moulding, Compression moulding, Thermoforming, Basic working principle + applications (no deep machine design).

UNIT 6: Engineering And Commodity Plastics & Industrial Applications (6 Periods)
Engineering plastics: SAN, ABS, PA, POM, PMMA, UHMHDPE, tiouro plastics, PET, PBT, PF, UF, ME, EPOXY, POLYESTER and polyurethane. Automotive (lightweight components, EV parts), Packaging (flexible, rigid, food packaging), Medical (syringes, disposables, implants), Electrical & Electronics (insulation, PCB materials), Construction (pipes, insulation panels)
General definitions of Commodity plastics: HDPE, HMHDPE, LDPE, LLDPE, PP, PS and PVC, PMM.

UNIT 7 : Sustainable Plastics & Recycling (3 Periods)
Plastic waste issues, Recycling methods (mechanical, chemical), Biodegradable plastics, Bio-based polymers, Circular economy concept.

INSTRUCTIONAL STRATEGY
The course should be delivered through a combination of lecture-cum-discussion, demonstration, multimedia presentations, and application-based learning methods. Fundamental concepts of polymers, plastics, material classification, and polymer structures should be explained using charts, models, animations, and industrial examples. Properties of plastics and the role of additives should be taught through specimen observation, comparative analysis, and case studies related to engineering applications. Plastic processing methods such as injection moulding, extrusion, blow moulding, and thermoforming should be demonstrated through videos, industrial visits, and practical demonstrations wherever possible. Engineering and commodity plastics should be taught using product samples and

industry-oriented discussions related to automotive, packaging, medical, and electrical applications. Sustainable plastics, recycling methods, and biodegradable polymers should be explained through seminars, group discussions, and project-based activities to develop environmental awareness and lifelong learning skills.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Plastic Materials J.A. Brydson Plastic Materials 17th 1999 Butterworth, London
2. Introduction to Plastics Engineering R.J. Crawford Introduction to Plastics Engineering 3rd 1998 Butterworth-Heinemann, Oxford
3. Polymer Science and Technology Joel R. Fried Polymer Science and Technology 2nd 2003 Prentice Hall, New Jersey
4. Plastics Technology Handbook Manas Chanda and Salil K. Roy Plastics Technology Handbook 4th 2006 CRC Press, New York
5. Textbook of Polymer Science Fred W. Billmeyer Textbook of Polymer Science 3rd 1984 Wiley-Interscience, New York
6. Manufacturing Processes for Engineering Materials Serope Kalpakjian and Steven R. Schmid.
7. Handbook of Plastics Recycling Francesco La Mantia Handbook of Plastics Recycling 1st 2002 Rapra Technology, UK
8. Engineering Materials: Polymers, Ceramics and Composites A.K. Bhargava Engineering Materials: Polymers, Ceramics and Composites 1st 2011 PHI Learning, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	3	10
2	3	10
3	3	10
4	5	20
5	5	20
6	6	20
7	3	10
Total	**28**	**100%**

THEORY	3.4 HEAT TREATMENT	L	T	P
		2	-	-

COURSE OBJECTIVES

1. To develop fundamental knowledge of heat treatment processes, principles of heating and cooling of metals, and their industrial applications.
2. To impart understanding of iron-carbon phase diagram, TTT curves, phase transformations, and microstructures formed during heat treatment of steels and cast irons.
3. To provide knowledge of various heat treatment processes for cast iron, steel, and tool steels including annealing, hardening, tempering, case hardening, and surface hardening methods.
4. To enable students to understand hardenability concepts, Jominy test, thermo-chemical treatment processes, and the effect of alloying elements on tool steels.
5. To develop awareness about heat treatment defects, their causes, prevention methods, safety precautions, and environmental considerations during heat treatment operations.
6. To impart knowledge of different heat treatment furnaces, furnace atmospheres, equipment, and their applications in manufacturing and tool engineering industries.

COURSE OUTCOMES (COS)

After completing this course, students will be able to:

CO1: Explain the fundamentals of heat treatment processes, heating and cooling principles, quenching media, and applications of heat treatment in industries.

CO2: Interpret the iron-carbon phase diagram, TTT curves, allotropy of iron, and phase transformations occurring during heat treatment of steels.

CO3: Describe heat treatment processes for cast iron and steel, including annealing, normalizing, hardening, tempering, case hardening, and surface hardening methods.

CO4: Explain the concepts of hardenability, Jominy test, thermo-chemical treatment processes, and the influence of alloying elements on tool steels. Identify heat treatment defects, their causes and preventive measures, and explain safety precautions and disposal practices used in heat treatment operations.

CO5: Describe the construction, working principles, applications, and furnace atmospheres of different heat treatment furnaces and equipment.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	1	-	1	1	-	1	*	*
CO2	3	3	1	1	-	-	1	*	*
CO3	3	2	2	2	1	-	1	*	*
CO4	3	3	2	2	2	1	1	*	*
CO5	3	2	2	2	1	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1. Introduction (3 Periods)

Heat Treatment and its applications. Definition & Principle : Concept of heating & cooling of metals. Heat treatment processes: Concept of Annealing, Normalizing, Hardening, Tempering, Quenching & Quenching medium. Different types of cast Iron

UNIT 2. Iron- Carbon Diagram & TTT curve (6 Periods)

Iron-Carbon phase diagram: Introduction: Iron-carbon phase diagram and its application. Definition & Principle: Concept of Iron-carbon phase diagram. Classification of phases. Concept of allotropy of iron. Micro constituents of iron and carbon system.

TTT curve: Transformation of Austenite, Pearlite, Bainite, Martensite & cementite. Introduction: Time-temperature-transformation (TTT) curve in Heat Treatment of Steel.

UNIT 3. Heat treatment process for cast iron and steel (10 Periods)

Heat Treatment of cast Iron: Concept of heat treatment for malleable and spheroidal cast iron.

Heat treatment process of steel: Introduction: Different processes of Heat Treatment of Steel. Hardenability, Introduction: Hardenability and its application. Definition & Principle: Concept of Hardenability, Jominy Test.

Case hardening of steel

Definition & Principle: Concept of different processes of Thermo chemical Treatment such as Nitriding, Carbonitriding, Nitro carbonizing, carbonizing, cyaniding.

Surface hardening: Introduction: Surface hardening and its application. Concept of flame hardening & induction hardening.

UNIT 4. Heat treatment of Tool steel and heat treatment defects, causes and preventions (5 Periods)

Tool steel: Introduction: Tool steels in Tool & Die Making and its types. Concept and classification of tool steel, effect of alloying elements in tool steel. DIN and BIS standards, Concept of heat treatment for tool steel and alloy steel.

Defects, causes and their prevention :Defects such as decarburization, quenching cracks, Excessive hardness, less hardness, soft spots. Concept of disposal of consumables used in Heat Treatment process. Concept of health hazards and precautions.

UNIT 5. Furnaces & equipment (4 periods)

Introduction: Furnaces in heat treatment and their use. Type of furnaces such as Induction furnace, salt bath furnaces. Study construction, features & function of different of Induction furnace, salt bath furnaces in heat treatment.

Introduction: Furnace atmosphere and application. Concept of Neutral atmosphere, gaseous atmosphere.

INSTRUCTIONAL STRATEGY

The course should be delivered through a combination of lecture-cum-discussion, demonstration, multimedia presentations, and practical-oriented teaching methods. Fundamental concepts of heat treatment, heating and cooling of metals, and different heat treatment processes should be explained using charts, videos, and industrial examples. Iron-carbon phase diagrams, TTT curves, and phase transformations should be taught through graphical interpretation, animations, and problem-solving exercises. Heat treatment processes for cast iron, steel, and tool steels should be demonstrated through workshop practices, case studies, and industrial applications. Concepts of hardenability, Jominy test,

thermo-chemical treatment, and surface hardening should be explained using laboratory demonstrations and specimen analysis. Heat treatment defects, causes, prevention methods, safety precautions, and disposal practices should be taught through discussions, industrial safety practices, and real-life examples. Furnaces, furnace atmospheres, and heat treatment equipment should be explained using models, industrial visits, videos, and equipment demonstrations to enhance practical understanding and industry readiness.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Heat Treatment: Principles and Techniques T.V. Rajan, C.P. Sharma and Ashok Sharma Heat Treatment: Principles and Techniques 2nd 2011 PHI Learning, New Delhi
2. Engineering Metallurgy R.A. Higgins Engineering Metallurgy Part I 6th 1993 Edward Arnold Publishers, London
3. Physical Metallurgy V.G. Kodgire and S.V. Kodgire Physical Metallurgy 1st 2014 Everest Publishing House, Pune
4. Tool and Manufacturing Engineers Handbook ASTME Tool and Manufacturing Engineers Handbook 4th 1983 McGraw Hill, New York
5. Manufacturing Technology P.N. Rao Manufacturing Technology Vol. I 4th 2013 Tata McGraw Hill, New Delhi
6. Workshop Technology B.S. Raghuwanshi Workshop Technology Vol. I 9th 2007 Dhanpat Rai Publications, New Delhi
7. Engineering Metallurgy R.K. Rajput Engineering Metallurgy 1st 2008 S. Chand & Company Ltd., New Delhi
8. Heat Treatment of Metals B.V. Narayana Murthy Heat Treatment of Metals 1st 2006 I.K. International Publishing House, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	3	15
2	6	20
3	10	30
4	5	20
5	4	15
Total	**28**	**100%**

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

THEORY	3.5.1- MECHANICS AND MATERIAL STRENGTH (P.E. -I)	L	T	P
		2	-	-

COURSE OBJECTIVES

1. To develop understanding of fundamental concepts of engineering mechanics and strength of materials used in engineering applications.
2. To impart knowledge of system of forces, equilibrium conditions, moments, and free body diagrams for solving engineering problems.
3. To develop the ability to determine centre of gravity, centroid, and moment of inertia of engineering sections and solids.
4. To provide understanding of friction, laws of friction, and working principles of simple machines used in engineering fields.
5. To impart knowledge of stresses, strains, elastic constants, and behavior of materials under different loading conditions.
6. To develop understanding of bending stresses, bending equations, and behavior of beams subjected to different types of loads and supports.
7. To provide knowledge of columns, struts, buckling, and failure of structural members under compressive loading.
8. To develop understanding of torsion, torque transmission, torsional rigidity, and design concepts related to shafts and power transmission systems.

COURSE OUTCOMES (COS)

After completing this course, students will be able to:
CO1: Explain the concepts of forces, moments, equilibrium, vector quantities, and apply laws of forces in engineering problems.
CO2: Determine centroid, centre of gravity, moment of inertia, radius of gyration, and section modulus for engineering sections and solids.
CO3: Explain the principles and laws of friction and analyze engineering problems involving frictional forces.
CO4: Describe the working principles of simple machines and calculate mechanical advantage, velocity ratio, efficiency, and law of machine.
CO5: Explain stresses, strains, elastic constants, factor of safety, and analyze tensile and compressive behavior of materials under loading.
CO6: Explain the theory of simple bending, bending stresses, moment of resistance, and analyze beams subjected to different loading conditions.
CO7: Explain the concepts of columns and struts, slenderness ratio, buckling load, crushing load, and Euler's formula.
CO8: Explain the concepts of torsion, torsion equation, torsional rigidity, torque transmission, and analyze stresses in shafts used for power transmission.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	3	1	1	-	-	1	*	*
CO2	3	2	1	1	-	-	1	*	*
CO3	3	3	1	1	-	-	1	*	*
CO4	3	2	2	1	1	-	1	*	*
CO5	3	3	2	2	1	-	1	*	*
CO6	3	3	2	2	1	-	1	*	*
CO7	3	2	2	1	1	-	1	*	*
CO8	3	3	2	2	1	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1. System of Forces **(4 Periods)**

System of forces and its application. Concept of force, type of forces, resultant of force, composition of force, resolution of force. Scalar and Vector Quantities unit system- S.I, C.G.S, M.K.S. Lami's theorem. Concept of moment, types of moments, law of moments. Resultant force. Varignon's theorem. Concept of condition of equilibrium, parallelogram law of forces, triangle law of forces, free body diagram.

UNIT 2. Centre of gravity & Moment of inertia **(3 Periods)**

Concept of Centre of gravity and centroid for basic shapes and solids. Moment of inertia and its application (I- section, T- section, L-section), second moment, radius of gyration, section modulus. Parallel axis theorem, perpendicular axis theorem.

UNIT 3. Friction **(4 Periods)**

Friction in engineering field. Concept of friction, limiting friction, co-efficient of friction, angle of friction, laws of friction.Principle of friction, limiting friction, co-efficient of friction, angle of friction, laws of friction.

UNIT 4. Simple machine **(3 Periods)**

Mechanical advantage and velocity ratio in simple machine. Law of machine, ideal machine, real machine, work done by machine, simple pulleys, lever.

UNIT 5. Stresses & strains **(4 Periods)**

Definition & principle: Classification of load, stresses, strains. Hooke's Law, Young modulus of

elasticity, nominal stress, yield point, plastic stage. Tensile & compressive stresses & strains, Definition & Principle: Concept of ultimate strength and breaking stress, percentage elongation. Proof stress, working stress, factor of safety. Strain energy due to direct stresses

UNIT 6. Simple bending (4 Periods)

Theory of simple bending (bending stresses), theory of simple bending and assumptions of pure bending. Concept of simple bending, bending stresses, moment of resistance, bending equation. Definition & Principle of beams, loads and supports.

UNIT 7. Column & strut (2 Periods)

Concept and classification of column and strut, short and long column, effective length (only formula), slenderness ratio, buckling load, crushing load. Euler formula.

UNIT 8. Torsion (4 Periods)

Concept of torsion, torsion equation and torsional rigidity. Definition & Principle: Concept of torque and torsion, torsion equation, torsional rigidity, angle of twist. Shaft (power transmission), Introduction: Power, torque and size of shaft. Concept of torque, power transmitted, angular displacement, shaft size, shear stress.

INSTRUCTIONAL STRATEGY

The course should be delivered through a combination of lecture-cum-discussion, numerical problem-solving, demonstration, and activity-based learning methods. Fundamental concepts of forces, equilibrium, friction, stresses, strains, bending, torsion, and columns should be explained using diagrams, models, animations, and real engineering examples. Free body diagrams, laws of forces, centre of gravity, and moment of inertia should be taught through graphical methods and practice exercises. Concepts of simple machines, beams, shafts, and structural members should be demonstrated using laboratory models and engineering applications. Numerical problems related to bending stress, torsion, friction, and column analysis should be solved through tutorial sessions and assignments to improve analytical skills. Practical demonstrations, multimedia presentations, and case studies should be used to explain engineering applications of mechanics and strength of materials. Group discussions, quizzes, and problem-based learning activities should also be included to strengthen conceptual understanding and develop engineering problem-solving abilities.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Engineering Mechanics S.S. Bhavikatti and K.G. Rajasekharappa Engineering Mechanics 4th 2014 New Age International Publishers, New Delhi
2. Strength of Materials R.K. Rajput Strength of Materials 6th 2018 S. Chand & Company Ltd., New Delhi
3. Engineering Mechanics R.S. Khurmi Engineering Mechanics 22nd 2013 S. Chand & Company Ltd., New Delhi
4. Strength of Materials S. Ramamrutham Strength of Materials 18th 2014 Dhanpat Rai Publications, New Delhi
5. Mechanics of Materials Ferdinand P. Beer, E. Russell Johnston and John T. DeWolf Mechanics of Materials 6th 2012 McGraw Hill Education, New York

6. Engineering Mechanics A.K. Tayal Engineering Mechanics 14th 2015 Umesh Publications, New Delhi
7. Strength of Materials S.S. Rattan Strength of Materials 3rd 2011 Tata McGraw Hill, New Delhi
8. Applied Mechanics and Strength of Materials R.S. Khurmi Applied Mechanics and Strength of Materials 1st 2005 S. Chand & Company Ltd., New Delhi
9. Engineering Mechanics S. Timoshenko and D.H. Young Engineering Mechanics 5th 2010 Tata McGraw Hill, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	4	15
2	3	10
3	4	15
4	3	10
5	4	15
6	4	10
7	2	10
8	4	15
Total	**28**	**100%**

THEORY	3.5.2- THERMAL ENGINEERING (P.E. -I)	L	T	P
		2	-	-

COURSE OBJECTIVES

1. To understand the basic concepts of heat, work, ideal gases, and thermodynamic processes used in thermal engineering applications.
2. To develop knowledge of laws of thermodynamics, thermodynamic systems, properties, and their applications in engineering systems.
3. To familiarize students with boilers, boiler mountings, accessories, and their working principles used in steam generation.
4. To understand the modes and laws of heat transfer used in thermal engineering systems and industrial applications.
5. To develop understanding of steam nozzles, steam turbines, condensers, and their applications in power generation systems.

COURSE OUTCOMES (COS)

CO1: Explain the concepts of heat, work, ideal gas laws, thermodynamic properties, and thermodynamic processes with P-V and T-S diagrams.
CO2: Apply the laws of thermodynamics and analyze thermodynamic systems, heat engines, refrigerators, and heat pumps.
CO3: Describe the construction, working, mountings, accessories, efficiency, and maintenance of boilers.
CO4: Explain different modes of heat transfer and apply the laws governing conduction, convection, and radiation.
CO5: Describe the construction and working principles of steam nozzles, steam turbines, and condensers used in thermal power systems.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	-	-	1	*	*
CO2	3	3	2	2	1	-	1	*	*
CO3	3	2	2	2	1	1	1	*	*
CO4	3	2	1	2	2	-	1	*	*
CO5	3	2	2	2	1	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1- Introduction (5 Periods)

Concept of heat & work Concept of Ideal gas, Charle's law, Boyle's law, Avogadro's law, equation of state, Characteristic gas constant and universal gas constant. Ideal gas processes: -Isobaric, Isochoric, Isothermal, Adiabatic, Polytropic, Isentropic with representation of the processes on P-V and T-S diagram.

UNIT 2- Laws Of Thermodynamics (6 Periods)

Concepts of pure substance, types of systems , properties of systems , Extensive and Intensive properties with units and conversion like P, V, p And temperature. Point function and path function. Laws of Thermodynamic: Zeroth Law, Temperature measurement, principle of energy conservation, irreversibility, Second Law of Thermodynamics, Kelvin Plank, Clausius statements Application of Second law to Heat Engine, Heat Pump and Refrigerator.

UNIT 3- Boilers & Mounting And Accesiries (6 Periods)

Boilers: Definition and classification of boilers, Cochran boiler, Lancashire boiler, Babcock and Wilcox boiler. Boiler Mountings and Accessories: Safety valve, Pressure gauge, Water level indicator, Feed check valve, Economizer, Superheater. Boiler Efficiency and Maintenance, Boiler draught.

UNIT 4- Heat Transfer (5 Periods)

Modes of heat transfer: Conduction, convection and radiation. Laws of heat transfer: Fourier law of conduction, Newton's law of cooling for convection, Stefan-Boltzmann law for radiation.

UNIT 5- Steam Turbines And Condensers (6 Periods)

Steam nozzle: Continuity equation, types of nozzles, concept of Mach number, critical pressure, application of steam nozzles. Steam turbine: Classification of turbines, Construction and working of Impulse and Reaction turbine. Steam condenser: Dalton's law of partial pressure, function and classification of condensers, construction and working of surface condensers.

INSTRUCTIONAL STRATEGY

The course shall be delivered through interactive lectures, numerical problem-solving sessions, demonstrations, and multimedia presentations to explain thermodynamic principles, gas laws, heat transfer, boilers, steam turbines, and condensers. P-V and T-S diagrams, charts, models, animations, and industrial case studies shall be used for better conceptual understanding. Practical demonstrations of boiler mountings, heat transfer equipment, and thermal systems shall be arranged wherever possible. Tutorials, assignments, quizzes, and group discussions shall be conducted to strengthen analytical and application skills related to thermal engineering systems and processes.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Thermal Engineering R. K. Rajput Thermal Engineering 10th 2019 Laxmi Publications, New Delhi.

2. Thermal Engineering R. S. Khurmi and J. K. Gupta Thermal Engineering 14th 2018 S. Chand Publications, New Delhi.

3. Engineering Thermodynamics P. K. Nag Engineering Thermodynamics 6th 2013 Tata McGraw Hill, New Delhi.

4. Heat and Thermodynamics D. S. Kumar Heat and Thermodynamics 2nd 2012 S. K. Kataria & Sons, New Delhi.

5. Heat Transfer J. P. Holman Heat Transfer 10th 2010 Tata McGraw Hill, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	5	15
2	6	20
3	6	25
4	5	15
5	6	25
Total	**28**	**100%**

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

THEORY	3.6 PRESS TOOL THEORY	L	T	P
		2	-	-

COURSE OBJECTIVES

After studying this course, the students will be able to:

1. Understand the fundamentals of press working operations, sheet metal cutting principles, and types of presses used in manufacturing industries.
2. Identify and explain the construction, functions, and applications of press tool accessories, die components, and various die systems.
3. Apply the principles of bending, forming, and drawing operations for the design and functioning of press tools and dies.
4. Analyze fine blanking operations, specialized press tooling applications, and factors affecting tool performance and service life.
5. Develop troubleshooting, maintenance, and operational skills related to press tools and sheet metal die systems used in production industries.

COURSE OUTCOMES (COS)

CO1: Explain press working fundamentals, sheet metal cutting operations, classifications of presses, and force calculations used in press tools.
CO2: Identify press tool accessories, transfer mechanisms, die components, and different types of die constructions used in press working.
CO3: Apply principles of bending and forming operations for selection and working of bending and forming dies.
CO4: Analyze drawing operations, drawing defects, secondary operations, and working principles of various drawing dies.
CO5: Explain fine blanking technology, specialized press tool applications, tool maintenance practices, and factors affecting tool life.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	-	-	1	*	*
CO2	3	2	2	2	-	-	1	*	*
CO3	3	3	3	2	1	-	1	*	*
CO4	3	3	2	2	1	-	1	*	*
CO5	3	2	2	2	2	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1- Press Working Fundamentals, Operations, And Machinery (5 Periods)

Press working operations- Shearing, cutting off, parting, blanking, Punching, piercing, slotting, perforating, Notching, semi notching, lancing, parting, Trimming, slitting, shaving.

Definition of Presses, Classification of Presses- According to power - Mechanical, hydraulic, Pneumatic, electromagnetic presses. According to construction – Solid or gap frame, open back inclinable, knee frame, horning, open end or end wheel. According to operation – Single action, double action, triple action, multi slide press. Press actuating mechanisms. Forces for cutting sheet metal –calculations of shear, principle of shearing, shear on punch, slug bending force, shear on die steel, stripping force. Strip layout, bridge and margin, Strip feeder.

UNIT 2 -Press Tool Accessories And Types Of Die Construction (6 Periods)

Ejection mechanism – Gravity, air, kicker, lifter, shovel, mechanical hand, ejection by next part. Transfer mechanisms – Conveyors, shuttle, turnover, turnaround, stacker, rails. Types of die construction: - Cut off, drop through, return type, compound, combination, continental, sub press, follow die, progressive die, transfer die, shuttle die. Function and nomenclature of die components: - Die, die set, die plate, punch, stripper plate, die spring, rubber keeper, stripper bolt, solid stripper, knockout plate, hold down plate, pad plate, blank holder, pressure pin. Miscellaneous components – Heal, stop block, bolster plate, backing plate, pilot, gauges, insert, cams, hinges and rockers. Commercially available die components – Die sets, die set attachment devices, punches, die buttons, retainers, springs, fluid springs, die cushion and its types.

UNIT 3-Bending And Forming Dies (5 Periods)

Bending of sheet metal – Neutral axis, metal movement, spring back, methods of overcoming spring back. Bending Operations – Bending, flanging, hemming, curling, seaming, and corrugating. Types of Bending dies (construction and working principle) – V bending and its types, edge bending, u bending. Forming operations: Embossing, bulging, crimping, tube forming. Miscellaneous press working operations – slugging, restrike or spank, extrude (holes), coining, hot trimming, cold trimming of die castings and plastic moldings, riveting, burnishing or sizing, Ironing. Forming dies – Construction and working principle of solid form dies, pad form dies, curling dies, embossing dies, coining dies, swaging dies, bulging dies.

UNIT 4 Drawing Dies And Dies For Secondary Operations (5 Periods)

Drawing operations & types of draws. Draw dies &its construction and working principle of Conventional draw die, redrawing die, reverse re drawing die, drawing of square or rectangular shapes. Draw die details – Blank holders, blank holding pressure and its importance, air vents, drawing inserts, draw beads. Drawing defects, causes and remedies. Dies for secondary operations: - Construction and working principle of – Semi piercing dies, shear form dies, dies for formed contours, notching die, shaving die, side piercing die.

UNIT 5 Fine Blanking Tool And Specialised Press Tool Applications, Press Tool Maintanance. (7 Periods)

Definition and Applications of fine blanking. Working principle of fine blanking tool, V Ring – function of V ring, Dimensions of V ring. Comparison of fine blanking with blanking. Calculation of press, fixing minimum distance from die aperture. Factors affecting Tool life. Importance of punch and die radius. Materials suitable for fine blanking, work hardening during fine blanking, steel, copper and copper alloys, aluminum and aluminum alloys. Fine Blanking Machines: Working principle – Ram movement, Drive systems Mechanical drives, hydraulic drives, Machine force, Ring indenter force, counter force. Fine blanking tools: Different types of tools – Compound die tooling

system with sliding punch, compound die tooling with fixed punch. Single Minute Exchange of Dies (SMED) – concept need and advantages. Factors affecting tool Service Life: Introduction, Elements of Tool performance, Procedure for investigation of tool failure, Trouble shooting in press tools, effect of heat treatment on service life of tools.

INSTRUCTIONAL STRATEGY

The course shall be delivered through interactive lectures, demonstrations, practical sessions, and CAD-based learning to develop theoretical knowledge and practical skills in press tool technology. Teaching shall include the use of industrial samples, charts, models, animations, and videos for explaining press operations, die constructions, bending, forming, drawing, and fine blanking processes. Numerical problem-solving sessions, assignments, and mini projects shall be conducted for force calculations, strip layouts, and die design concepts. Industrial visits, expert lectures, group discussions, and seminar presentations shall be arranged to provide exposure to modern press shop practices, tool maintenance, troubleshooting, and SMED applications. Continuous assessment shall be carried out through tests, practical performance, viva voce, assignments, and project work.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Press Tool Design Handbook P. H. Joshi Press Tool Design Handbook 2nd 2010 Tata McGraw Hill, New Delhi
2. Tool Design Cyril Donaldson, George H. Lecain and V. C. Goold Tool Design 3rd 2002 Tata McGraw Hill, New Delhi
3. Manufacturing Technology: Foundry, Forming and Welding P. N. Rao Manufacturing Technology Vol. II 4th 2013 Tata McGraw Hill, New Delhi
4. Production Technology HMT Production Technology 18th 2010 Tata McGraw Hill, New Delhi
5. Tool Engineering and Design G. R. Nagpal Tool Engineering and Design 5th 2011 Khanna Publishers, New Delhi
6. Fundamentals of Tool Design Society of Manufacturing Engineers Fundamentals of Tool Design 6th 2010 SME Publications, USA
7. Sheet Metal Work K. C. John Sheet Metal Work 2nd 2009 PHI Learning Pvt. Ltd., New Delhi
8. Workshop Technology Vol. II W. A. J. Chapman Workshop Technology Vol. II 5th 2012 CBS Publishers, New Delhi
9. Die Design Fundamentals Paquin and Crowley Die Design Fundamentals 1st 2006 Industrial Press Inc., New York
10. Pressworking and Die Design V. C. Pandya and V. B. Shah Pressworking and Die Design 1st 2008 Tata McGraw Hill, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	5	20
2	6	20
3	5	20
4	5	20
5	6	20
Total	**28**	**100%**

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

PRACTICAL	3.7 GENERAL WORKSHOP PRACTICE – II BASIC MILLING & GRINDING & AUTO CAD PRACTICLE	L	T	P
		-	-	14

COURSE OBJECTIVES

This course aims to develop the practical skills required for basic machining and computer-aided drafting operations. It provides hands-on experience in performing milling operations such as plain milling, face milling, step milling, profile milling, and sawing, as well as in manufacturing simple components like V-blocks. The course also enables students to carry out surface and cylindrical grinding operations to achieve the desired dimensional accuracy and surface finish. In addition, it introduces students to AutoCAD and develops their ability to create engineering drawings using absolute, relative, and polar coordinate systems, direct distance entry, and User Coordinate System (UCS) commands. The course further aims to strengthen students' understanding of engineering drawings, machining processes, and quality requirements while promoting safe workshop practices and professional skills required in manufacturing and design environments.

COURSE OUTCOMES (COS)

After successful completion of this course, the student will be able to:

CO1: Perform basic milling operations such as plain milling, face milling, step milling, profile milling, and sawing operations on a horizontal milling machine following standard machining practices.

CO2: Manufacture simple machine components such as V-blocks by selecting appropriate milling operations, tools, and machining parameters.

CO3: Carry out surface and cylindrical grinding operations to produce parallel surfaces, steps, right angles, and cylindrical profiles with the required dimensional accuracy and surface finish.

CO4: Create 2D engineering drawings in AutoCAD using absolute, relative, and polar coordinate systems for machine components and geometric profiles.

CO5: Develop engineering drawings using direct distance entry and User Coordinate System (UCS) commands to generate inclined and complex machine features accurately.

CO6: Apply machining and CAD skills to prepare, inspect, and document simple mechanical components as per engineering drawing specifications and workshop safety standards.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	2	1	1	1	*	*
CO2	3	2	3	2	1	1	1	*	*
CO3	3	2	2	3	1	1	1	*	*
CO4	3	2	3	3	-	1	1	*	*
CO5	3	3	3	3	-	1	2	*	*
CO6	3	3	3	3	2	2	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

Practical Exercises for Milling and Grinding Practice

1. Basic Milling Practice

Exercise 1: Plain/Face Milling Practice
Exercise 2: Step Milling Practice
Exercise 3: Profile Milling Practice
Exercise 4: Sawing Operation on Horizontal Milling Machine
Exercise 5: V-Block Manufacturing

2. Basic Grinding Practice

Surface Grinding Exercises

Exercise 1: Grinding of Parallel Plate
Exercise 2: Step Grinding Practice
Exercise 3: Right Angle Grinding Practice

Cylindrical Grinding Exercises

Exercise 4: Straight Cylindrical Grinding
Exercise 5: Step Cylindrical Grinding

3.Auto CADD Practice

Exercise 1: Drawing Using Absolute Coordinate System

- Draw a rectangle using absolute coordinate entry.
- Draw a triangle using absolute coordinate points.
- Draw a simple machine plate profile.

Exercise 2: Drawing Using Relative Coordinate System

- Draw stepped profiles using relative coordinates.
- Draw zig-zag and offset shapes.
- Create simple bracket drawing.

Exercise 3: Drawing Using Polar Coordinate System

- Draw hexagon and polygon shapes.
- Draw inclined machine component profile.
- Draw angular bracket.

Exercise 4: Direct Distance Entry Practice

- Draw horizontal and vertical layouts.
- Create stepped block profile.
- Draw simple keyway profile.

Exercise 5: UCS (User Coordinate System) Shifting Practice

- Shift UCS to inclined surface.
- Draw rectangle and circle in shifted UCS.
- Draw inclined slot profile.

THEORY	4.1 WORK SHOP TECHNOLOGY-IV (Grinding)	L	T	P
		1	-	-

COURSE OBJECTIVES

1. To understand the purpose and applications of grinding processes in manufacturing industries.
2. To develop knowledge of grinding wheel elements, wheel specifications, and wheel selection methods.
3. To familiarize students with grinding wheel maintenance operations such as truing, dressing, balancing, and mounting.
4. To understand different grinding methods and working principles of grinding machines.
5. To develop basic operational and safety knowledge related to grinding processes and machines.

COURSE OUTCOMES (COS)

CO1: Explain the purpose of grinding and applications of grinding processes in manufacturing.
CO2: Describe the elements, shapes, types, and BIS specifications of grinding wheels.
CO3: Perform wheel maintenance operations such as truing, dressing, balancing, and mounting of grinding wheels.
CO4: Explain different grinding methods including surface, cylindrical, and center-less grinding processes.
CO5: Describe the construction, working principles, and applications of various grinding machines and select suitable grinding wheels for different operations.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	-	-	1	*	*
CO2	3	2	2	2	-	-	1	*	*
CO3	3	3	3	2	1	-	1	*	*
CO4	3	3	2	2	1	-	1	*	*
CO5	3	2	2	2	2	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Introduction To Grinding Process (2 Periods)
Purpose of Grinding: Introduction to grinding process, Applications of grinding in manufacturing, Advantages and limitations of grinding
Basics of Grinding, Material removal mechanism, Comparison of grinding with machining operations

UNIT 2: Grinding Wheels (4 Periods)
Elements of Grinding Wheel: Abrasives, Grade, Structure, Bond.
Types and Shapes of Grinding Wheels: Common wheel shapes, Built-up wheels, Mounted wheels, Diamond wheels.
Specification of Grinding Wheels: BIS specification system, Wheel marking and nomenclature.

UNIT 3: Grinding Wheel Maintenance (2 Periods)
Truing and Dressing: Purpose and methods of truing, Purpose and methods of dressing.
Balancing and Mounting: Wheel balancing methods, Safe mounting procedures, Safety precautions during wheel handling.

UNIT 4: Grinding Methods (3 Periods)
Surface Grinding: Principle and applications, Horizontal and vertical spindle grinding.
Cylindrical Grinding: Plain cylindrical grinding, Internal cylindrical grinding.
Center-less Grinding: Principle of center-less grinding, Advantages and applications

UNIT 5: Grinding Machines And Wheel Selection (3 Periods)
Grinding Machines: Cylindrical grinder, Surface grinder, Internal grinder, Center-less grinder, Tool and cutter grinder, Selection of Grinding Wheel, Factors affecting wheel selection, Wheel selection for different materials and operations.

INSTRUCTIONAL STRATEGY
The course shall be delivered through interactive lectures, demonstrations, machine shop practice, charts, models, and multimedia presentations. Practical exposure shall be provided for wheel mounting, dressing, balancing, and grinding operations. Industrial case studies, assignments, and discussions shall be used to enhance understanding of grinding processes, machine applications, and grinding wheel selection techniques.

MEANS OF ASSESSMENT
- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Manufacturing Technology R. K. Jain Manufacturing Technology 17th 2014 Khanna Publishers, New Delhi
2. Workshop Technology W. A. J. Chapman Workshop Technology Vol. II 5th 2012 CBS Publishers, New Delhi
3. Production Technology HMT Production Technology 18th 2010 Tata McGraw Hill, New Delhi
4. Manufacturing Engineering and Technology Serope Kalpakjian Manufacturing Engineering and Technology 6th 2009 Pearson Education, New Delhi
5. Elements of Workshop Technology S. K. Hajra Choudhury Elements of Workshop Technology Vol. II 14th 2010 Media Promoters and Publishers, Mumbai

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	2	15
2	4	25
3	2	20
4	3	20
5	3	20
Total	**14**	**100%**

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

PRACTICUM	4.2.1 ADVANCE MANUFACTURING PROCESS CNC (P.E-II)	L	T	P
		2	-	3

COURSE OBJECTIVES

1. To understand the fundamentals, concepts, advantages, and applications of CNC technology in modern manufacturing industries.
2. To develop knowledge of classification, control systems, coordinate systems, and axis identification used in NC/CNC machines.
3. To familiarize students with manual and computer-aided CNC part programming using G-codes, M-codes, canned cycles, and programming principles.
4. To understand tooling systems, machine specifications, machine control units, and selection criteria of CNC machines.
5. To develop knowledge of construction, working principles, operations, and applications of CNC turning, milling, machining centers, EDM, wire-cut EDM, and CNC grinding machines.

COURSE OUTCOMES (COS)

CO1: Explain the concepts, advantages, limitations, and environmental requirements of CNC technology and CNC machines.
CO2: Describe different classifications of NC/CNC systems, feedback systems, coordinate systems, and axis identification methods.
CO3: Develop basic CNC part programs using manual programming techniques, G-codes, M-codes, canned cycles, and computer-aided programming concepts.
CO4: Explain tooling systems, machine specifications, machine control units, and selection criteria for CNC machines.
CO5: Describe the construction, working principles, operations, and applications of CNC lathe, CNC milling machine, machining centre, CNC EDM, wire-cut EDM, and CNC grinding machines.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	1	-	1	*	*
CO2	3	3	2	2	1	-	1	*	*
CO3	3	3	3	3	1	1	2	*	*
CO4	3	2	2	3	1	1	1	*	*
CO5	3	2	2	3	2	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

DETAILED CONTENTS

UNIT 1: Introduction to CNC Technology (5 Periods)

Overview of CNC machining, Concept of NC, CNC, and DNC, Advantages of CNC over, conventional machining, Merits and limitations of CNC machines, Environmental requirements for CNC machines.

Practical:

1: Identification of CNC Machine Parts

2: Comparative Study of Conventional and CNC Machines

UNIT 2: Classification of NC/CNC Systems (5 Periods)

Based on Feedback Control, Open loop control system, Closed loop control system, Feedback devices. Based on Control System Features: Point-to-point control, Straight-line control, Continuous path control. Based on Coordinate System: Absolute coordinate system, Incremental coordinate system, Based on Axis Identification: Linear axes, Rotary axes.

Practical:

1: Demonstration of Open Loop and Closed Loop Systems

2: Coordinate System Practice & CNC Axis Identification Exercise

UNIT 3: Fundamentals of Part Programming (5 Periods)

Manual Part Programming: Concept and applications, NC coding system and program forma, G-codes and M-codes, Programming for point-to-point, linear, and contour operations, Computer-Aided Part Programming, CNC programming using computers, Subroutines and loops, Canned cycles, Principles of CNC programming.

Practical:

1: Manual Part Programming Using G and M Codes

UNIT 4: Tooling and Machine Specifications (5 Periods)

Tooling for CNC Machines: Design features of CNC cutting tools. Tool holders and inserts, Automatic Tool Changer (ATC), Specifications of CNC Machines, Machine coordinates and axes, Spindle speed and feed rates, Machine Control Unit (MCU), Cooling and lubrication systems, Selection of CNC machine based on application.

Practical:

1: Tool Offset and Tool Setting Practice

UNIT 5: CNC Machines and Operations (8 Periods)

CNC Lathe: Construction and main parts, Machine reference and work reference, Tool compensation (tool nose radius), Turning operations and programming basics.

CNC Milling Machine: Construction and working, Tool selection and tool setting, Milling operations and programming fundamentals.

CNC Machining Centre: Operations: Milling, Drilling, Reaming, Tapping, Accessories and attachments, working principles.

CNC EDM (Spark Erosion): Principle of EDM, Dielectric medium, Process parameters and tooling Applications

CNC Wire Cut EDM: Working principle: Wire selection and process parameters: Construction features.

CNC Grinding Machines: Types and construction, Grinding wheel selection, CNC programming for grinding operations**.**

Practical:

1: CNC Turning Operations

2: CNC Milling Operations

INSTRUCTIONAL STRATEGY

The course shall be delivered through interactive lectures, demonstrations, multimedia presentations, and practical CNC programming sessions to develop understanding of CNC technology and machine operations. CAD/CAM software demonstrations, CNC simulation programs, industrial videos, and machine models shall be used for explaining CNC systems, coordinate systems, tooling, and machine specifications. Hands-on exercises in part programming using G-codes, M-codes, canned cycles, and tool offset settings shall be conducted. Industrial case studies, assignments, seminars, and group discussions shall be arranged to enhance knowledge of CNC machining centres, EDM, wire-cut EDM, and CNC grinding operations. Continuous assessment through tutorials, practical exercises, viva voce, and programming assignments shall be adopted for effective learning.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Computer Numerical Control Machines Pabla B. S. and Adithan M. Computer Numerical Control Machines 2nd 2010 New Age International Publishers, New Delhi
2. CNC Machines H. S. Bawa CNC Machines 1st 2005 Tata McGraw Hill, New Delhi
3. CAD/CAM and Automation M. Groover and E. Zimmers CAD/CAM and Automation 1st 2012 Prentice Hall of India, New Delhi
4. Automation, Production Systems and Computer Integrated Manufacturing Mikell P. Groover Automation, Production Systems and CIM 3rd 2015 Pearson Education, New Delhi
5. CNC Programming Principles and Applications Mike Lynch CNC Programming Principles and Applications 1st 2004 Industrial Press Inc., New York
6. Production Technology HMT Production Technology 18th 2010 Tata McGraw Hill, New Delhi
7. Manufacturing Technology P. N. Rao Manufacturing Technology Vol. II 4th 2013 Tata McGraw Hill, New Delhi
8. Computer Aided Manufacturing Rao P. N. Computer Aided Manufacturing 3rd 2010 Tata McGraw Hill, New Delhi
9. CNC Control Setup for Milling and Turning Peter Smid CNC Control Setup for Milling and Turning 1st 2009 Industrial Press Inc., New York
10. Principles of Modern Manufacturing Mikell P. Groover Principles of Modern Manufacturing 5th 2013 Wiley India Pvt. Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	5	15
2	5	15
3	5	20
4	5	20
5	8	30
Total	**28**	**100%**

PRACTICUM	4.2.2 MANUFACTURING ENGINEERING (P.E-II)	L	T	P
		2	-	3

COURSE OBJECTIVES

1. To develop fundamental knowledge of manufacturing processes used in tool and die industries.
2. To understand metal casting, forming, machining, welding, and non-traditional manufacturing processes.
3. To familiarize students with machine tools, cutting tools, and manufacturing operations.
4. To develop understanding of modern manufacturing techniques and process selection.
5. To enhance practical and analytical skills related to manufacturing engineering applications.

COURSE OUTCOMES (COS)

CO1: Explain the fundamentals of manufacturing processes and engineering materials used in production industries.
CO2: Describe casting, metal forming, and welding processes used in manufacturing applications.
CO3: Explain machining operations, machine tools, cutting tools, and process parameters used in production.
CO4: Describe unconventional and modern manufacturing processes used in tool and die industries.
CO5: Select suitable manufacturing processes and machines for production of engineering components.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	1	-	1	*	*
CO2	3	2	2	2	1	-	1	*	*
CO3	3	3	2	2	1	1	1	*	*
CO4	3	2	2	3	1	1	2	*	*
CO5	3	3	3	2	2	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Introduction To Manufacturing Engineering (5 Periods)

Introduction to Manufacturing, Definition and scope of manufacturing engineering, Manufacturing systems and production methods, Classification of manufacturing processes, Engineering Materials, Ferrous and non-ferrous materials, Properties and applications of engineering material, selection of materials for manufacturing, Production Systems, Job production, Batch production, Mass production, Lean manufacturing concepts

Practical:

1: Identify ferrous and non-ferrous materials.

2: Study physical properties and industrial applications of materials.

UNIT 2: Casting, Forming And Welding Processes (6 Periods)

Casting Processes, Sand casting process, Pattern and core making, Casting defects and remedies, Metal Forming Processes, Rolling, Forging, Extrusion, Drawing, Sheet metal operations, Welding Processes, Gas welding, Arc welding, Resistance welding, Welding defects and safety precautions.

Practical:

1: Identify casting defects using samples/charts and suggest remedies.

UNIT 3: Machining Processes And Machine Tools (7 Periods)

Fundamentals of Machining, Types of machining operations, Cutting parameters: speed, feed and depth of cut, Cutting fluids and their applications, Conventional Machine Tools, Lathe machine, Drilling machine, Shaper and planer, Milling machine, Grinding machine, Cutting Tools, Tool materials, Single point and multi-point cutting tools, Tool wear and tool life.

Practical:

1: Identify single-point and multi-point cutting tools and tool materials.

2: Calculate cutting speed, feed, and depth of cut for machining operations.

UNIT 4: Non-Traditional And Modern Manufacturing Processes (5 Periods)

Non-Traditional Machining, EDM, Wire-cut EDM, ECM, Laser beam machining, CNC and Automation, Introduction to CNC machines, CNC machining applications, CAD/CAM concepts, Flexible manufacturing systems.

Practical:

1: Identify CNC machine components and observe CNC machining operations.

2: Create simple component drawing using CAD software and generate tool path.

UNIT 5: Process Selection, Quality And Safety (5 Periods)

Process Selection, Factors affecting process selection, Selection of machines and tools, Economics of manufacturing, Quality Control, Inspection methods, Limits, fits and tolerances, Surface finish concepts, Industrial Safety, Safety precautions in manufacturing shops, Personal protective equipment, Safe handling of machines and tools.

Practical:

1: Measure dimensions using vernier caliper, micrometer, and gauges.

2: Identify types of fits and tolerance zones using samples/charts.

INSTRUCTIONAL STRATEGY

The course shall be delivered through interactive lectures, demonstrations, practical exposure, industrial case studies, charts, models, and multimedia presentations. Machine shop demonstrations and manufacturing process videos shall be used for better understanding of machining, welding, forming, and CNC operations. Assignments, tutorials, group discussions, and industrial visits shall be conducted to strengthen practical knowledge and industrial awareness.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Manufacturing Technology P. N. Rao Manufacturing Technology Vol. I & II 4th 2013 Tata McGraw Hill, New Delhi
2. Production Technology HMT Production Technology 18th 2010 Tata McGraw Hill, New Delhi
3. Workshop Technology W. A. J. Chapman Workshop Technology Vol. I & II 5th 2012 CBS Publishers, New Delhi
4. Elements of Workshop Technology S. K. Hajra Choudhury Elements of Workshop Technology Vol. I & II 14th 2010 Media Promoters and Publishers, Mumbai
5. Manufacturing Engineering and Technology Serope Kalpakjian Manufacturing Engineering and Technology 6th 2009 Pearson Education, New Delhi
6. Production Engineering P. C. Sharma Production Engineering 12th 2014 S. Chand Publications, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	5	20
2	6	20
3	7	20
4	5	20
5	5	20
Total	**28**	**100%**

PRACTICUM	4.3 PRESS TOOL DESIGN-I	L	T	P
		1	-	2

COURSE OBJECTIVES

After completing this course, the students will be able to:

1. Understand the principles, construction, and applications of progressive, bending, and piercing press tools used in sheet metal industries.
2. Develop strip layouts, blank developments, and perform bend calculations for designing sheet metal components.
3. Design and analyze various press tool components such as punches, pilots, strippers, bolsters, and bending tools using standard design procedures.
4. Prepare detailed part drawings, assembly drawings, and Bill of Materials (BOM) for press tool manufacturing.
5. Select suitable tool materials and recommend appropriate heat treatment processes for improving tool performance and life.

COURSE OUTCOMES (COS)

After completing this course, the students will be able to:

CO1: Explain the construction, working principles, and applications of progressive, bending, and piercing tools used in press working operations. Develop blank layouts, strip layouts, and calculate bend lengths

CO2: Design progressive tools, Design bending tools and second piercing tools**.**

CO3: Prepare detailed part drawings, assembly drawings, and Bill of Materials (BOM) using standard drafting and dimensioning practices.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	3	2	2	-	-	1	*	*
CO2	3	3	3	2	1	1	1	*	*
CO3	2	2	3	3	-	2	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Progressive Tool Design (8 Periods)

Introduction to Progressive Tools: Definition and applications of progressive tools, Types of progressive tools, Advantages and limitations of progressive tools, working principle of progressive press tools.

Design of Progressive Tool: Design procedure of progressive tools using solid stripper,
Functions of pitch-punch and pilot, Constructional details of pitch-punch and pilot arrangement, Selection of die block, punch, stripper, and guide components.
Construction of Pitch-Punch: Definition and purpose of pitch-punch, Construction and working of pitch-punch, Design considerations for pitch-punch
Blank Development and Bend Calculation: Principles of blank development, Methods of blank development for sheet metal components, Bend allowance and bend deduction, Bend length calculation for different bending operations.
Strip Layout Design: Importance of strip layout, Factors affecting strip layout design, Calculation of strip width, pitch, and material utilization, Economy in strip layout design.
Design Calculations of Tool Components: Calculation of top bolster thickness, Calculation of punch holder thickness, Calculation of bottom bolster thickness, Selection of standard components for press tools.
Drafting and Dimensioning: Preparation of part drawings, Dimensioning practices for press tool components, Assembly drawing of progressive tools, Standard conventions used in press tool drafting.
Practical:

1: Preparation of Strip Layout

- Design strip layout for a simple sheet metal component
- Calculate strip width, pitch, and material utilization
- Determine percentage of scrap and economy factor

2: Blank Development Exercise

- Develop blank for simple bent component
- Prepare development drawing using bend allowance method
- Verify developed blank dimensions practically

3: Design Calculations of Progressive Tool

- Calculate punching force, stripping force, and die clearance
- Calculate top bolster thickness, punch holder thickness, and bottom bolster thickness

4: Drafting of Progressive Tool Components

- Prepare detailed part drawing of punch, die, stripper, and pilot
- Practice standard dimensioning and tolerancing methods

5: Assembly Drawing of Progressive Tool

- Prepare assembly drawing of progressive press tool using CAD/manual drafting
- Indicate working positions and sequence of operations

UNIT 2: Bending and Piercing Tool Design (3 Periods)
Bending Tool Design: Introduction to bending operations, Types of bending tools, Design procedure for bending tools, Calculation of bending force and spring back allowance.
Piercing Tool Design: Introduction to piercing operation, Design of second piercing tool using floating stripper, Construction and working of floating stripper, Advantages of floating stripper arrangement.
Part Drawing and Assembly Drawing: Preparation of detailed part drawings, Assembly drawing of bending and piercing tools, Dimensioning and tolerancing practices.
Practical

1: Design of Simple Bending Tool

- Design bending tool for a given component
- Calculate bending force and spring back allowance

2: Design of Piercing Tool

- Design second piercing tool using floating stripper arrangement
- Calculate piercing force and clearance

UNIT 3: Bill of Materials (BOM) **(3 Periods)**

Definition and importance of BOM, Preparation of Bill of Materials for press tools, Standard specifications of tool components. Tool Materials, Selection criteria for press tool materials, Materials used for punches, dies, strippers, and bolsters, Properties and applications of tool steels.

Heat Treatment of Tool Components: Purpose of heat treatment in press tools, Heat treatment processes for punches and dies, Hardening, tempering, and surface treatment methods, Effect of heat treatment on tool life and performance.

Practical:

1: Preparation of Bill of Materials (BOM)

- Prepare BOM for progressive tool assembly
- Mention quantity, material specification, and standard size of components

2: Mini Project on Press Tool Design

- Design a simple progressive, bending, or piercing tool for a given component
- Prepare strip layout, calculations, BOM, and assembly drawing as final submission

INSTRUCTIONAL STRATEGY

This course will be delivered through a combination of classroom lectures, demonstrations, drafting practice, laboratory work, and project-based learning to develop both theoretical knowledge and practical skills in press tool design. The instructor will explain the concepts of progressive tools, bending tools, piercing tools, strip layout, blank development, and tool component calculations using charts, models, multimedia presentations, and industrial examples. Practical demonstrations and workshop sessions will be conducted to familiarize students with tool assemblies, press operations, drafting techniques, and heat treatment processes. Students will perform design calculations, prepare part and assembly drawings, and develop strip layouts using manual methods as well as CAD software. Problem-solving exercises, assignments, and case studies will be used to strengthen analytical and design capabilities. Industrial visits, seminars, and mini projects related to press tool manufacturing and design will be encouraged to provide industry exposure and promote self-learning. Continuous assessment through class tests, practical evaluations, viva-voce, drawing assignments, and project work will be carried out to monitor student progress and attainment of course outcomes.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. D. Eugene Ostergaard Basic Die Making ISBN 07-046090-6
2. Prakash H. Joshi McGraw Hill Book Co. Press Tools Design & Construction ISBN 81-85814-46-5
3. American Society of Tool & Manufacturing Engineers (F.W. Wilson) Fundamental of Tool Design ISBN 0-87692-058-10
4. Wheeler Publishing Prentice Hall of India Pvt. Ltd. New Delhi C. Donaldson, George H. Lecain V.C. Goold A. Kumar Tool Design ISBN 0-07-099274-6
5. Fundamentals of Tool Design Tata McGraw Hill CITD (ISTE) Dhanpat Rai & Co. Tool Engineering Parameters TETCOS CITD (ISTE) – Hyderabad
6. Surrender Kumar & Umesh Chandra Production Engg. Design -- Satya Prakashan, New Delhi Donaldson Fundamental of tool design Tata McGraw Hill

SUGGESTED DISTRIBUTION OF MARKS

Topic Number	Time Allotted (Hrs.)	Marks Allocation (%)
1	8	40
2	3	30
3	3	30
Total :	**14**	**100%**

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

THEORY	4.4 MOULD THEORY	L	T	P
		3	-	-

COURSE OBJECTIVES

After completing this course, the students will be able to:

1. Understand the fundamentals, terminology, and industrial applications of moulds and moulding processes used in manufacturing industries.
2. Identify different types of moulds, mould components, and select suitable mould materials based on application requirements.
3. Understand the design and working principles of feeding systems, gating systems, ejection systems, and cooling systems used in moulds.
4. Apply manufacturing processes and modern machining methods for mould production and finishing operations.
5. Analyze common mould defects, their causes, remedies, and quality control methods for improving mould performance and product quality.

COURSE OUTCOMES (COS)

After completing this course, the students will be able to:

CO1: Explain the fundamentals of mould theory, moulding processes, terminology, and industrial applications of moulds used in manufacturing industries.

CO2: Identify different types of moulds, mould components, and select suitable mould materials based on required mechanical and thermal properties.

CO3: Explain the construction and working of feeding systems, gating systems, and ejection systems used in mould design.

CO4: Describe the importance of cooling and heating systems in moulds and apply basic concepts of heat transfer for cycle time optimization.

CO5: Explain conventional and advanced mould manufacturing processes such as CNC machining, EDM, and additive manufacturing used in mould production. Identify common mould defects, analyze their causes, suggest remedies.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	1	-	1	*	*
CO2	3	2	2	1	1	-	1	*	*
CO3	3	3	2	2	1	1	1	*	*
CO4	3	3	2	2	2	1	1	*	*
CO5	3	3	3	3	2	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Introduction to Mould Theory (9 Periods)

Definition and importance of moulds, Role of moulds in manufacturing industries, Types of moulding processes: Injection moulding, Compression moulding, Blow moulding, Extrusion dies, Basic terminology: Shrinkage, draft angle, taper, flash, Industrial applications.

UNIT 2: Types of Moulds, Construction & Material Selection (9 Periods)

Classification of moulds: Two-plate, three-plate moulds, Hot runner & cold runner, Family & multi-cavity moulds, Basic mould structure: Core & cavity, Bolster plates, Guide pillars & bushes, Parting line. Tool steels (P20, H13, H11etc.), Properties: Hardness, Wear resistance, Thermal conductivity, Material selection criteria.

UNIT 3: Feeding System (Gating System) & Ejection System (9 Periods)

Components: Sprue, runner, gate, Types of gates: Edge, pin, fan, submarine, Design considerations: Flow behavior, Pressure loss, Runner balancing.

Types of ejection: Pin ejector, Sleeve ejector, Air ejector, Stripper ejector, Ejector layout design, Defects due to improper ejection.

UNIT 4: Cooling & Heating System (7 Periods)

Importance of temperature control, Cooling channel design, Heat transfer basics, Cycle time optimization.

UNIT 5: Mould Manufacturing Processes & Mould Defects & Troubleshooting (8 Periods)

Conventional processes: Lathe, milling, drilling, Advanced processes: CNC machining, EDM (Electrical Discharge Machining), Additive manufacturing, Surface finishing & polishing.

Common defects: Short shot, Flash, Sink marks, Warpage, Causes & remedies, Quality control methods.

INSTRUCTIONAL STRATEGY

This course will be delivered through a combination of classroom teaching, practical demonstrations, laboratory sessions, and industry-oriented learning methods to develop theoretical understanding and practical knowledge of mould technology. The instructor will explain the fundamentals of mould theory, moulding processes, mould construction, gating systems, cooling systems, and mould manufacturing processes using lectures, charts, models, multimedia presentations, and industrial case studies. Demonstrations of mould components, mould assemblies, CNC machining, EDM operations, and mould defect analysis will be conducted to strengthen practical understanding. Students will be encouraged to prepare mould sketches, component layouts, and process flow diagrams to improve visualization and design skills. Numerical problems related to shrinkage, cooling channel design, and gating systems will be solved to develop analytical ability. Laboratory exercises, assignments, seminars, industrial visits, and mini projects related to mould design and manufacturing will be conducted to provide hands-on exposure to industrial practices. Continuous assessment through tests, viva-voce, assignments, practical evaluations, and project work will be carried out to monitor the attainment of course outcomes.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

Text Books

1. Pye R.G.W., "Injection Mould Design", Affiliated East-West Press Pvt. Ltd., 2000.
2. M.V. Joshi, "Mould Design and Manufacturing", Tata McGraw Hill Publishing Co. Ltd., 2001.
3. Sharma P.C., "Production Engineering", S. Chand & Company Ltd., 2014.
4. Khurmi R.S. and Gupta J.K., *"A Textbook of Production Engineering"*, S. Chand & Company Ltd., 2013.
5. Khanna O.P., "A Textbook of Production Technology", Dhanpat Rai Publications, 2012.

Reference Books

1. Rosato D.V. and Rosato M.G., "Injection Moulding Handbook", Springer Publications, 2000.
2. Ostwald P.F. and Munoz J., "Manufacturing Processes and Systems", John Wiley & Sons, 1997.
3. Krar Steve F., "Technology of Machine Tools", McGraw Hill Publications, 2005.
4. Groover Mikell P., "Fundamentals of Modern Manufacturing", John Wiley & Sons, 2010.
5. Brydson J.A., "Plastics Materials", Butterworth-Heinemann Publications, 1999.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	9	25
2	9	25
3	9	20
4	7	15
5	8	15
Total	**42**	**100%**

THEORY	4.5 FUNDAMENTAL APPLICATIONS OF ELECTRICAL & ELECTRONICS	L	T	P
		2	-	-

COURSE OBJECTIVES

After completing this course, students will be able to:

1. Understand fundamental concepts of A.C. electricity, single-phase and three-phase systems used in industrial applications.
2. Explain construction, working principles, characteristics, and applications of transformers, D.C. motors, and induction motors.
3. Understand electrical wiring systems, installation practices, and testing procedures as per Indian Electricity rules.
4. Develop awareness about electrical safety practices, earthing systems, and first aid measures for electric shock.
5. Understand basic semiconductor devices, rectifiers, filters, and power supply circuits used in electrical and electronic applications.
6. Apply basic electrical and electronics knowledge in operation and maintenance of industrial and tool room equipment.

COURSE OUTCOMES (COS)

CO1: Explain the basic concepts of electricity, alternating current, and single-phase and three-phase systems used in industrial applications.

CO2: Describe the construction, working principle, characteristics, and applications of transformers and D.C. motors.

CO3: Explain the working principle, construction, starting methods, and applications of single-phase and three-phase induction motors.

CO4: Understand electrical wiring systems, installation methods, testing procedures, and Indian Electricity (IE) rules. Apply electrical safety practices and first aid procedures

CO5: Identify and explain semiconductor devices, rectifiers, filters, and basic electronic power supply circuits used in electrical and electronic systems.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	1	-	1	*	*
CO2	3	2	2	2	1	-	1	*	*
CO3	3	2	2	2	1	-	1	*	*
CO4	2	2	1	3	3	1	1	*	*
CO5	3	2	2	2	1	-	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTAINED

UNIT 1: A.C. Fundamentals (4 Periods)

Basics of electricity: voltage, current, resistance, Alternating current and its characteristics, Single-phase and three-phase systems, Applications of single-phase and three-phase circuits,

UNIT 2: Electrical Machines (8 Periods)

Transformer: Principle of mutual induction, Construction of single-phase and three-phase transformers, EMF equation of transformer, Cooling methods and maintenance, Applications and specifications

D.C. Motor: EMF equation and back EMF, Types: series, shunt, compound motors, Construction and working, Applications and comparison of motors.

Induction Motor (Single & Three Phase): Working principle of induction motor, Construction of squirrel cage motor, Starting methods and Applications.

UNIT 3: Utilization of Electrical Power (6 Periods)

Electrical Wiring Installation & Testing, Types of wiring systems, Domestic wiring circuits, Testing of electrical installations, Indian Electricity (IE) rules, Comparison of wiring methods.

UNIT 4: Electrical Safety (4 Periods)

Electrical Safety & Earthing: Electrical hazards and shock effects, First aid for electric shock, Earthing: concept and necessity, Methods of earthing, Earth resistance.

UNIT 5: Basic Electronics (6 Periods)

5Semiconductor Devices: Diodes: types, characteristics, applications, Transistors: BJT, FET, UJT, Thyristor famil. Power Supply, Rectifiers: half-wave, full-wave, bridge, Filters and their applications.

INSTRUCTIONAL STRATEGY

The course will be delivered through lecture-cum-discussion, demonstration, and practical-oriented teaching methods. Charts, models, multimedia presentations, and industrial examples will be used to explain electrical and electronics concepts. Hands-on activities such as component identification, wiring practice, testing, and safety demonstrations will be conducted to enhance practical understanding. Problem-solving sessions, assignments, and group discussions will be used to strengthen analytical and application skills related to electrical machines, wiring systems, safety, and basic electronics.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

LIST OF RECOMMENDED BOOKS

1. Basic Electrical Engineering, S. Chand & Company Ltd., New Delhi, 2018.
2. Principles of Electrical Engineering, S. Chand & Company Ltd., New Delhi, 2008.
3. A Textbook of Electrical Technology (Vol. I), S. Chand Publishing, New Delhi, 2014.
4. Electrical Technology, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 2004.
5. Electrical Wiring, Estimating and Costing, Khanna Publishers, New Delhi, 2012.
6. Basic Electronics, S. Chand & Company Ltd., New Delhi, 2006.
7. Electronic Devices and Circuits, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2012.
8. Fundamentals of Electrical Engineering, PHI Learning Pvt. Ltd., New Delhi, 2009.

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

SUGGESED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	4	20
2	8	20
3	6	20
4	4	20
5	6	20
Total	**28**	**100%**

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PRACTICUM	4.6 JIGS & FIXTURES DESIGN	L	T	P
		2	-	2

COURSE OBJECTIVES

After completion of this course, students will be able to:

1. Understand the construction and applications of plane drill jigs and inspection fixtures used in manufacturing industries.
2. Identify locating, clamping, guiding, and gauging elements used in jig and fixture manufacturing.
3. Develop skills in marking, machining, fitting, assembly, and inspection operations for jig and fixture components.
4. Select suitable materials and manufacturing processes for producing jigs and inspection fixtures.
5. Perform alignment, accuracy checking, and functional testing of jigs and fixtures.
6. Follow safety practices during manufacturing, assembly, and inspection operations.

COURSE OUTCOMES (COS)

CO1: Explain the construction, functions, and applications of plane drill jigs and inspection fixtures.
CO2: Perform machining, fitting, and assembly operations involved in manufacturing plane drill jigs and inspection fixtures.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	2	1	1	1	1	*	*
CO2	3	2	3	3	2	2	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Manufacture of Plane Drill Jigs (14 periods)

Study of plane drill jig drawing and specifications, Introduction and applications of plane drill jig in drilling operations, Selection of suitable material for jig body and jig bushes, Identification of locating, clamping, and guiding elements, Marking and layout of jig body, Manufacturing operations: sawing, drilling, milling, boring, grinding, and fitting, Machining of locating surfaces and drilling guide holes, Fitting of drill bushes and locating pins, Assembly of clamping devices and guide elements, Alignment and accuracy checking of jig components, Trial drilling and performance testing of plane drill jig, Inspection of dimensional accuracy and hole positions, Safety precautions during manufacturing and assembly operations.

Practical's:

1. Study of plane drill jig drawing and identification of components.
2. Selection of suitable material for jig body and drill bushes.
3. Marking and layout of jig body as per drawing.
4. Machining operations: sawing, drilling, milling, boring, and grinding.

UNIT 2: Manufacture of Inspection Fixtures (for Plane jig) (14 periods)

Study of plane drill jig component drawing and inspection requirements, Introduction to inspection fixtures and their applications in quality control, Selection of suitable material for inspection fixture manufacturing, Design considerations for locating and clamping of plane drill jig, Selection of locators, supports, and gauges, Marking and layout of fixture components, Manufacturing operations: cutting, drilling, milling, grinding, and fitting, Assembly of fixture body, locators, and clamping elements, Checking alignment and dimensional accuracy, Inspection of hole position, spacing, and perpendicularity of plane drill jig, Trial inspection and functional testing of fixture, Safety precautions during manufacturing and inspection operations.

Practical's:

1.Study of inspection fixture drawing and inspection requirements.
2. Selection of suitable materials for fixture manufacturing.
3. Identification of locators, supports, clamps, and gauges.
4. Marking and layout of fixture components.
5. Manufacturing operations: cutting, drilling, milling, grinding, and fitting.

INSTRUCTIONAL STRATEGY

The course shall be delivered through demonstration, workshop practice, and activity-based learning methods. Students will perform marking, machining, fitting, assembly, and inspection operations using standard workshop machines and measuring instruments. Industrial drawings, models, and actual jig and fixture components will be used for practical understanding. Continuous supervision, trial testing, and inspection activities will help students develop hands-on manufacturing and quality control skills.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Jigs and Fixtures, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2003.
2. An Introduction to Jig and Tool Design, ELBS Publications, London, 2005.
3. Jig and Fixture Design, Delmar Cengage Learning, USA, 2004.
4. Tool Design, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.
5. Fundamentals of Tool Design, SME Publications, Michigan, 2010.
6. Production Engineering, S. Chand & Company Ltd., New Delhi, 2012.
7. Workshop Technology Volume II, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 2006.
8. Manufacturing Engineering and Technology, Pearson Education, New Delhi, 2014.

SUGGESTED DISTRIBUTION OF MARKS

Unit	Time Allotted (Periods)	Marks Allotted (%)
1	14	50
2	14	50
Total	**28**	**100%**

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

PRACTICAL	4.7 MILLING, GRINDING (CNC MACHINING)	L	T	P
		-	-	8

Course Objectives

This course aims to develop advanced machining skills in milling and grinding operations used in manufacturing industries. It provides practical knowledge of vertical milling machines, cutting tools, work-holding devices, and machining processes such as face milling, slot milling, groove milling, and step milling for producing accurate machine components. The course also develops proficiency in surface and cylindrical grinding operations, including wheel mounting, balancing, dressing, and grinding of flat, angular, external, and internal surfaces. Students will learn to inspect machined components for dimensional accuracy, surface finish, parallelism, flatness, and taper using appropriate measuring instruments. The course further emphasizes the safe operation of machine tools, quality control practices, and the application of engineering principles in precision manufacturing.

Course Outcomes (COs)

After successful completion of the course, the student will be able to:

CO1: Identify the construction, controls, accessories, and operating principles of vertical milling and grinding machines.

CO2: Select appropriate cutting tools, grinding wheels, and work-holding devices for performing advanced milling and grinding operations.

CO3: Perform face milling, slot milling, groove milling, and step milling operations to manufacture machine components with required dimensional accuracy.

CO4: Carry out surface and cylindrical grinding operations, including wheel mounting, balancing, dressing, and grinding of flat, angular, external, and internal surfaces.

CO5: Inspect machined and ground components using suitable measuring instruments to evaluate dimensions, surface finish, flatness, parallelism, taper, and concentricity.

CO6: Apply safe machining practices, quality standards, and modern manufacturing techniques while performing advanced milling and grinding operations.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	1	-	2	-	1	1	*	*
CO2	3	2	2	3	1	1	1	*	*
CO3	3	3	3	3	1	1	1	*	*
CO4	3	3	2	3	1	1	1	*	*
CO5	3	3	2	3	1	2	1	*	*
CO6	2	2	2	2	3	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

List of Practicals

ADVANCE MILLING PRACTICE

1. Identification of vertical milling machine parts and controls.
2. Selection and mounting of milling cutters and work holding devices.
3. Face milling operation on mild steel specimen.
4. Slot milling operation using slot drill/end mill cutter.
5. Step milling operation for manufacturing step clamp profile.
6. Groove milling operation on vertical milling machine.
7. Inspection of machined dimensions and surface finish.
8. Safety precautions during milling operations.

ADVANCE GRINDING PRACTICE

1. Identification of surface grinding machine parts and accessories.
2. Wheel mounting, balancing, and dressing operations.
3. Surface grinding of V-block.
4. Slot grinding operation on step clamp.
5. Grinding of flat and angular surfaces.
6. Inspection of parallelism, flatness, and surface finish.
7. Identification of cylindrical grinding machine parts and controls.
8. External cylindrical grinding (OD grinding) of spline bush.
9. Internal cylindrical grinding (ID grinding) of spline bush.
10. Inspection of OD, ID, taper, and surface finish.
11. Safety precautions during grinding operations.

THEORY	4.8.1 ENGINEERING ECONOMICS & ACCOUNTANCY (O.E-I)	L	T	P
		2	-	-

COURSE OBJECTIVES:

To acquire knowledge of basic economics to facilitate the process of economic decision making.

1. To acquire knowledge on basic financial management aspects.
2. To develop the basic skills to analyze financial statements.

COURSE OUTCOMES (CO) :

CO1: Explain the fundamental concepts of managerial economics, firm objectives, and the decision-making process in an engineering context.

CO2: Analyze market dynamics by applying the concepts of demand and supply elasticity and forecasting techniques.

CO3: Apply production functions and cost analysis techniques to optimize resources and estimate short-run and long-run costs.

CO4: Determine appropriate pricing strategies based on market structures (perfect/imperfect competition) and government regulations.

CO5: Interpret financial statements (Balance Sheet, P&L) and evaluate investment risks/returns using Ratio Analysis, NPV, and IRR.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	1	-	-	-	1	2	1	*	*
CO2	2	3	-	1	2	2	1	*	*
CO3	2	3	1	-	1	2	1	*	*
CO4	1	2	-	-	3	2	1	*	*
CO5	2	3	-	2	1	3	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

UNIT – 1: Introduction **(4 Periods)**

Managerial Economics; Relationship with other disciplines; Firms: Types, objectives and goals; Managerial decisions; Decision analysis.

UNIT – 2: Demand & Supply Analysis **(5 Periods)**

Demand; Types of demand; Determinants of demand; Demand function; Demand elasticity; Demand forecasting; Supply; Determinants of supply; Supply function; Supply elasticity.

UNIT – 3: Production and Cost Analysis **(6 Periods)**

Production function; Returns to scale; Production optimization; Least cost input; Isoquants; Managerial uses of production function; Cost Concepts; Cost function; Types of Cost; Determinants of cost; Short run and Long run cost curves; Cost Output Decision; Estimation of Cost

UNIT – 4: Pricing **(5 Periods)**

Determinants of Price; Pricing under different objectives and different market structures; Price discrimination; Pricing methods in practice; Role of Government in pricing control.

UNIT– 5: Financial Accounting (Elementary Treatment) **(8 Periods)**

Balance sheet and related concepts; Profit & Loss Statement and related concepts; Financial Ratio Analysis; Cash flow analysis; Funds flow analysis; Comparative financial statements; Analysis & Interpretation of financial statements; Investments; Risks and return evaluation of investment decision; Average rate of return; Payback Period; Net Present Value; Internal rate of return

RECOMMENDED BOOKS:

1. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House, New Delhi, 2018
2. McGuigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics', Thomson Southwestern, 10th Edition, 2005.
3. Prasanna Chandra. 'Fundamentals of Financial Management', Tata Mcgraw Hill Publishing Ltd., 4th edition, 2005.
4. Samuelson. Paul A and Nordhaus W.D., 'Economics', Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.
5. Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press, New Delhi, 2007.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	04	17
II	05	20
III	06	20
IV	05	20
V	08	23
Total	**28**	**100**

THEORY	4.8.2 DISASTER MANAGEMENT (O.E.-I)	L	T	P
		2	-	-

COURSE OBJECTIVES:

Following are the objectives of this course:

1. To learn about various types of natural and man-made disasters.
2. To know pre- and post-disaster management for some of the disasters.
3. To know about various information and organisations in disaster management in India.
4. To get exposed to technological tools and their role in disaster management.

COURSE OUTCOMES (CO):

After completing this course, student will be:

CO1: Acquainted with fundamental concepts of disaster, hazard, vulnerability, risk, and capacity, and explain their inter-relationships.

CO2 : Classify various types of disasters (Geological, Hydro-meteorological, Biological, Man-made) and analyze their causes, trends, and consequences.

CO3 : Apply the Disaster Management Cycle (Pre, During, Post) and global frameworks (Hyogo, IDNDR) to plan for risk assessment and mitigation.

CO4 : Familiarised with institutional and legal mechanism of Disaster Management in India, including the DM Act 2005 and the role of various agencies.

CO5: Able to select scientific tools (GIS, RS, GPS) and engineering practices (structural/non-structural mitigation) for disaster preparedness and safe construction.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	2	-	-	-	3	-	1	*	*
CO2	3	2	-	-	3	-	2	*	*
CO3	1	2	1	-	3	2	2	*	*
CO4	2	-	-	-	3	1	2	*	*
CO5	3	2	1	2	3	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

Unit – I: Understanding Disaster (2 Periods)
Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

Unit – II: Types, Trends, Causes, Consequences and Control of Disasters (5 Periods)
Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

Unit - III: Disaster Management Cycle and Framework (8 Periods)
Disaster Management Cycle – Paradigm Shift in Disaster Management. Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness. During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Stretegy, Hyogo Framework of Action.

Unit – IV: Disaster Management in India (5 Periods)
Disaster Profile of India – Mega Disasters of India and Lessons Learnt. Disaster Management Act 2005 – Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies 457 Open Elective Courses

Unit – V: Applications of Science and Technology for Disaster Management (8 Periods)
Geo-informatics in Disaster Management (RS, GIS, GPS and RS). Disaster Communication System (Early Warning and Its Dissemination). Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non-Structural Mitigation of Disasters S&T Institutions for Disaster Management in India

RECOMMENDED BOOKS:
1. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management.
2. Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR, New Delhi.
3. Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries, Daya Publishers, Delhi.
4. Alexander, David, Natural Disasters, Kluwer Academic London.
5. Ghosh, G. K., Disaster Management, A P H Publishing Corporation.
6. Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	02	10
II	05	19
III	08	28
IV	05	19
V	08	24
Total	**28**	**100**

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

AUDIT COURSE	4.9 ESSENCE OF INDIAN KNOWLEDGE AND TRADITION	L	T	P
		2	-	-

COURSE OBJECTIVE:
To introduce the rich heritage of the Indian Knowledge System, bridging ancient wisdom with modern science and promoting holistic well-being through Yoga and traditional healthcare practices.

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Explain the foundational structures of the Indian Knowledge System, including the Vedas, Upavedas, Vedangas, and Upangas, and discuss their historical significance.
CO2: Relate ancient Indian scientific and technological achievements to modern science and analyze the convergence of science and spirituality.
CO3: Describe the basic principles of Yoga and Holistic Healthcare and evaluate their benefits and potential for integration with modern medicine.
CO4: Analyze case studies to demonstrate the contemporary relevance and practical application of Indian Knowledge Systems in solving modern problems.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	1	-	-	-	3	-	2	*	*
CO2	2	2	-	-	2	-	2	*	*
CO3	-	-	-	-	3	2	3	*	*
CO4	1	2	2	-	3	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

UNIT – I: Introduction to Indian Knowledge System **(16 Periods)**
Overview of Indian Knowledge System
Importance and relevance
1. Introduction to the Vedas
2. Upavedas
3. Vedangas
4. Upangas

UNIT – II: Modern Science and Indian Knowledge System **(6 Periods)**
1. Relevance of Science and Spirituality,
2. Science and Technology in Ancient India,

UNIT – III: Yoga and Holistic Healthcare **(4 Periods)**

1. Basic principles of Yoga
2. Benefits of holistic healthcare practices
3. Integration with modern healthcare

UNIT – IV: Case Studies / Assignment **(2 Periods)**

Practical Applications / Case studies demonstrating the relevance of Indian Knowledge System in modern times

ASSESSMENT

Viva -Voce Exam

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	16	50
2.	06	20
3.	04	15
4.	02	15
Total	**28**	**100**

THEORY	5.1 FORGING THEORY & DESIGN	L	T	P
		2	-	-

COURSE OBJECTIVES

After completion of this course, students will be able to:

1. Understand the fundamentals of forging processes and forging dies used in manufacturing industries.
2. Identify forging equipment, die elements, and forging operations used in open die and closed die forging.
3. Understand the classification, construction, and applications of different forging dies.
4. Apply basic design parameters for forged components and forging tools.
5. Understand forging defects, inspection methods, maintenance, and safety practices in forging operations.
6. Develop basic knowledge of material selection, estimation, and cost considerations for forging dies.

COURSE OUTCOMES (COS)

CO1: Explain the forging process, forging equipment, forging materials, and industrial applications of forged components.

CO2: Describe forging operations, die elements, metal flow principles, and forging defects with remedies.

CO3: Classify different types of forging dies and explain their construction and applications.

CO4: Apply design parameters such as draft angle, machining allowance, tolerances, and parting line in forging die design.

CO5: Understand die material selection, estimation methods, maintenance procedures, and safety practices used in forging industries.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	1	-	1	*	*
CO2	3	2	2	2	1	-	1	*	*
CO3	3	2	2	1	1	-	1	*	*
CO4	3	3	3	2	1	1	1	*	*
CO5	2	2	1	1	3	2	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Introduction to Forging and Forging Dies (5 Hours)

Introduction to forging process and its importance in manufacturing industries. Advantages and limitations of forging. Types of forging processes: open die forging, closed die forging, upsetting, and cold forging. Basic forging equipment: forging hammer and forging press. Forging materials and their properties. Introduction to forging dies and die features. Principles of metal flow during forging. Industrial applications of forged components

UNIT 2: Forging Operations and Forging Defects (6 Hours)

Closed Die Hammer Forging: Construction and working of forging hammer. Die elements: fuller, edger, blocker, finisher, and bender. Pre-forging and finishing operations. Trimming operations and trimming tools

Press Forging and Cold Forging: Construction and working of forging press. Metal flow in press forging, Principles of upsetting and cold forging. Basic cold forging operations

Forging Defects: Types of forging defects. Causes of defects. Inspection methods. Remedies and preventive measures

UNIT 3: Elements and Classification of Forging Dies (5 Hours)

Elements of Forging Dies: Top die and bottom die. Die impressions: fuller, edger, blocker, finisher. Alignment and reference edges. Sequence of forging operations

Classification of Forging Dies: Open die forging dies. Closed die forging dies. Upsetting dies, Cold forging dies, Extrusion dies. Selection criteria for forging dies.

UNIT 4: Design Parameters of Forging Dies (6 Hours)

Design of Forged Components: Machining allowance, Draft angle, Parting line, Fillets and radii, Web and rib dimensions, Forging tolerances**.**

Design of Forging Tools: Design considerations for fuller, edger, blocker, and finisher, Metal flow considerations. Preparation of simple detail and assembly drawings**.**

Trimming Tools: Introduction to trimming operations. Trimming force concept. Selection of trimming equipment

UNIT 5: Die Materials, Estimation, Maintenance and Safety (6 Hours)

Die Materials and Specifications: Selection of die materials, Specifications of forging tools and machines, Introduction to die heat treatment.

Estimation: Material estimation. Machine time and cycle time estimation. Preparation of simple bill of materials (BOM). Basic cost estimation

Maintenance and Safety: Maintenance of forging dies and tools. Safe handling of dies and forged components. Storage procedures for dies and tools. Safety precautions in forging shop.

INSTRUCTIONAL STRATEGY

The course shall be delivered through lecture-cum-discussion, demonstration, and industry-oriented teaching methods. Models, charts, forging die samples, and multimedia presentations will be used to explain forging operations and die elements. Industrial case studies, drawing interpretation, and problem-solving sessions will help students understand die design concepts and forging defects. Demonstrations of forging equipment, inspection methods, and safety practices will be conducted to develop practical understanding related to forging die manufacturing and maintenance.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Manufacturing Technology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.
2. Manufacturing Engineering and Technology, Pearson Education, New Delhi, 2014.
3. Forging Handbook, Springer Publications, Germany, 2006.
4. Tool Design, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.
5. Fundamentals of Tool Design, SME Publications, Michigan, 2010.
6. Production Engineering, S. Chand & Company Ltd., New Delhi, 2012.
7. Workshop Technology Volume II, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 2006.
8. Manufacturing Processes, Wiley India Pvt. Ltd., New Delhi, 2009.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	5	20
2	6	20
3	5	20
4	6	20
5	6	20
Total	**28**	**100%**

THEORY	5.2 HYDRAULICS & PNEUMATICS	L	T	P
		2	-	-

COURSE OBJECTIVES

After completion of this course, students will be able to:

1. Understand the basic properties and behavior of fluids used in hydraulic and pneumatic systems.
2. Explain principles of fluid flow and fundamental laws used in fluid power systems.
3. Identify components of hydraulic and pneumatic systems and understand their functions.
4. Understand the working of actuators, valves, compressors, pumps, filters, and regulators used in industrial applications.
5. Interpret basic hydraulic and pneumatic circuit diagrams using ISO symbols.
6. Develop knowledge of fluid power applications used in manufacturing and tool room industries.

COURSE OUTCOMES (COS)

CO1: Explain fluid properties, pressure measurement methods, and types of fluid flow used in hydraulic and pneumatic systems.

CO2: Apply basic fluid flow principles such as Pascal's law, continuity equation, and Bernoulli's principle.

CO3: Identify components of hydraulic systems and explain their functions in hydraulic circuits.

CO4: Identify components of pneumatic systems and explain their working and applications.

CO5: Interpret hydraulic and pneumatic symbols, valves, actuators, and basic circuit diagrams used in industrial systems.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	1	-	1	*	*
CO2	3	3	2	1	1	-	1	*	*
CO3	3	2	2	2	1	-	1	*	*
CO4	3	2	2	2	1	-	1	*	*
CO5	3	2	3	3	1	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1. Introduction **(5 Periods)**

Fuid, types of fluid, properties of fluid viz mass density, specific density, viscosity, compressibility, surface tension, capillarity and their units. Pressure and its measurement. Pressure gauges- bourdon tube pressure gauge and mechanical pressure gauges.

UNIT 2. Flow of fluids **(5 Periods)**

Types of fluid flow- steady and unsteady, uniform and non-uniform, laminar and turbulent. Continuity equation, Pascal's law, Bernoulli's statement.

UNIT 3. Components of hydraulic system **(6 Periods)**

Basic components of hydraulic system and function of each component in hydraulic circuit.
Oil reservoirs, motors and pumps, Filters- definitions and purpose, Seals and packing- definition and purpose.

UNIT 4. Components of Pneumatic system **(6 Periods)**

Basic components-function of each component, Air-compressors & its types (introduction and necessity), Air-cylinders (introduction and necessity), Air filters and regulators (introduction and necessity)

UNIT 5. Hydraulic and Pneumatic Circuits **(6 Periods)**

Actuators- introduction and types (single acting and double acting), Valves- introduction and types (check valve, pressure control valve and flow control valve), Concept, Meaning and ISO symbols, Basic hydraulic and pneumatic Circuits-Type, circuit diagrams.

INSTRUCTIONAL STRATEGY

The course shall be delivered through lecture-cum-discussion, demonstration, and practical-oriented teaching methods. Charts, models, multimedia presentations, and industrial components will be used to explain hydraulic and pneumatic systems. Demonstrations of pumps, valves, compressors, actuators, and circuit elements will help students understand working principles and applications. Problem-solving sessions, circuit interpretation exercises, and industrial examples will be used to strengthen analytical and practical understanding of fluid power systems.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Hydraulics and Pneumatics, Jaico Publishing House, Mumbai, 2011.
2. Fluid Power with Applications, Pearson Education, New Delhi, 2014.
3. Hydraulic and Pneumatic Controls, S. Chand & Company Ltd., New Delhi, 2008.
4. Oil Hydraulic Systems, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2009.
5. Pneumatic Systems: Principles and Maintenance, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2005.
6. Industrial Hydraulics, McGraw Hill Publications, New York, 2001.
7. Hydraulics and Fluid Mechanics, Metropolitan Book Company Pvt. Ltd., New Delhi, 2010.
8. Fluid Mechanics and Hydraulic Machines, S. Chand & Company Ltd., New Delhi, 2013.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	5	20
2	5	20
3	6	20
4	6	20
5	6	20
Total	**28**	**100%**

PRACTICUM	5.3 MOULD DESIGN-I	L	T	P
		1	-	2

COURSE OBJECTIVES

After completing this course, students will be able to:

1. Design two-plate moulds with different ejection mechanisms for simple and complex plastic components.
2. Apply design concepts for multi-cavity moulds, runner systems, gating systems, and cooling arrangements.
3. Develop skills in mould component calculations, assembly drafting, and standard mould base selection.

COURSE OUTCOMES (COs)

CO1: Design two-plate moulds using ejector pin mechanisms for plastic components considering shrinkage allowance, draft angle, gating, and cooling systems.
CO2: Design spool moulds using finger-CAM and stripper plate ejection mechanisms for components having undercuts and side-core movements.
CO3: Develop multi-cavity mould designs with balanced runner and gating systems for mass production applications.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	3	3	2	3	1	1	*	*
CO2	3	3	3	2	3	1	1	*	*
CO3	3	3	3	2	3	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Design of Two-Plate Mould using Ejector Pin Mechanism (4 Periods)

Two-Plate Mould Construction, Elements of Two-Plate Mould, Ejector Pin Mechanism, Design Considerations, Calculation and Drafting.
Practical: Design of two-plate mould using ejector pin mechanism

UNIT 2: Design of Spool Mould using Finger-CAM & Stripper Plate Ejection Mechanism (5 Periods)

Introduction to Spool Mould, Finger-CAM Mechanism, Side Core and Undercut Mechanism, Stripper Plate Ejection Mechanism, Mould Construction, Design Procedure.
Practical: Design of spool mould using finger-CAM & stripper plate ejection mechanism

UNIT 3: Design of Two-Plate Mould for Four-Cavity Mould (5 Periods)

Multi-Cavity Moulds, Cavity Layout, Runner and Gate Design, Cooling System Design, Ejection System, Design Calculations, Drafting and Assembly.

Practical: Design of two-plate mould for 4 cavity mould

INSTRUCTIONAL STRATEGY

The instructional strategy for this course should focus on developing both theoretical understanding and practical mould design skills through a balanced combination of classroom teaching, CAD-based practice, industrial exposure, and project-oriented learning. Teaching should begin with fundamental concepts of injection mould construction, mould elements, ejection systems, runner and gating systems, cooling arrangements, and cavity layouts using lectures, charts, animations, and industrial case studies. Demonstration of standard mould components, ejector mechanisms, stripper plate systems, and finger-CAM arrangements should be carried out using physical models and CAD software such as AutoCAD, SolidWorks, and CATIA. Continuous assessment through practical work, CAD exercises, viva-voce, assignments, and sessional tests should be adopted to evaluate students' understanding and design competency.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Injection Mould Design,R.G.W. Pye, 4th Edition, Longman Scientific & Technical / East-West Press, Volume 1, 1989.
2. Injection Molds, Georg Menges, Walter Michaeli, Paul Mohren, 6th Edition, Hanser Publishers, Volume 1, 2001.
3. Injection Mold Design Engineering,David O. Kazmer, 2nd Edition, Hanser Publications, Volume 1, 2016.
4. Plastic Mold Engineering Handbook,Joel Osborne, First Edition, McGraw Hill Publications, Volume 1, 1999.
5. Principles of Plastic Injection Mould Design,Glenn Beall, First Edition, Elsevier Publications, Volume 1, 2012.
6.Tool Design,Cyril Donaldson, George H. Lecain and V.C. Goold, 4th Edition, Tata McGraw Hill Education, Volume 1, 2003.
7. Manufacturing Engineering and Technology, Serope Kalpakjian and Steven Schmid, 7th Edition, Pearson Education, Volume 2, 2014.
8. Plastic Product Material and Process Selection Handbook, Charles A. Harper, First Edition, McGraw Hill Publications, Volume 1, 2005.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	4	30
2	5	35
3	5	35
Total	**14**	**100%**

PRACTICUM	5.4 PRESS TOOL DESIGN-II	L	T	P
		2	-	8

COURSE OBJECTIVES

1. To develop understanding of draw tools, deep drawing operations, and various types of draw tools used in sheet metal industries.
2. To impart knowledge of draw tool elements, drawing calculations, punch and die design, and clearance selection for deep drawing applications.
3. To develop skills in the design and drafting of forming tools used for sheet metal forming operations.
4. To provide practical knowledge of bend allowance, punch and die profile selection, assembly drawing preparation, and BOM generation.
5. To enable students to prepare detailed manufacturing drawings and tool assemblies using standard drafting practices and CAD software.

COURSE OUTCOMES (COs)

CO1: Apply principles of deep drawing and forming operations for designing draw tools and forming tools, including punch, die, clearance, bend allowance, and drawing calculations.
CO2: Prepare detailed component drawings, assembly drawings, and Bill of Materials (BOM) for draw tools and forming tools using standard drafting practices and CAD software.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	3	3	2	3	1	1	*	*
CO2	3	2	3	3	2	2	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Draw Tool Design **(14 Periods)**

Definition and applications of draw tools. Principle of deep drawing operation, Types of Draw Tools, Simple draw tool, Combination draw tool, Redrawing tool, Progressive draw tool. Elements of Draw Tool. Drawing Calculations, Draw Tool Design, Punch and die design, Clearance selection, Design considerations and assembly drawing.

Practical:

1. Sketching and identification of elements of draw tool such as punch, die block, blank holder, stripper, pressure pad, guide pillars, and bushes.
2. Preparation of component drawing for deep drawing operation.

3. Blank development and blank size calculation for drawn components.
4. Calculation of drawing ratio, percentage reduction, and number of draws required.
5. Design calculations for punch and die dimensions considering clearance.
6. Preparation of detailed drawings of draw tool components.
6. Practical assignment on complete forming tool design and detailing.

UNIT 2: Forming Tool Design (14 Periods)

Definition and applications of forming tools. Types of forming operations. Forming Tool Elements. Design of Forming Tool, Design procedure for forming tool, Selection of punch and die profile, Clearance and bend allowance considerations, Drafting of Tool Components, Drafting standards, Detailed drawing of each component, Assembly drawing preparation. Preparation of BOM.

Practical:

1.Sketching and identification of forming tool elements such as punch, die, pressure pad, guide system, and punch holder.
2. Preparation of component drawing for forming operation.
3. Calculation of bend allowance and clearance for forming operation.
4. Selection and design of punch and die profile for forming tool.
5. Preparation of Bill of Materials (BOM) for forming tool assembly.
6. Practical assignment on complete forming tool design and detailing.

INSTRUCTIONAL STRATEGY

The course should be delivered through classroom lectures, design demonstrations, CAD-based drafting practice, numerical problem-solving sessions, and practical assignments to develop theoretical understanding and tool design skills. Teaching should begin with the fundamentals of deep drawing and forming operations using industrial examples, charts, and videos. Demonstration of draw tool and forming tool elements such as punch, die, stripper, pressure pad, guide pillars, and blank holder should be carried out using tool models and sectional drawings. Numerical sessions should focus on blank development, drawing ratio, bend allowance, clearance calculations, and determination of number of draws required. Practical sessions should emphasize preparation of component drawings, detailed tool drawings, assembly drawings, and BOM using drafting standards and CAD software such as AutoCAD, Solid Works, and CATIA. Students should be encouraged to complete practical assignments involving complete draw tool and forming tool design. Industrial visits, seminars, and case studies related to press tool manufacturing industries should be organized to provide practical exposure. Continuous assessment should be conducted through assignments, viva-voce, design exercises, practical work, and sessional examinations.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1.Press Tool Design and Construction,Paquin J.R. and Crowley M.L., Tata McGraw Hill Publications, Volume 1, 2002.
2.Tool Design,Cyril Donaldson, George H. Lecain and V.C. Goold, 4th Edition, Tata McGraw Hill Education, Volume 1, 2003.
3. Die Design Handbook, ASTME, McGraw Hill Publications, 3rd Edition, Volume 1, 1995.

4. Manufacturing Technology – Foundry, Forming and Welding, P.N. Rao, 3rd Edition, McGraw Hill Education, Volume 1, 2013.
5. Pressworking Principles and Practices, Shiro Kobayashi and Soo-Ik Oh, Oxford University Press, Volume 1, 2000.
6. Sheet Metal Work, K.R. Gopalakrishna, Subhas Stores Publications, Volume 1, 2011.
7. Engineering Drawing, N.D. Bhatt and V.M. Panchal, 53rd Edition, Charotar Publishing House, Volume 1, 2016.
8. Production Technology, HMT Limited, Tata McGraw Hill Publications, Volume 2, 2001.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	14	50
2	14	50
Total	**28**	**100%**

PRACTICUM	5.5 CNC & CAM PROGRAMING	L	T	P
		1	-	2

COURSE OBJECTIVES

1. To develop understanding of engineering drawings, dimensioning methods, tolerances, fits, and GD&T used in manufacturing industries.
2. To enable students to interpret assembly drawings, detail drawings, and manufacturing standards according to BIS/ISO practices.
3. To develop knowledge of CNC/VMC machine architecture, machine components, and CNC controller systems.
4. To provide fundamentals of CNC programming, simulation, CAM, and post processing for turning and milling operations.
5. To develop practical skills in tolerance analysis, GD&T application, CNC programming, and virtual machining simulation.
6. To prepare students for modern manufacturing environments involving CAD/CAM and CNC technologies.

COURSE OUTCOMES (COs)

CO1: Apply engineering drawing standards, dimensioning methods, tolerances, fits, and GD&T concepts for interpretation and preparation of manufacturing drawings.
CO2: Develop CNC turning and milling programs and perform CNC simulation, verification, CAM, and post processing using CNC/VMC machine concepts and controllers.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	3	2	2	3	1	1	*	*
CO2	3	3	3	3	3	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Engineering Drawings, Dimensioning and Tolerancing (7 periods)

Importance of engineering drawings in manufacturing, Types of drawings: Assembly drawing, Part drawing, Detail drawing, Exploded view drawing, Drawing standards and conventions. Principles of dimensioning, Linear dimensioning, Angular dimensioning, Chain and baseline dimensioning, Coordinate dimensioning, Dimensioning standards as per BIS/ISO. Tolerances and Fits, Need for tolerances in manufacturing, Types of tolerances: Unilateral tolerance, Bilateral tolerance, Limit dimensions, Tolerance accumulation, Types of fits: Clearance fit, Transition fit, Interference fit, Hole basis and shaft basis systems. Geometric Dimensioning and Tolerancing (GD&T)

Practicals:

1. Identification and classification of manufacturing drawings.
2. Practice on dimensions, tolerances, symbols, and annotations.
3. Application of various dimensioning techniques on industrial drawings.

4. Tolerance analysis exercises on machine components.
5. Study of fit conditions using case studies.
6. Preparation and interpretation of section views.
7. Assignment of tolerances to holes, shafts, and surfaces.
8. Tolerance stack-up analysis for assemblies.
9. Application of GD&T symbols on industrial drawings.
10. Identification and analysis of different types of fits in assemblies.

UNIT 2: CNC / VMC Machine Architecture and Controllers (7 periods)

Introduction to CNC and VMC Machines, Architecture of CNC / VMC Machine, Machine structure and components: Machine bed, Spindle system, Axis drive system, Tool magazine and ATC, Servo motors, Ball screw mechanism, Control panel, Working principle of CNC/VMC machine. CNC Controllers: Introduction to CNC controllers, Types of controllers: Fanuc and Siemens, Functions and features of controllers, Significance of controllers in CAM post processing, work offsets. Turning and Milling Programming, CNC Simulation and Verification, CAM and Post Processing.

Practicals:

1. Study of CNC/VMC machine architecture using machine simulator.
2. Identification of CNC machine components and functions.
3. Study of different CNC controllers using simulators.
4. Practice on basic G-codes and M-codes.
5. Development of virtual turning programs.
6. Simulation of turning operations.
7. Development of virtual milling programs.
8. Simulation of milling operations.
9. Tool path verification using CAM software.
10. Generation and checking of CNC post-processed programs using simulator software.

INSTRUCTIONAL STRATEGY

The course should be delivered through a combination of classroom lectures, CAD/CAM demonstrations, CNC simulation practice, industrial case studies, and hands-on exercises to develop both theoretical knowledge and practical competency. Teaching should begin with engineering drawing standards, dimensioning practices, tolerances, fits, and GD&T concepts using industrial drawings and real manufacturing examples. Demonstration of assembly drawings, section views, tolerance analysis, and GD&T applications should be carried out through drawing sheets and CAD software. Practical sessions should include interpretation of manufacturing drawings, tolerance stack-up analysis, and application of GD&T symbols on industrial components. For CNC/VMC topics, machine simulators and multimedia demonstrations should be used to explain machine architecture, spindle systems, servo drives, ATC mechanisms, and CNC controllers such as Fanuc and Siemens. Students should practice CNC turning and milling programming using G-codes and M-codes through virtual machining software and CAM packages.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Engineering Drawing: N.D. Bhatt and V.M. Panchal, 53rd Edition, Charotar Publishing House, Volume 1, 2016.
2. A Textbook of Engineering Drawing,R.K. Dhawan, S. Chand Publications, Volume 1, 2018.
3. Geometric Dimensioning and Tolerancing, David A. Madsen, Delmar Cengage Learning, 8th Edition, Volume 1, 2017.

4. CNC Programming Principles and Applications, Mike Mattson, Delmar Cengage Learning, Volume 1, 2010.
5. Computer Numerical Control, HMT Limited, Tata McGraw Hill Publications, Volume 1, 2004.
6. CAD/CAM Principles and Applications, P.N. Rao, 4th Edition, McGraw Hill Education, Volume 1, 2020.
7. CNC Control Setup for Milling and Turning, Peter Smid, Industrial Press Inc., Volume 1, 2012.
8. Automation, Production Systems and Computer Integrated Manufacturing, Mikell P. Groover, 4th Edition, Pearson Education, Volume 2, 2015.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	7	50
2	7	50
Total	**14**	**100%**

THEORY	5.6.1 PRODUCTION PLANNING, CONTROL & COST ESTIMATION (P.E.-III)	L	T	P
		2	-	-

COURSE OBJECTIVES

1. To develop understanding of production systems, productivity concepts, and techniques for productivity improvement in manufacturing industries.
2. To impart knowledge of production planning activities such as inventory control, material planning, process planning, routing, scheduling, and production control.
3. To enable students to understand utilization of resources such as man, machine, and material for effective production management.
4. To develop understanding of cost concepts, overheads, depreciation methods, and break-even analysis used in industrial organizations.
5. To provide knowledge and practical skills related to job costing, production estimation, and preparation of estimated manufacturing costs.
6. To prepare students for industrial applications in production planning, production control, costing, and manufacturing management systems.

COURSE OUTCOMES (COs)

CO1: Explain different types of production systems, productivity concepts, and techniques for productivity improvement used in manufacturing industries.
CO2: Apply inventory control techniques, material planning methods, and process planning procedures for effective production management.
CO3: Perform routing, scheduling, loading, dispatching, and production control activities using industrial planning tools and charts.
CO4: Analyze various elements of cost, overheads, depreciation methods, and break-even analysis for manufacturing organizations.
CO5: Prepare job cost estimation by interpreting engineering drawings, estimating material cost, operation time, overhead expenses, and total manufacturing cost.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	2	1	1	*	*
CO2	3	3	2	2	3	2	1	*	*
CO3	3	3	3	2	3	2	1	*	*
CO4	3	3	2	1	3	2	1	*	*
CO5	3	3	3	2	3	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Production System & Productivity (5 Periods)

Production and Methods of Production, Types of production: Job production, Batch production, Mass production, Productivity, Concept and importance of productivity, Factors affecting, productivity, Techniques for productivity improvement.

UNIT 2: Production Planning (6 Periods)

Stores & Inventory Control: Functions of stores and store layout, Centralized and decentralized stores, Inventory control techniques: Economic Order Quantity (EOQ), ABC analysis, Inventory control for cost reduction.

Material Planning: Concept of material planning, Master Production Schedule (MPS), Bill of Materials (BOM, Material Requirement Planning (MRP), Operating cycle.

Process Planning: Concept and importance of process planning, Information required for process planning, Selection of manufacturing processes, Machine selection and capacity planning, Preparation of route sheets and operation sheets.

UNIT 3: Production Control (5 Periods)

Routing and Scheduling: Concepts of routing and scheduling, Types of scheduling, Critical ratio scheduling, Use of charts (Gantt charts, control charts).

Loading, Dispatching & Follow-up: Concepts of loading, dispatching, and follow-up, Job cards and progress cards, Production monitoring and control, Value analysis and audit, Utilization of man, machine, and material.

UNIT 4: Elements of Cost (6 Periods)

Types of cost: Fixed cost, Variable cost, Material cost, Labour cost , Prime cost and factory cost, Break-even analysis (concept and graphical method). Overheads & Depreciation, Types of overheads and allocation methods, Depreciation methods: Straight line method, Sinking fund method .

UNIT 5: Cost Estimation (6 Periods)

Components of Job Estimation: Concept of cost estimation, Pricing, profit, and loss, Elements of job costing, Selection of machines and resources.

Estimation Procedure: Interpretation of engineering drawings, Estimation of material cost, Time estimation for operations, Calculation of overhead expenses, Preparation of total estimated cost.

INSTRUCTIONAL STRATEGY

The course should be delivered through a combination of classroom teaching, industrial case studies, numerical problem-solving sessions, group discussions, and practical exercises related to production planning and cost estimation. Teaching should begin with the fundamentals of production systems, productivity concepts, and different methods of production using industrial examples and case studies. Concepts of stores management, inventory control, EOQ, ABC analysis, MRP, process planning, routing, scheduling, loading, dispatching, and follow-up should be explained through charts, industrial formats, and real production documents. Numerical exercises should be conducted for EOQ calculations, break-even analysis, depreciation methods, material planning, and job costing to strengthen analytical skills. Demonstrations of production planning formats such as route sheets, operation sheets, Gantt charts, job cards, and BOM should be included during practical sessions. Industrial visits and seminars related to manufacturing industries, production departments, and inventory systems should be organized to provide practical exposure. Assignments, mini-projects, and case studies related to production control and cost estimation should be encouraged to develop managerial and decision-making abilities. Continuous assessment should be carried out through tutorials, assignments, viva-voce, unit tests, and numerical problem-solving exercises.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Production Planning and Control,S. K. Mukhopadhyay, 2nd Edition, PHI Learning Pvt. Ltd., Volume 1, 2015.
2. Industrial Engineering and Production Management, Martand Telsang, 8th Edition, S. Chand Publications, Volume 1, 2018.
3. Production and Operations Management, R. Paneerselvam, 3rd Edition, PHI Learning Pvt. Ltd., Volume 1, 2012.
4. Production Planning and Industrial Management, O.P. Khanna, Dhanpat Rai Publications, Volume 1, 2010.
5. Elements of Costing, N.K. Prasad, Book Syndicate Pvt. Ltd., Volume 1, 2014.
6. Cost Accounting Principles and Practice, M.N. Arora, 12th Edition, Vikas Publishing House, Volume 1, 2016.
7. Manufacturing Planning and Control for Supply Chain Management, F. Robert Jacobs and William Berry, 6th Edition, McGraw Hill Education, Volume 2, 2011.
8. Operations Management, S.N. Chary, 6th Edition, Tata McGraw Hill Education, Volume 1, 2019.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	5	20
2	6	20
3	5	20
4	6	20
5	6	20
Total	**28**	**100%**

THEORY	5.6.2 MECHATRONICS (P.E-III)	L	T	P
		2	-	-

COURSE OBJECTIVES:
To equip with the comprehensive ability to integrate mechanical, electronic, and fluid power systems by analyzing and designing solutions using sensors, controllers (PLC/PID), drives, and hydraulic/pneumatic circuits for industrial automation.

COURSE OUTCOMES (CO):
At the end of the course, the student will be able to:
CO1: Explain the fundamentals of mechatronics systems, their architecture, and real-time applications.
CO2: Select appropriate sensors, transducers, and controllers for data conversion and signal processing in automation.
CO3: Discuss the operation and application of electrical drives and mechanical mechanisms.
CO4: Design hydraulic circuits by selecting suitable pumps, valves, and actuators to meet specific force and speed requirements.
CO5: Develop pneumatic system designs using standard graphic symbols and explain the production, distribution, and conditioning of compressed air.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	-	1	-	1	*	*
CO2	3	2	2	2	-	-	2	*	*
CO3	3	1	1	2	-	-	1	*	*
CO4	3	2	2	2	-	1	1	*	*
CO5	3	2	2	2	1	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

Unit – I: Introduction to Mechatronics **(5 Periods)**
Introduction to System Concepts, Analysis and Design, Mechatronics basic definitions; systems and components; Systems with mixed disciplines, Electronics Fundamentals Review.

Unit – II: Elements in Mechatronics **(8 Periods)**
Data conversion devices, sensors, micro-sensors, transducers, signal processing devices, timers; Microprocessors, Microcontrollers, PID Controllers and PLCs

Unit – III: Drives **(5 Periods)**
Stepper Motors, Servo Drives, Linear Motion bearings, cams; Systems controlled by camshafts, electronic cams, Tool magazines and indexing mechanisms.

Unit – IV: Hydraulic Systems **(5 Periods)**
Flow, Pressure and Direction Control Valves, Actuators, Supporting Elements, Hydraulic Power Packs, Pumps; Design of Hydraulic circuits

Unit – V: Pneumatic System **(5 Periods)**
Production, Distribution and conditioning of compressed air; System Components and Graphic representations; Design of Systems.

RECOMMENDED BOOKS:

1. Analysis and design of Dynamic Systems Cochin, Era and Cadwallender, Addison Wesley, 1997
2. Mechatronics Engineering Tomkinson, D. And Horne, J. Longman McGraw Hill, 1996
3. Mechatronics Bolton, W, Pearson Prentice Hall edition, 2008.
4. Fundamental of mechatronic M. Jouaneh Cengage Learning ISBN – 978-1111569020
5. Mechatronics – An Integrated Approach Clarence W. de Silva CRC Press ISBN – 978-0849312748

SUGGESTED SOFTWARE/LEARNING WEBSITES:

1. https://youtu.be/Ro_tFv1iH6g
2. https://www.motioncontroltips.com/faq-what-are-stepper-drives-and-how-do-they-work/
3. https://science.howstuffworks.com/robot.htm
4. https://howtomechatronics.com

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	05	20
II	08	23
III	05	20
IV	05	20
V	05	17
Total	**28**	**100**

THEORY	5.7.1 ECONOMIC POLICIES IN INDIA (O.E-II)	L	T	P
		2	-	-

COURSE OBJECTIVES:

The objective of this course is to familiarize the students of different streams with the basic concepts, structure, problems and issues concerning Indian economy.

COURSE OUTCOMES(CO):

CO1: Explain the basic features of the Indian economy, including demographic trends, and analyze major economic problems like poverty, unemployment, and inflation.

CO2: Discuss the role of the agricultural sector, the impact of land reforms and the Green Revolution, and evaluate current agricultural policies.

CO3: Describe the industrial development pattern, the significance of small-scale industries, and the growth of the service sector in India.

CO4: Analyze the framework of economic planning (Planning Commission vs. NITI Aayog), and the impact of Monetary, Fiscal, and LPG policies.

CO5: Interpret India's external sector performance, including foreign trade composition, Balance of Payments, and the impact of Globalization and WTO.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	1	2	-	-	2	1	2	*	*
CO2	1	2	-	-	2	1	1	*	*
CO3	1	1	-	-	2	2	2	*	*
CO4	1	2	-	-	3	3	2	*	*
CO5	1	2	-	-	2	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT

Unit – 1: Basic features and problems of Indian Economy: (8 Periods)

Economic History of India; Nature of Indian Economy, demographic features and Human Development Index, Problems of Poverty, Un employment, Inflation, income inequality, Black money in India.

Unit – 2: Sectorial composition of Indian Economy: (5 Periods)

Issues in Agriculture sector in India, land reforms Green Revolution and agriculture policies of India,

Unit – 3: (4 Periods)

Industrial development, small scale and cottage industries, industrial Policy, Public sector in India,

service sector in India.

Unit – 4: Economic Policies: **(6 Periods)**
Economic Planning in India, Planning commission v/s NITI Aayog, Five Year Plans, monetary policy in India, Fiscal Policy in India, Centre state Finance Relations, Finance commission in India. LPG policy in India.

Unit – 5: External sector in India: **(5 Periods)**
India's foreign trade value composition and direction, India Balance of payment since 1991, FDI in India, Impact of Globalization on Indian Economy, WTO and India.

RECOMMENDED BOOKS:

1. Dutt Rudder and K.P.M Sunderam (2017). Indian Economy. S Chand & Co. Ltd. New Delhi.
2. Mishra S.K & V.K Puri (2017). Indian Economy and –Its Development Experience. Himalaya Publishing House.
3. Singh, Ramesh, (2016): Indian Economy, Tata-McGraw Hill Publications, New Delhi.
4. Dhingra, I.C., (2017): March of the Indian Economy, Heed Publications Pvt. Ltd.
5. Karam Singh Gill, (1978): Evolution of the Indian Economy, NCERT, New Delhi
6. Kaushik Basu (2007): The Oxford Companion to Economics of India, Oxford University Press.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	08	23
2	05	20
3	04	17
4	06	20
5	05	20
Total	**28**	**100**

THEORY	5.7.2 PROJECT MANAGEMENT (O.E-II)	L	T	P
		2	-	-

COURSE OBJECTIVES:
The aim of this course is to help the students to develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.

COURSE OUTCOMES(CO):
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:
CO1: Explain the fundamental concepts of project management, including the project life cycle and priorities, and construct a Work Breakdown Structure (WBS) for a given project.
CO2: Apply the capital budgeting process to generate and screen project ideas and analyze market feasibility using demand forecasting techniques.
CO3: Estimate project costs, working capital requirements, and prepare projected financial statements including Cash Flow and Break-Even analysis.
CO4: Evaluate the financial viability of projects using discounting (NPV, IRR) and non-discounting (Payback, ARR) capital budgeting techniques and social cost-benefit analysis.
CO5: Develop project schedules using Network Planning techniques (CPM/PERT) to analyze time-cost trade-offs and determine the least cost duration.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	2	1	1	-	-	3	1	*	*
CO2	2	2	-	-	1	3	2	*	*
CO3	2	2	-	-	-	3	1	*	*
CO4	2	2	-	-	2	3	2	*	*
CO5	2	3	1	2	-	3	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT

UNIT-I: Concept of a project: **(4 Periods)**

Classification of projects- importance of project management- The
project life cycle- establishing project priorities (scope-cost-time) project priority matrix- work break down structure.

UNIT-II: Capital budgeting process: **(6 Periods)**

Planning- Analysis-Selection-Financing-Implementation-Review.
Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process- Technical analysis

UNIT-III: Financial estimates and projections: **(6 Periods)**

Cost of projects-means of financing-estimates of sales and production-cost of production-working capital requirement and its financing-profitability , projected cash flow statement and balance sheet. Break even analysis.

UNIT-IV: Basic techniques in capital budgeting: **(6 Periods)**

Non discounting and discounting methods- payback period- Accounting rate of return-net present value-Benefit cost ratio-internal rate of return.
Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects**.**

UNIT-V: Project administration: **(6 Periods)**

Progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress,
time-cost trade off.
Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms. Determination of least cost duration. Post project evaluation.
Introduction to various Project management software.

INSTRUCTIONAL STRATEGY
Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial and start- up qualities in the students.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term written tests
- Model/Proto type making.

RECOMMENDED BOOKS:

1. Project planning, analysis, selection, implementation and review – Prasannachandra – Tata McGraw Hill
2. Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson – McGraw Hill
3. Project management - David I Cleland - Mcgraw Hill International Edition, 1999
4. Project Management – Gopala krishnan – Mcmillan India Ltd.
5. Project Management-Harry-Maylor-Peason Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	04	18
II	06	22
III	06	20
IV	06	20
V	06	20
Total	**28**	**100**

AUDIT COURSE	5.8 INDIAN CONSTITUTION	L	T	P
		2	-	-

COURSE OBJECTIVES:

To provide a comprehensive understanding of the Indian Constitution's history and philosophy, and to familiarize them with the administrative structure, powers, and functions of the Union, State, and Local governments, along with the Judiciary and Election Commission.

COURSE OUTCOMES:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

CO1: Explain the making of the Indian Constitution, interpret the Preamble, and discuss the significance of Fundamental Rights and Duties.

CO2: Describe the structure of the Union Executive, detailing the powers and roles of the President, Prime Minister, and Council of Ministers.

CO3: Distinguish between the functions of the Lok Sabha and Rajya Sabha and explain the jurisdiction and structure of the Supreme Court.

CO4: Discuss the administrative framework of State Governments, focusing on the roles of the Governor, Chief Minister, and State Secretariat.

CO5: Outline the hierarchy and functions of Local Administration, including District Administration, Municipal Corporations, and Zila Panchayats.

CO6: Examine the structure of the Election Commission of India and its critical role in conducting free and fair elections.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	-	-	-	-	3	1	3	*	*
CO2	-	-	-	-	2	2	2	*	*
CO3	-	-	-	-	3	1	2	*	*
CO4	-	-	-	-	2	2	2	*	*
CO5	-	-	-	-	3	2	2	*	*
CO6	-	-	-	-	3	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT

Unit – I: The Constitution – Introduction **(06 Periods)**
The History of the Making of the Indian Constitution
Preamble and the Basic Structure, and its interpretation
Fundamental Rights and Duties and their interpretation

Unit – II: Union Government **(06 Periods)**
Structure of the Indian Union Government
President – Election, Role and Power
Prime Minister and Council of Ministers

Unit – III: Indian Legislature & Judiciary **(06 Periods)**
Composition of Lok Sabha and Rajya Sabha
Powers & Functions of Lok Sabha and Rajya Sabha
Structure of Supreme Court including Appointment of Judges
Powers & Functions of Supreme Court

Unit – IV: State Government **(03 Periods)**
Governor – Role and Power
Chief Minister and Council of Ministers State Secretariat

Unit – V: Local Administration **(04 Periods)**
District Administration
Municipal Corporation
Zila Panchayat

Unit – VI: Election Commission **(03 Periods)**
Structure of Election Commission of India
Role and Function of Election Commission

INSTRUCTIONAL STRATEGY
Teach the Indian Constitution through interactive methods like case studies, debates, and role-plays to engage students. Use visuals and simplified texts to explain key features like fundamental rights and duties. Encourage discussions on amendments and landmark judgments. Incorporate quizzes and group projects to foster critical thinking and civic awareness.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS:

1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2. The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition
4. Our Constitution Subhash Chand Kashyap NBT New Delhi.

SUGGESTED SOFTWARE/LEARNING WEBSITES:

1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/
5. https://ncert.nic.in/textbook.php

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	06	21
II	06	21
III	06	21
IV	03	11
V	04	15
VI	03	11
Total	**28**	**100**

THEORY/PRACTICAL	6.1 DIE CASTING THEORY & DESIGN	L	T	P
		1	-	2

COURSE OBJECTIVES

1. To develop understanding of casting technology, die casting principles, terminology, and industrial applications of die casting processes.
2. To impart knowledge of hot chamber and cold chamber die casting machines, their construction, working principles, and selection criteria.
3. To develop skills in die design including gating systems, ejection systems, core mechanisms, draft angles, and die material selection.
4. To provide understanding of die casting alloys, melting practices, operational cycles, and molten metal treatment processes.
5. To enable students to identify casting defects, analyze their causes, apply remedial measures, and understand die maintenance practices for improving die life and casting quality.

COURSE OUTCOMES (COs)

CO1: Explain the principles of casting, die casting processes, terminology, and industrial applications of die casting technology.
CO2: Describe the construction, working principles, components, and selection criteria of hot chamber and cold chamber die casting machines.
CO3: Apply die design concepts related to gating systems, ejection systems, cores, draft angles, radii, and die materials for die casting applications.
CO4: Analyze die casting materials, melting methods, molten metal treatment processes, and operational cycles used in die casting industries.
CO5: Identify casting defects, analyze their causes, recommend corrective measures, and explain die maintenance practices for improving casting quality and die life.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	2	1	1	*	*
CO2	3	2	2	2	3	1	1	*	*
CO3	3	3	3	2	3	1	1	*	*
CO4	3	3	2	2	3	1	1	*	*
CO5	3	3	3	1	3	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

DETAILED CONTENTS

UNIT 1: Introduction to Casting and Die Casting (3 Periods)

Principles of casting technology, advantages and limitations of casting, and its application in industrial scenarios. Definition of die casting, pressure die casting, gravity die casting, and its

distinction from sand casting. Terminology used in die casting such as parting line, runner, gate, ejector, and core.

Practicals:
1. Study of different casting processes and identification of casting products.
2. Comparative study of sand casting, pressure die casting, and gravity die casting processes.
3. Demonstration of basic casting operations using models or videos.

UNIT 2: Die Casting Machines (3 Periods)
Hot Chamber Machine: Principle, working, components, and applications (mainly for low-melting-point alloys).
Cold Chamber Machine: Principle, working, components, and applications (mainly for aluminum/copper alloys).
Machine Selection: Factors influencing the choice of machine, capacity calculation, and locking force mechanism.

Practicals:
1. Study of major components of hot chamber die casting machine.
2. Study of major components of cold chamber die casting machine.

UNIT 3: Die Design Elements (3 Periods)
Die Materials: Selection of materials for dies (die steel), heat resistance, and thermal fatigue.
Gating and Risering: Design of sprue, runner, and gate, types of gating systems, feeding systems, and directional solidification.
Ejection System: Types of ejectors (pins, plates), ejector plate mechanism.
Cores: Core pulling mechanisms (mechanical and hydraulic), side cores.
Draft and Radii: Designing for draft angles and generous fillets/radii to facilitate material flow &removal.

Practicals:
1. Study of die materials and their properties used in die casting industries.
2. Design and sketching of gating systems including sprue, runner, and gate.

UNIT 4: Die Casting Materials and Processes (3 Periods)
Alloys Used: Characteristics of alloys used in die casting (Zinc, Aluminum, Magnesium, Copper).
Melting and Treatment: Melting furnaces (crucible, induction), metal handling, degassing, and modification of molten metal.
Operational Cycle: Step-by-step process: Closing, Injection, Cooling, Opening, and Ejection.

Practicals:
1. Preparation of process flow chart for die casting operation.

UNIT 5: Casting Quality, Defects, and Maintenance (2 Periods)
Defects: Detailed analysis of casting defects (porosity, misrun, cold shut, shrinkage, flashing) and their causes. Remedies for casting defects.
Die Maintenance: Preventative maintenance, lubrication of dies, and die life extension.

Practicals:
1. Identification and analysis of casting defects such as porosity, misrun, cold shut, shrinkage, and flashing using industrial samples.
2. Study of causes and remedies for common die casting defects.
3. Preparation of defect analysis charts and corrective action reports.

INSTRUCTIONAL STRATEGY

The course should be delivered through classroom lectures, industrial case studies, demonstrations, practical exercises, and multimedia presentations to develop theoretical understanding and industrial knowledge of die casting technology. Teaching should begin with the fundamentals of casting processes, die casting principles, and industrial applications using charts, videos, and real casting samples. Demonstrations of hot chamber and cold chamber die casting machines should be carried out using machine models, animations, and industrial videos to explain machine components, operational cycles, and locking mechanisms. Die design concepts such as gating systems, ejection systems, side cores, draft angles, and die materials should be explained through sectional drawings, CAD models, and industrial examples. Practical sessions should focus on defect identification, gating layout studies, die component analysis, and calculation exercises related to machine capacity and locking force. Industrial visits to foundries and die casting industries should be organized to expose students to actual die casting operations, melting practices, and quality control methods. Group discussions, seminars, assignments, and mini-projects related to casting defects, die maintenance, and process optimization should be encouraged to improve analytical and problem-solving abilities. Continuous assessment should include assignments, viva-voce, practical observations, unit tests, and case study analysis.

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

Practical/Laboratory Topics

- Practice on 3-D model software (Solidworks/ Creo/ UG/ Catia) used for die casting die design.
- Design and drawing of a die casting die for a simple component(ceiling fan cover) using solid model software (Solidworks/ Creo/ UG/ Catia).
- Drafting of part drawing and preparation of BOM.

RECOMMENDED BOOKS

1.Die Casting Engineering: A Hydraulic, Thermal and Mechanical Process, Benny Paul, Marcel Dekker Inc., Volume 1, 1989.
2. Principles of Metal Casting, Richard W. Heine, Carl R. Loper and Philip C. Rosenthal, Tata McGraw Hill Publications, 2nd Edition, Volume 1, 2006.
3. Die Casting Design and Processes, George W. Service, Society of Manufacturing Engineers (SME), Volume 1, 2007.
4. Foundry Technology, Peter Beeley, 2nd Edition, Butterworth-Heinemann Publications, Volume 1, 2001.
5. Manufacturing Technology – Foundry, Forming and Welding, P.N. Rao, 3rd Edition, McGraw Hill Education, Volume 1, 2013.
6. Fundamentals of Metal Casting, Ravi B. Khanna, Dhanpat Rai Publications, Volume 1, 2014.
7. Metal Casting: Principles and Practice,T.V. Ramana Rao, New Age International Publishers, Volume 1, 2007.
8. Manufacturing Engineering and Technology, Serope Kalpakjian and Steven Schmid, 7th Edition, Pearson Education, Volume 2, 2014.

SUGGESTED DISTRIBUTION OF MARKS

TOPIC NO .	TIME ALLOTTED (HRS.)	MARKS ALLOTTED (%)
1	3	20
2	3	20
3	3	20
4	3	20
5	2	20
TOTAL :	**14**	**100%**

CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

THEORY	6.2 ENTREPRENEURSHIP AND START-UPS	L	T	P
		2	-	-

COURSE OBJECTIVES:

To foster an entrepreneurial mind set by equipping students with the skills to identify business opportunities, formulate comprehensive business plans, understand management functions, and navigate the financial and legal landscapes of starting and sustaining a venture.

COURSE OUTCOMES:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

CO1: Explain the concept of entrepreneurship, classify business structures, and distinguish between the roles of an entrepreneur and manager.

CO2: Identify feasible business ideas using activity maps and develop a preliminary Business Plan based on case study analysis.

CO3: Analyze market strategies using STP and SWOT analysis, and formulate the Vision, Mission, and Objectives for a start-up.

CO4: Discuss the fundamental functions of management, organizational structures, and the processes of recruitment, selection, and training.

CO5: Select appropriate financing methods (Govt schemes, Venture Capital) and apply Intellectual Property Rights (IPR) concepts to protect business ideas.

CO6: Describe the strategies for business succession, harvesting, and the legal types of dissolution.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	-	-	-	-	2	3	2	*	*
CO2	-	2	2	-	1	3	2	*	*
CO3	-	2	2	-	2	3	2	*	*
CO4	-	-	-	-	1	3	1	*	*
CO5	-	2	-	-	2	3	2	*	*
CO6	-	-	-	-	1	3	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

UNIT- 1: Introduction to Entrepreneurship and Start – Ups **(05 Periods)**

Definitions, Classification of Entrepreneur
Traits of an Entrepreneur, Intrapreneurship, Motivation
Types of Business Structures- On the Basis of size and on the basis of ownership
Similarities/differences between entrepreneurs and managers

UNIT- 2: Business Ideas and their implementation **(04 Periods)**

Discovering ideas and visualizing the business
Activity map
Business Plan (Case Study)

UNIT- 3: Ideas to Start-up **(08 Periods)**

Marketing and Accounting- Definition and Importance.
Market Analysis – STP (Segmentation, Targeting, Positioning)
Competition evaluation and Strategy Development – Vision, Mission, Goal, Objectives.
Risk analysis- SWOT Analysis.

UNIT – 4: Management **(06 Periods)**

Definition Concept and Functions of Management
Company's Organization Structure- Concept and Classification
Recruitment and Selection- Definition, Training and Development- Importance.

UNIT – 5: Financing and Protection of Ideas **(03 Periods)**

Financing methods available for Entrepreneurship/ Startups in India (Government Scheme, Banking, NBFCs, SHG and Micro Financing).
Intellectual Property Rights- Overview of - Copyrights, Trademark, Geographical Indicators, Patenting and Licenses
Communication of Ideas to potential investors – Investor Pitch.

UNIT – 6: Succession, Dissolution and Harvesting strategy **(02 Periods)**

Ways of succession
Types of Dissolution

INSTRUCTIONAL STRATEGY

Entrepreneurship and start-ups include use experiential learning, integrate real-world projects, provide mentorship, foster interdisciplinary collaboration, partner with businesses, invite industry professionals for lectures, organize business plan competitions, offer practical consulting opportunities, and help students launch real ventures to build entrepreneurial skills and mindsets.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/Prototype making.

RECOMMENDED BOOKS:

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company – Steve Blank and Bob Dorf, K & S Ranch, ISBN: 978-0984999392
2. Entrepreneurship Development (A New Venture Creation) – Vasant Desai, Himalaya Publishing House
3. Entrepreneurship Development – S.S. Khanka, S. Chand & Company Ltd., New Delhi
4. Entrepreneurship Development – Gupta and Srinivasan, S. Chand & Company Ltd., New Delhi

5. Demand: Creating What People Love Before They Know They Want It – Adrian J. Slywotzky with Karl Weber, Headline Book Publishing, ISBN: 978-0755388974
6. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses – Eric Ries, Penguin UK, ISBN: 978-0670921607
7. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business – Clayton M. Christensen, Harvard Business Review Press, ISBN: 978-1422196021

SUGGESTED SOFTWARE/LEARNING WEBSITES:

1. https://www.fundable.com/learn/resources/guides/startup
2. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/
3. https://www.finder.com/small-business-finance-tips
4. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/
5. NPTEL Course on Entrepreneurship https://onlinecourses.nptel.ac.in/noc23_mg74/preview
6. National Geographic Channel you tube Video on "GI Tag Crafts of Bharat"

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	05	15
II	04	15
III	08	25
IV	06	20
V	03	10
VI	02	15
Total	**28**	**100**

THEORY	6.3 QUALITY MANAGEMENT	L	T	P
		1	-	-

COURSE OBJECTIVES:

The objective of this course is to provide diploma students with fundamental knowledge of Total Quality Management (TQM), quality improvement techniques, statistical quality tools, quality standards, and continuous improvement practices used in modern industries. The course aims to develop skills required for quality assurance, process control, customer satisfaction, and industrial productivity in manufacturing and service sectors.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1: Understand the concepts, principles, and importance of Total Quality Management in industries

CO2: Apply quality control tools and statistical techniques for process improvement and defect reduction.

CO3: Understand quality assurance systems, ISO standards, and quality auditing practices.

CO4: Analyze continuous improvement techniques such as Kaizen, Six Sigma, Lean Manufacturing, and 5S practices.

CO5: Develop awareness of modern industrial quality practices, customer satisfaction, sustainability, and Industry 4.0 quality concepts

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	1	2	1	1	*	*
CO2	3	3	2	3	1	1	1	*	*
CO3	2	2	2	3	2	2	1	*	*
CO4	2	3	3	2	3	2	2	*	*
CO5	2	2	2	2	3	2	3	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

UNIT 1: Introduction to Total Quality Management (3 Periods)

Concept of Quality, Definitions of Quality, Evolution of Quality Management, Inspection, Quality Control, Quality Assurance, TQM, Principles of TQM, Customer Satisfaction and Customer Focus, Quality Costs, Benefits of TQM,

Quality Gurus: Deming, Juran, Crosby, Kaoru Ishikawa

UNIT 2: Quality Control Tools and Techniques (3 Periods)

Seven Basic Quality Tools: Cause and Effect Diagram, Pareto Chart, Histogram, Check Sheet, Scatter Diagram, Control Chart, Flow Chart

Statistical Process Control (SPC), Process Capability, Acceptance Sampling, Introduction to Quality Circles

UNIT 3: Quality Standards and Quality Assurance (3 Periods)

Quality Assurance Concepts, ISO 9001: Quality Management System, ISO 14001: Environmental Management System, Occupational Health and Safety Basics, Documentation in Quality Systems

Quality Audit: Internal Audit, External Audit, Calibration and Maintenance Practices

UNIT 4: Quality Improvement Techniques and Case Studies (3 Periods)

Benchmarking, Root Cause Analysis, Failure Mode and Effect Analysis (FMEA), Quality Circles, Supplier Quality Management, Customer Complaint Handling, Industrial Case Studies

UNIT 5: Modern Quality Management (2 Periods)

ISO 9001:2015 Fundamentals, Documentation and Audits, Lean Manufacturing, Six Sigma Basics, TPM (Total Productive Maintenance), Sustainability and Green Quality Practices.

INSTRUCTIONAL STRATEGY

Interactive lectures using chalk-board, PPTs, and multimedia tools. Explanation of TQM concepts with real industrial examples. Discussion on current quality practices in manufacturing and service industries.

MEANS OF ASSESSMENT

1. Assignments and quiz/class tests
2. Sessional test
3. Viva-voce

RECOMMENDED BOOKS:

1. Dale H. Besterfield, “Total Quality Management”, Pearson Education.
2. Subburaj Ramasamy, “Total Quality Management”, Tata McGraw-Hill Education.
3. Kanishka Bedi, “Quality Management”, Oxford University Press.
4. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, Cengage Learning.
5. Poornima M. Charantimath, “Total Quality Management”, Pearson Education.
6. S. Kumar, “Total Quality Management”, Laxmi Publications.
7. Douglas C. Montgomery, “Introduction to Statistical Quality Control”, Wiley India.
8. Amitava Mitra, “Fundamentals of Quality Control and Improvement”, Wiley India.
9. Sunil Sharma, “Total Engineering Quality Management”, Macmillan Publishers.
10. John S. Oakland, “Total Quality Management and Operational Excellence”, Routledge Publications.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	3	20
II	3	20
III	3	20
IV	3	20
V	2	20
Total	**14**	**100%**

PRACTICAL	6.4 MOULD DESIGN-II	L	T	P
		-	-	2

COURSE OBJECTIVE

This course aims to develop the knowledge and skills required for the design of moulds and tooling components used in manufacturing industries. It enables students to apply design principles for three-plate moulds, dog-leg cam mechanisms, and moulds with internal-cut generation systems. The course also develops proficiency in preparing engineering drawings and CAD models while emphasizing functional requirements, manufacturability, and standard engineering design practices.

COURSE OUTCOMES (COS)

CO1: Design and develop three-plate moulds considering functional and manufacturing requirements.
CO2: Design tooling components using dog-leg cam mechanisms and moulds for generating internal cuts.
CO3: Prepare and evaluate engineering drawings/CAD models of moulds and tooling systems using appropriate design standards.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	3	3	2	1	1	1	*	*
CO2	3	3	3	2	1	1	1	*	*
CO3	2	2	2	3	-	2	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

LIST OF PRACTICALS

1. Design of 3-plate mould.
2. Design of tool(component) using Dog-leg Cam
3. Design of mould using jigler for generating internal cuts

PROJECT	6.5 IN-HOUSE- PROJECT	L	T	P
		4	-	16

In House Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The students should identify themselves or accept the given project assignment at least two to three months in advance. The project work identified in collaboration with industry should be preferred. Each teacher is expected to guide the project work of 5–6 students. The project assignments may consist of:

- Programming customer based applications
- Web page designing (Only dynamic)
- Database applications
- Software Development

LEARNING OUTCOMES

After undergoing this subject, the student will be able to:

• Use effectively oral, written and visual communication
• Demonstrate skill and knowledge of current information and technological tools and techniques specific to the professional field of study.
• Identify, analyze and solve problems creatively through sustainment critical investigation.
• Develop leadership abilities.
• Apply fundamental and disciplinary concepts and methods in ways appropriate to their areas of study.

THEORY	6.6.1 RENEWABLE ENERGY TECHNOLOGIES (OE-III)	L	T	P
		2	-	-

COURSE OBJECTIVE

The objectives of this course are to:

1. Provide a comprehensive understanding of the current and future global energy scenario.
2. Introduce students to renewable and non-conventional energy sources as alternatives to fossil fuels.
3. Enable understanding of solar, wind, and bio-energy systems and their working principles.
4. Develop the ability to evaluate suitable renewable energy options for a given location.
5. Familiarize students with economic, environmental, and sustainability aspects of renewable energy technologies.

COURSE OUTCOMES (CO):

After successful completion of this course, the students will be able to:

CO1: Explain the global energy scenario, energy resources, and the need for renewable energy with economic and environmental perspectives.

CO2: Describe principles, components, and applications of solar energy systems including solar thermal and solar PV technologies.

CO3: Explain wind energy fundamentals, types of wind energy systems, site selection, and performance aspects.

CO4: Evaluate bio-energy generation methods such as biomass combustion, biogas, biofuels, and cogeneration systems.

CO5: Identify and compare alternative renewable energy sources such as tidal, wave, hydro, geothermal, hydrogen, fuel cells, and hybrid systems for suitable applications.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcomes (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic / Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PSO1	PSO2
CO1	3	1	–	–	2	–	2	*	*
CO2	3	2	2	1	1	1	1	*	*
CO3	2	2	2	–	1	1	1	*	*
CO4	2	2	1	1	2	1	1	*	*
CO5	2	3	1	1	3	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT

UNIT-1: **(6 Periods)**

Introduction: World Energy Use; Reserves of Energy Resources; Environmental Aspects of Energy Utilization; Renewable Energy Scenario in India and around the World; Potentials; Achievements / Applications; Economics of renewable energy systems.

UNIT -2: **(6 Periods)**

Solar energy: Solar Radiation; Measurements of Solar Radiation; Flat Plate and Concentrating Collectors; Solar direct Thermal Applications; Solar thermal Power Generation Fundamentals of Solar Photo Voltaic Conversion; Solar Cells; Solar PV Power Generation; Solar PV Applications.

UNIT -3: **(5 Periods)**

Wind Energy: Wind Data and Energy Estimation; Types of Wind Energy Systems; Performance. Site Selection; Details of Wind Turbine Generator; Safety and Environmental Aspects.

UNIT -4: **(5 Periods)**

Bioenergy: Biomass direct combustion; Biomass gasifiers; Biogas plants; Digesters; Ethanol production; Bio diesel; Cogeneration; Biomass Applications.

UNIT -5: **(6 Periods)**

Other Renewable Energy Sources: Tidal energy; Wave Energy; Open and Closed OTEC Cycles; Small Hydro-Geothermal Energy; Hydrogen and Storage; Fuel Cell Systems; Hybrid Systems.

INSTRUCTIONAL STRATEGY

1. Teacher should focus on conceptual clarity.
2. An industrial visit can be organized in relevant industries. Audio-visuals aids should be used to teach.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Seminar, Presentation, Viva-voce.

RECOMMENDED BOOKS:

1. O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi (ed. 2018)
2. Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN Spon Ltd., UK, 2006.
3. Solar Energy, Sukhatme. S.P., Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
4. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, U.K., 1996.
5. Fundamental of Renewable Energy Sources, GN Tiwari and MK Ghoshal, Narosa, New Delhi, 2007.
6. Renewable Energy and Environment-A Policy Analysis for India, NH Ravindranath, UK Rao, B Natarajan, P Monga, Tata McGraw Hill.
7. Energy and The Environment, RA Ristinen and J J Kraushaar, Second Edition, John Willey & Sons, New York, 2006.
8. Renewable Energy Resources, JW Twidell and AD Weir, ELBS, 2006.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	06	19
2.	06	24
3.	05	19
4.	05	19
5.	06	19
Total	28	100

THEORY	6.6.2 ARTIFICIAL INTELLIGENCE (O.E-III)	L	T	P
		2	-	-

COURSE OBJECTIVES

The objectives of this course are to:

1. Introduce students to the fundamental concepts, goals, and applications of Artificial Intelligence.
2. Enable understanding of intelligent agents and their interaction with different environments.
3. Develop basic knowledge of search algorithms and problem-solving techniques used in AI.
4. Familiarize students with fuzzy logic systems and their role in decision-making.
5. Introduce neural network concepts and their applications in intelligent systems.

COURSE OUTCOMES (CO):

After successful completion of this course, the students will be able to:

CO1: Explain the concept, goals, history, and applications of Artificial Intelligence.
CO2: Describe intelligent agents, their types, and properties of environments.
CO3: Apply basic search algorithms and heuristic techniques for problem solving.
CO4: Explain principles and components of fuzzy logic systems.
CO5: Describe the structure and working of neural networks including perceptron and back-propagation.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcomes (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PSO 1	PSO 2
CO1	3	1	–	–	–	–	1	*	*
CO2	2	2	–	–	–	–	1	*	*
CO3	2	3	–	–	–	–	1	*	*
CO4	2	2	–	–	–	–	1	*	*
CO5	2	2	1	–	–	–	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)
* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT:

UNIT 1 – Introduction to Artificial Intelligence **(06 Periods)**

- Artificial Intelligence (AI) definition
- Goals of AI
- History of AI
- Applications of AI

UNIT 2 – Agents and Environments **(06 Periods)**

- Agent Terminology, Types of Agents – Simple Reflex Agents, Model Based Reflex Agents, Goal Based Agents
- Nature of Environments, Properties of Environments

UNIT 3 – Search Algorithms Terminology **(06 Periods)**
• Brute Force Search Strategies – Breadth First Search, Depth First Search.
• Heuristic Search Strategies, Local Search Algorithms.

UNIT 4 – Fuzzy Logic Systems **(05 Periods)**
Introduction to Fuzzy Logic and Fuzzy systems,
• Membership functions,
• Fuzzification/Defuzzification

UNIT 5 – Neural Networks **(05 Periods)**
Basic structure of Neural Networks
• Perceptron
• Back-propagation

RECOMMENDED BOOKS

Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial Intelligence use cases Denis Rothman Packt Publishing ISBN – 978-1788990547

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	06	15
2	06	25
3	06	20
4	05	20
5	05	20
Total	**28**	**100**

8. GUIDELINES FOR ASSESSMENT OF STUDENT-CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 50 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

i. 15 Marks for general behaviour and discipline

(by HODs in consultation with all the teachers of the department)

ii. 10 Marks for attendance as per following:

(by HODs in consultation with all the teachers of the department)

a) 75 - 80% 6 Marks

b) 80 - 85% 8 Marks

c) Above 85% 10 Marks

iii. * Even Semester:

25 Marks maximum for the subject of plant maintenance & safety and industrial management that given by the maintenance head of department.

**Odd Semester:

25 Marks maximum

a) Language Lab Practices / foreign language practices

b) Group Discussion and Personality Development

c) Industrial Visits/Industrial Talks

d) Power Point Presentations and Resume Making

e) Development of Aptitude and Reasoning Skills

f) Participation in the technical Exhibitions, Symposiums, Seminars, Workshops at the Institute /District/State/National Level.

9. RESOURCE REQUIREMENT

A. PHYSICAL RESOURCES

a. Space requirement

Norms and standards laid down by All India Council for Technical Education (AICTE) are to be followed to work out space requirement in respect of classrooms, tutorial rooms, drawing halls, laboratories, space required for faculty, student amenities and residential area for staff and students.

b. Equipment Requirement:

Following Laboratories are required:

GENERAL WORKSHOP PRACTICE-II (BASIC MILLING & GRINDING)

S. No.	Name of Equipment	Broad Specifications	Quantity
1	Conventional Milling (vertical)	BFW(VF-2)- 800 x 230 x 400	6
2.	Conventional Milling (Horizontal)	BFW(HF-2)- 800 x 230 x 400	2
3.	Conventional Milling (Universal)	BFW(UF-2)- 800 x 230 x 400	2
4.	Surface Grinding	HMT(451)- 500 x 220 x 180	5
5.	Cylindrical Grinding	HMT (Anubhab-130)- D-130 x 500	3

ADVANCE MANUFACTURING PROCESS CNC

S. No.	Name of Equipment	Broad Specifications	Quantity
1	CNC VMC (Fanuc Oi MF)	S&T Engineers(VL 550)- 550 x 400 x 450	2
2.	CNC MILLING (Fanuc Oi MF)	S&T Engineers(VL 760)- 760 x 400 x 400	4
3.	CNC MILLING (SEIMENS)	ACE (MCV350L)- 750 x 300 x 400	4
4.	CNC TURNING (Fanuc)	ACE (LT16 LM)- 150 x Dia 200 x 400	4
5.	CNC TURNING (SEIMENS)	BFW (Orbi Turn)- 150 x Dia 270 x 425	4

MANUFACTURING ENGINEERING

S. No.	Name of Equipment	Broad Specifications	Quantity
1	Analog Vernier Caliper	0-200mm	5
2.	Digital Vernier Caliper	0-300mm	5
3.	Analog outside micrometer	(0-300mm), (0-25mm), (25-50mm), (75-100mm)	7
4.	Digital outside micrometer	(0-25mm), (25-50mm)	10
5.	Single point cutting tool	Turning & Milling	10
6.	Multi point cutting tool	Dia- 8mm, 10mm, 12mm, 20mm, 16mm, 25mm	12

PRESS TOOL DESIGN-I & II

S. No.	Name of Equipment	Broad Specifications	Quantity
1	Conventional Milling (vertical)	BFW(VF-2)- 800 x 230 x 400	6
2.	Conventional Milling (Horizontal)	BFW(HF-2)- 800 x 230 x 400	2
3.	Conventional Milling (Universal)	BFW(UF-2)- 800 x 230 x 400	2
4.	Surface Grinding	HMT(451)- 500 x 220 x 180	5
5.	Cylindrical Grinding	HMT (Anubhab-130)- D-130 x 500	3
6.	CNC VMC (Fanuc Oi MF)	S&T Engineers(VL 550)- 550 x 400 x 450	2
7.	CNC MILLING (Fanuc Oi MF)	S&T Engineers(VL 760)- 760 x 400 x 400	4
8.	CNC MILLING (SEIMENS)	ACE (MCV350L)- 750 x 300 x 400	4
9.	CNC TURNING (Fanuc)	ACE (LT16 LM)- 150 x Dia 200 x 400	4
10.	CNC TURNING (SEIMENS)	BFW (Orbi Turn)- 150 x Dia 270 x 425	4
11.	Auto CADD	Auto CADD version- 16, 18 & 26 (Installed in computer system)	40
12.	Conventional lathe	Accurate (WGL-200)- 200 x D200 x 700	10

JIGS & FIXTURES DESIGN

S. No.	Name of Equipment	Broad Specifications	Quantity
1	Desktop Computer	Operating system: windows Processor: Intel i5 RAM: 8GB	40
2.	Auto CADD Software	Auto CADD version- 16, 18 & 26 (Installed in each computer system)	40
3.	Conventional lathe	Accurate (WGL-200)- 200 x D200 x 700	10
4.	Single point cutting tool	Turning & Milling	10
5.	CNC MILLING (SEIMENS)	ACE (MCV350L)- 750 x 300 x 400	4
6.	CNC TURNING (SEIMENS)	BFW (Orbi Turn)- 150 x Dia 270 x 425	4

CNC MACHINE (MILLING & GRINDING)

S. No.	Name of Equipment	Broad Specifications	Quantity
1	CNC VMC (Fanuc Oi MF)	S&T Engineers(VL 550)- 550 x 400 x 450	2
2.	CNC MILLING (Fanuc Oi MF)	S&T Engineers(VL 760)- 760 x 400 x 400	4
3.	CNC MILLING (SEIMENS)	ACE (MCV350L)- 750 x 300 x 400	4
4.	Surface Grinding	ROYAL (RSG450)- 400 x 180 x 335	1
5.	Cylindrical Grinding	GRINDEX (SERBIA) (BSC 700 U PLC)- 300 x CH175 x 700	1

MOULD DESIGN- I & II

S. No.	Name of Equipment	Broad Specifications	Quantity
1	Conventional Milling (vertical)	BFW(VF-2)- 800 x 230 x 400	6
2.	Conventional Milling (Horizontal)	BFW(HF-2)- 800 x 230 x 400	2
3.	Conventional Milling (Universal)	BFW(UF-2)- 800 x 230 x 400	2
4.	Surface Grinding	HMT(451)- 500 x 220 x 180	5
5.	Cylindrical Grinding	HMT (Anubhab-130)- D-130 x 500	3
6.	CNC VMC (Fanuc Oi MF)	S&T Engineers(VL 550)- 550 x 400 x 450	2
7.	CNC MILLING (Fanuc Oi MF)	S&T Engineers(VL 760)- 760 x 400 x 400	4
8.	CNC MILLING (SEIMENS)	ACE (MCV350L)- 750 x 300 x 400	4
9.	CNC TURNING (Fanuc)	ACE (LT16 LM)- 150 x Dia 200 x 400	4
10.	CNC TURNING (SEIMENS)	BFW (Orbi Turn)- 150 x Dia 270 x 425	4
11.	Auto CADD	Auto CADD version- 16, 18 & 26 (Installed in computer system)	40
12.	Conventional lathe	Accurate (WGL-200)- 200 x D200 x 700	10

CNC & CAM PROGRAMING

S. No.	Name of Equipment	Broad Specifications	Quantity
1	CNC CMM	MITUTOYO CRISTA (S 9106)- 900 x 1000 x 800	1
2.	SOFTWARES	MASTERCAM 2019 US 3 AXIS	20
		MASTERCAM 2019 US 5 AXIS	5
		NX CAD/CAM (PERPETUAL)	20
		NX CAD/CAM/CAE (PERPETUAL)	1

DIE CASTING DESIGN

S. No.	Name of Equipment	Broad Specifications	Quantity
1	Injection Moulding Machine	200 T	1
2.	Hydraulic Press machine	350 T	1
3.	Mechanical Press Machine	100 T	1

10. EVALUATION SCHEME GUIDELINES: As Per AICTE ATTACHED (ANNEXURE- 2)

a. Theory Courses:

- Internal Assessment: 40%
- End Semester Examination: 60%
- Passing Criteria: A student must secure a minimum of 40% marks separately in both internal assessment and end semester examination to pass the course.

b. Practical Courses:

- Internal Assessment: 60%
- End Semester Examination: 40%
- Passing Criteria: A student must secure a minimum of 40% marks separately in both internal assessment and end semester examination to pass the course.

c. Summer Internship / Projects / Seminars, etc.:

- Evaluation is based on the following components:
  - Quality of work completed
  - Report preparation and documentation
  - Viva-voce performance
  - Presentation skills

Note:
Internal assessment is conducted based on the student's overall performance, which includes:

- Two best out of three mid-semester tests
- Quizzes and assignments
- Class participation and attendance
- Viva-voce and lab records (for practical subjects)

ANNEXURE- 2

EVALUATION METHODOLOGY

1. EVALUATION METHOD for THEORY

	Internal Assessment (40 marks)				External Assessment (60 marks)
	IA 1	**IA 2**	**IA 3**	**IA 4**	
Mode	**Written Test**	**Written Test**	**Attendance and Assignments**	**Pre – Semester Examination**	**End Semester Examination**
Portion	2 units	2 units	Regularly	All units	All units
Duration1hr	1hr	1hr	-	3hrs	3hrs
Exam Marks	20	20	20	60	60
Converted to	10	10	15	15	60
Tentative Schedule	5^{th} Week	10^{th} Week	Regularly	12^{th} -13^{th} Week	

IA1 and IA2: A written assessment test worth 20 marks should be conducted for two units. The marks earned (20 marks) will be converted to 10 marks. The best of the two assessments will be evaluated for an internal 10-mark assessment.

IA3: Assignments given after the completion of each unit, along with attendance throughout the semester, will be assessed for a total of 15 marks.

IA4: The pre-semester examination should follow the end-semester examination question pattern. The marks should be adjusted to 15 for internal assessment.

2. EVALUATION METHOD for PRACTICAL

	Internal Assessment (60 marks)				External Assessment (40 marks)
	IA 1	**IA 2**	**IA 3**	**IA 4**	
Mode	**Practical Test**	**Practical Test**	**Attendance and Practical Documentation**	**Practical Test and Quiz – Viva Voce**	**Practical Examination**
Portion	50% Practical	50% practical	All practical	All practical	All practical
Duration	3hrs	3 hrs	Regularly	3 hrs	3hrs
Exam Marks	20	20	20	20	40
Tentative Schedule	5th Week	10th Week	Regularly	12th -13th Week	

IA1 and IA2: Complete all exercises and experiments as outlined and retain them for the practical test. The test should be conducted in accordance with the evaluation scheme. The best of the two practical tests will be internally evaluated for a total of 20 marks.

IA3: Maintain a practical file for each exercise while ensuring attendance throughout the semester. Submit the required documents for the practical file, quiz, and practical test along with a valid certificate (Progress Card). This will be assessed for 20 marks.

IA4: The pre-semester practical examination, quiz, and viva-voce should follow the end-semester practical examination pattern, with marks adjusted to 20 for internal assessment.

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION

Part	Description	Marks Allotted	Marks Allotted (For 3.7)	Marks Allotted (For 4.7)
A.	Objective	**5**	**15**	**17.5**
B.	Circuit Diagram	**5**	**15**	**17.5**
C.	Procedure and Connections	**10**	**30**	**35**
D.	Observation Table and Calculation	**10**	**30**	**35**
E.	Result and its Discussion, Conclusion	**10**	**30**	**35**
F.	Practical Test	**20**	**60**	**70**
	Total	**60**	**180**	**210**

SUGGESTED DISTRIBUTION OF MARKS FOR **EXTERNAL** EVALUATION

Part	Description	Marks Allotted	Marks Allotted (For 3.7)	Marks Allotted (For 4.7)
A.	Objective	**5**	**15**	**17.5**
B.	Circuit Diagram	**5**	**15**	**17.5**
C.	Procedure and Connections	**5**	**15**	**17.5**
D.	Observation Table and Calculation	**5**	**15**	**17.5**
E.	Result and its Discussion, Conclusion	**10**	**30**	**35**
F.	Viva-Voce	**10**	**30**	**35**
	Total	**40**	**120**	**140**

3. EVALUATION METHOD for PRACTICUM (End Exam-Practical)

	Internal Assessment (60 marks)				External Assessment (40 marks)
	IA 1	**IA 2**	**IA 3**	**IA 4**	
Mode	**Practical Test**	**Practical Test**	**Attendance and Practical Documentation**	**Micro Project**	**Practical Examination**
Portion	50% practical	50% practical	All practical	All practical	All practical
Duration	3hrs	3 hrs	Regularly	Regularly	3hrs
Exam Marks	20	20	20	20	40
Tentative Schedule	5th Week	10th Week	Regularly	12th -13th Week	

IA1 and IA2: Complete all exercises and experiments as instructed and retain them for the practical test. The test should be conducted according to the evaluation scheme. The best of the two practical tests will be internally assessed for a total of 20 marks.
IA3: Maintain a practical file for each exercise, ensuring attendance throughout the semester. Submit the required documents for the practical file, quiz, practical test, and end-semester examination, along with a valid certificate (Progress Card). This will be evaluated by 20 marks.
IA4: Submit a micro-project report along with a fabrication model or analysis report. The performance of each student in the group will be assessed by both the laboratory supervisor and an internal examiner. This evaluation will contribute 20 marks.

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION

Part	Description	Marks Allotted	Marks Allotted
A.	Objective	**5**	**17.5**
B.	Circuit Diagram	**5**	**17.5**
C.	Procedure and Connections	**10**	**35**
D.	Observation Table and Calculation	**10**	**35**
E.	Result and its Discussion, Conclusion	**10**	**35**
F.	Mini Project	**20**	**70**
	Total	**60**	**210**

SUGGESTED DISTRIBUTION OF MARKS FOR **EXTERNAL** EVALUATION

Part	Description	Marks Allotted	Marks Allotted
A.	Objective	**5**	**17.5**
B.	Circuit Diagram	**5**	**17.5**
C.	Procedure and Connections	**5**	**17.5**
D.	Observation Table and Calculation	**5**	**17.5**
E.	Result and its Discussion, Conclusion	**10**	**35**
F.	Viva-Voce	**10**	**35**
	Total	**40**	**140**

4. EVALUATION METHOD for PRACTICUM (End Exam-Theory)

	Internal Assessment (40 marks)						External Assessment (60marks)
	IA 1		IA 2		IA 3	IA 4	
Mode	**Written Test**	**Practical Test**	**Written Test**	**Practical Test**	**Attendance and Practical Documentation**	**Pre Semester Examination and Micro Project**	**End Semester Examination**
Portion	2 units	Practical related to the units	2 units	Practical related to the units	All unit	All Practical	All unit
Duration	1hr	3hrs	1hr	3 hrs	3hrs	Regularly	3hrs
Exam Marks	10	20	10	20	60	60	60
	30		30				
Converted to	10		10		15	15	60
Tentative Schedule	5th Week		10th Week		Regularly	12th -13th Week	

IA1 and IA2: A written assessment test worth 10 marks should be conducted for two **UNIT**s. Complete all exercises and experiments as outlined and retain them for the practical test worth 20 marks. The practical test should be conducted in accordance with the evaluation scheme. The total marks earned (30 marks) will be converted to 10 marks. The best of the two assessments will be internally evaluated for a total of 10 marks.

IA3: Attendance and the pre-semester examination should follow the end-semester examination question paper pattern. The marks should be adjusted to 15 for internal assessment.

IA4: Maintain a practical file for each exercise. Submit the required documents for the practical file, quiz/viva-voice, practical test, and end-semester examination, along with a valid certificate (Progress Card). This will be assessed for 40 marks. Additionally, submit a micro-project report along with a fabrication model or analysis report. The performance of each student in the group will be evaluated by both the laboratory supervisor and an internal examiner. The total of 60 marks will be converted to 15 marks

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION FOR IA4

Part	Description	Marks Allotted
A.	Objective	**5**
B.	Circuit Diagram	**5**
C.	Procedure and Connections	**5**
D.	Observation Table and Calculation	**5**
E.	Result and its Discussion, Conclusion	**10**
F.	Attendance & Mini Project	**10**
	Total	**40**

11. LIST OF EXPERTS

1. Shri Ajay Bajpai, Joint Director cum Incharge, MSME TC Kanpur.
2. Shri. Pradipta Swain, Consultant, MSME TC Kanpur.
3. Shri. Bhupender Pratap Singh, Teaching Assistant (T.A), MSME TC Kanpur.
4. Shri. Akshay Awasthi, Teaching Assistant (T.A), MSME TC Kanpur.

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CORRECTED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026