COMPETENCY BASED CURRICULUM

ADVANCE DIPLOMA IN
TOOL AND DIE MAKING

(Duration 04 Years)
NSQF Level – 6

Under
Haryana State Board of Technical Education

Developed By

Curriculum Development Center
National Institute of Technical Teachers Training & Research
(Ministry of Education, Government of India)
Sector - 26, Chandigarh, UT, India.

(September, 2024)

PREFACE

Learning and learning experience are the foundation of any education system. Appropriateness of education and its useful implications stand on the platform of knowledge and skill. But the knowledge and skill cannot be quantified qualitatively without ensuring learning experience. Curriculum is the pathway to select and organise learning experience. It helps the teachers to provide tangible resources, goals and objectives to learners. Curriculum acts as a catalyst to stimulate creativity, innovation, ethics, values, responsibility and many human factors. Curriculum embodies rigour and high standards and creates coherence to empower learner to meet the industrial and societal needs. Curriculum is a central guide for a teacher to plan a standard based sequence for the instructional delivery.

The industrial revolution 4.0 has forced the technical education system to reinvent the curriculum to meet the human resource requirement of the industry. The data driven systems relying on the subjects like machine-learning, Artificial Intelligence, Data Science etc are literally forcing the technical education system to offer different subjects differently to address the emerging challenges. The non-linear way of learning now facilitates students to choose path of knowledge to skill or vice-versa. The bi-directional process requires innovative curriculum design and revision. Diploma programme is now more challenging than ever. The level of skill and knowledge demanded by industry from diploma holders are highly interdisciplinary at the same time address special need. Hence, there is a need to align the curriculum to National Skill Qualification Framework (NSQF).

National Education Policy, NEP-2020 has now opened up diversities for the education system to explore and exploit to make the education relevant. The policy emphasises to inculcate value, ethics, respect to culture and society etc along with industry ready knowledge and skill among the students. The interdisciplinary nature of curriculum, academic bank of credits and integration of technology in teaching-learning envisaged in NEP-2020 make it more challenging for curriculum development. NITTTR, Chandigarh has developed the art of curriculum development over 54 years of its existence. The expertise and experience available in the institute follow time-tested and acclaimed scientific methods to design/revise curriculum. The experienced faculty members entrusted with the curriculum development or revision activities are well-versed with NSQF, NEP and Outcome based education. I am happy to note that **Haryana State Board of Technical Education, Panchkula, Haryana** reposed their confidence on this expertise to develop **AICTE/NSQF/NEP 2020** aligned curriculum for the state. This documented curriculum is an outcome of meticulous planning and discussions among renowned experts of the subject through series of workshops. The effective implementation of this curriculum supported with quality instructional resources will go a long way in infusing the learning experience among learners to make them industry ready.

Director

National Institute of Technical Teachers Training & Research, Chandigarh

ACKNOWLEDGEMENT

We gratefully acknowledge the assistance and guidance received from the following persons:

i) Principal Secretary Technical Education-cum-Chairman, Haryana State Board of Technical Education, Panchkula, Haryana for initiating this project on designing of AICTE/NSQF/NEP 2020 aligned curriculum.

ii) Director General, Technical Education, Haryana for taking keen interest in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.

iii) Secretary, Haryana State Board of Technical Education, Panchkula, Haryana for his untiring assistance and support in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.

iv) Management Officials of Haryana State Board of Technical Education, Panchkula, Haryana for taking keen interest in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.

v) Director, National Institute of Technical Teachers' Training and Research, Chandigarh for his support and academic freedom provided to Curriculum Development Centre.

vi) All the participants from Industry / field Organizations, Academic Institutions, State Technical Universities / Polytechnics for their professional & academic inputs during curriculum workshops.

vii) Faculty and staff of Curriculum Development Centre, NITTTR, Chandigarh for their dedicated contribution and support in design of NSQF aligned curriculum.

viii) Faculty from different departments of NITTTR, Chandigarh for their valuable inputs in design of NSQF aligned curriculum.

Professor & Head
Curriculum Development Center
National Institute of Technical Teachers Training & Research, Chandigarh

TABLE OF CONTENTS

Sr. No.	Description	Page No.
	Preface	i - i
	Acknowledgement	ii - ii
	Table of Contents	iii - iv
	FOUR YEAR NSQF/NEP 2020 ALIGNED DIPLOMA	
1.	Salient Features	1-1
2.	NSQF Guidelines	2-7
3.	NEP 2020	7-8
4.	Diploma Programme Outcomes	9-9
5.	Deriving Curriculum Areas from Diploma Programme Outcomes	10-13
	FIRST YEAR NSQF LEVEL – 3	
6.	Study and Evaluation Scheme	14-14
7.	Horizontal and Vertical Subjects Organization	15-15
8.	Competency Profile and Employment Opportunities	16-16
9.	Programme Outcomes	17-17
10.	Assessment of Programme and Course Outcomes	18-23
11.	Subject Contents	24-56
	SECOND YEAR NSQF LEVEL – 4	
12.	Study and Evaluation Scheme	57-57
13.	Horizontal and Vertical Subjects Organization	58-58
14.	Competency Profile and Employment Opportunities	59-59
15.	Programme Outcomes	60-60
16.	Assessment of Programme and Course Outcomes	61-67
17.	Subject Contents	68-105
	THIRD YEAR NSQF LEVEL – 5	
18.	Study and Evaluation Scheme	106-106
19.	Horizontal and Vertical Subjects Organization	107-107

20.	Competency Profile and Employment Opportunities	108-109
21.	Programme Outcomes	110-110
22.	Assessment of Programme and Course Outcomes	111-114
23.	Subject Contents	115-150
FOURTH YEAR NSQF LEVEL – 6		
24.	Study and Evaluation Scheme	151-151
25.	Horizontal and Vertical Subjects Organization	152-152
26.	Competency Profile and Employment Opportunities	153-154
27.	Programme Outcomes	155-155
28.	Assessment of Programme and Course Outcomes	156-158
29.	Subject Contents	159-180
FOUR YEAR NSQF/NEP 2020 ALIGNED DIPLOMA		
30.	Assessment Tools & Criterion	v - ix
31.	Teaching Learning Tools for Effective Implementation	x – xiii
32.	List of Experts	xiv – xvii
33.	Appendix - List of Equipment	xviii-xxiv

1. SALIENT FEATURES

1.	Name	:	**Advance Diploma in Tool and Die Making**
2.	Duration	:	**04 Years**
3.	Hours per week	:	**35**
4.	Entry Qualification	:	**10th Pass**
5.	Student Intake	:	**As per sanctioned strength**
6.	Pattern	:	**Annual**
7.	Scheme	**:**	**Multi Point Entry and Exit**
8.	NSQF Level	:	**6**
9.	Theory Practical Ratio	:	**27 : 73**
10.	Industrial Training and Project	:	**On the Job Training and Project Work.**
11.	In-house/Industrial Training	:	**Mandatory after Second and Third Year**

2. NSQF GUIDELINES

National Skill Qualification Framework has defined total Ten Levels. Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Fig.1: NSQF Domains

NSQF LEVEL - 3 COMPLIANCE

The NSQF level - 3 descriptor is as follows:

Process	• Person may carry out a job which may require limited range of activities routine and predictable.
Professional Knowledge	• Basic facts, process and principle applied in trade of employment.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application.
Core Skill	• Communication written and oral, with minimum required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Under close supervision. Some responsibility for own work within defined limit.

Fig 2: NSQF Level – 3 Descriptor

Work requiring knowledge, skills and aptitudes at level 3 will be routine and predictable. Job holders will be responsible for carrying out a limited range of jobs under close supervision. Their work may require the completion of a number of related tasks. People carrying out these job roles may be described as "Semi skilled workers". Individuals in jobs which require level 3 qualifications will normally be expected to be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation and should know the basic facts, processes and principles applied in the trade for which they are qualified and be able to apply the basic skills of the trade to a limited range of straightforward jobs in the occupation.

They will be expected to understand what constitutes quality in their job role and more widely in the sector or sub-sector and to distinguish between good and bad quality in the context of the jobs they are given. Job holders at this level will be expected to carry out the jobs they are given safely and securely. They will work hygienically and in ways which show an understanding of environmental issues. This means that they will be expected to take responsibility for their own health and safety and that of fellow workers and, where appropriate, customers and/or clients. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social environment. They should be able to make a good contribution to team work.

NSQF LEVEL - 4 COMPLIANCE

The NSQF level-4 descriptor is given below:

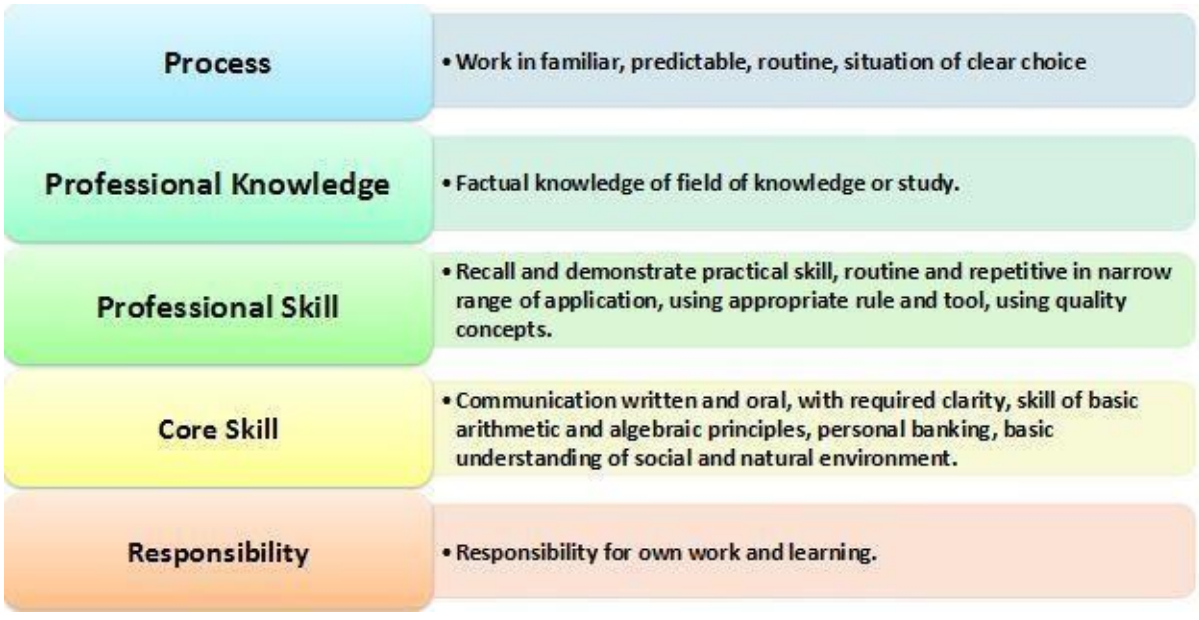


Fig 3: NSQF Level – 4 Descriptor

Work requiring knowledge, skills and aptitudes at level 4 will be carried out in familiar, predictable and routine situations. Job holders will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. People carrying out these jobs may be described as "skilled workers". Individuals in jobs which require level 4 qualifications should be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation in which they are employed, to appreciate the nature of the occupation and to understand and apply the rules which govern good practice. They will be able to make choices about the best way to carry out routine jobs where the choices are clear.

They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their job roles. Job holders at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They will work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment. They should be able to guide or lead teams on work within their capability.

NSQF LEVEL - 5 COMPLIANCE

The NSQF level-5 description is given below:

Process	• Job that requires well developed skill, with clear choice of procedures in familiar context.
Professional Knowledge	• Knowledge of facts, principles, processes and general concepts, in a field of work or study.
Professional Skill	• A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information.
Core Skill	• Desired mathematical skill; understanding of social, political; and some skill of collecting and organising information, communication.
Responsibility	• Responsibility for own work and learning and some responsibility for others' works and learning

Fig 4: NSQF Level – 5 Descriptor

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning. People carrying out these jobs may be described as "fully skilled workers" or "supervisors".

Individuals employed to carry out these jobs will be expected to be able to communicate clearly in speech and writing and may be required to apply mathematical processes. They should also be able to collect and organise information to communicate about the work. They will solve problems by selecting and applying methods, tools, materials and information. They will be expected to have previous knowledge and skills in the occupation, and to know and apply facts, principles, processes and general concepts in the occupation. They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise.

In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

NSQF LEVEL - 6 COMPLIANCE

The NSQF level-6 description is given below:

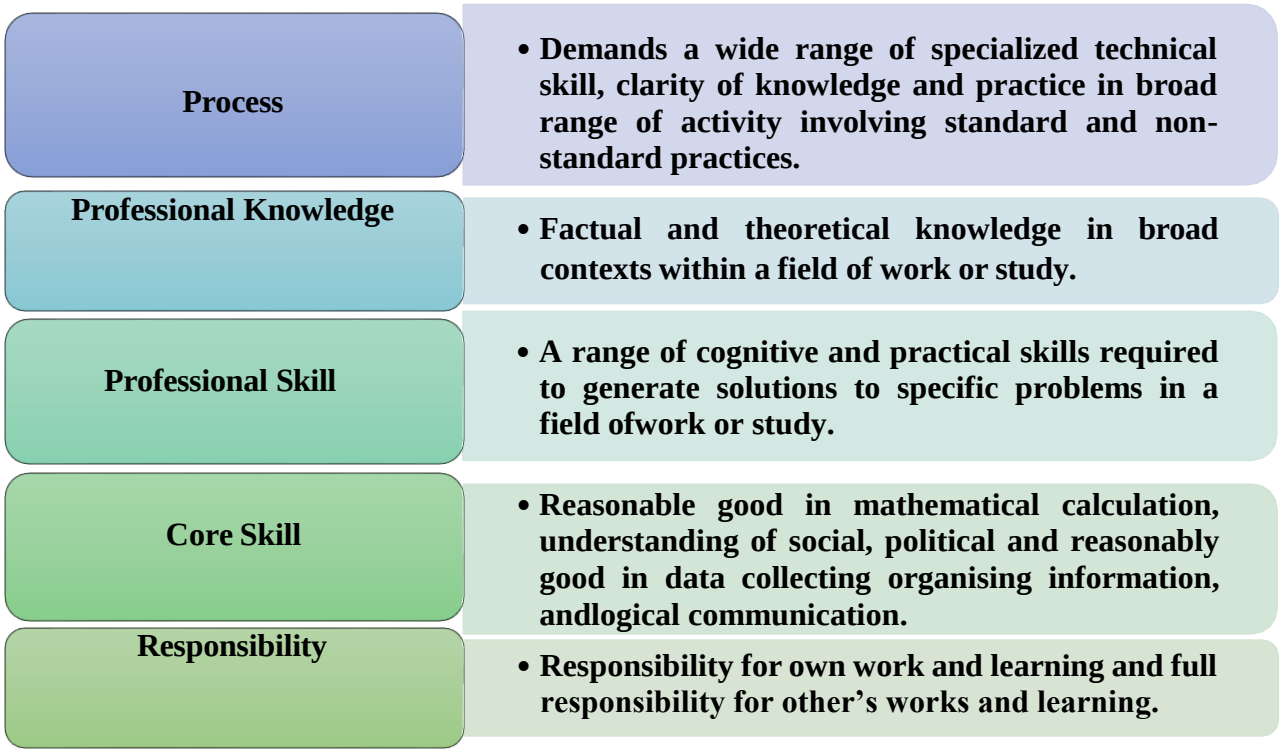


Fig 5: NSQF Level-6 Descriptor

Work requiring knowledge, skills and aptitudes at level 6 will require the use of both standard and nonstandard practices. Job holders will carry out a broad range of work which will require a wide range of specialised technical skills backed by clear factual and theoretical knowledge.

Individuals in jobs which require level 6 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They are likely to have full responsibility for others' work and learning. People carrying out these jobs may be described as "master technicians" and "trainers".

Individuals employed to carry out these job roles will be expected to be able to communicate clearly in speech and writing and may be required to carry out mathematical calculations. They should also be able to collect data, organise information, and communicate logically about the work. They will solve problems by selecting and applying methods, tools, materials and information.

They will be expected to have broad factual and theoretical knowledge applying to practice within the occupation, and a range of practical and cognitive skills. They will be able to generate solutions to problems which arise in their practice.

They will be expected to understand what constitutes quality in the occupation and to distinguish between good and bad quality in the context of all aspects of their work. They will be expected to work in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or manage.

In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

3. NATIONAL EDUCATION POLICY (NEP) - 2020

NEP 2020 aims at a comprehensive holistic education to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral - in an integrated manner. A holistic arts education will help develop well-rounded individuals that possess: critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

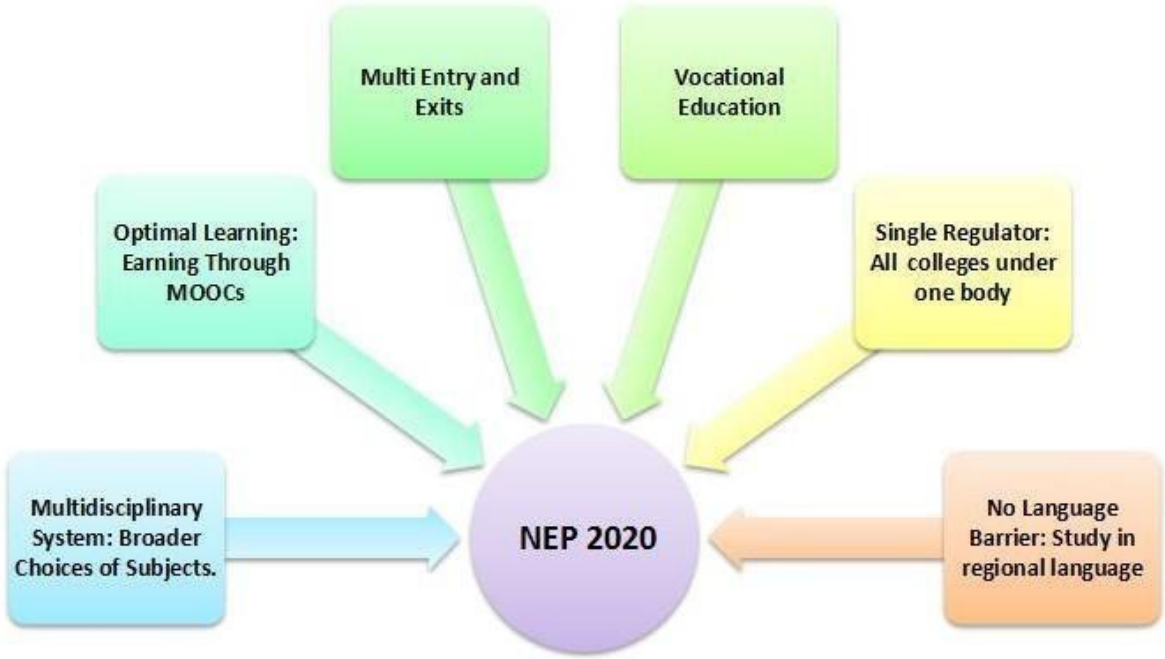


Fig 5: NEP 2020

Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialisation in a subject or subjects. Pedagogy for courses will strive for significantly less rote learning and an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking. The flexible and innovative curriculum shall emphasize on offering credit-based courses and projects in the areas of community engagement and service, environmental education and value-based education. as part of a holistic education, students will be provided with opportunities for internships with local industry, businesses, artists, crafts persons, villages and local communities, etc., as well as

research internships with faculty and researchers at their own or other HEIs or research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Effective learning requires relevant curriculum, engaging pedagogy, continuous formative assessment and adequate student support. The curriculum must be updated regularly aligning with the latest knowledge requirements and shall meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students - thus directly influencing learning outcomes. The assessment methods have to be scientific and test the application of knowledge. Higher Education Institutes should move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs should also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

4. ADVANCE DIPLOMA PROGRAMME OUTCOMES

The programme outcomes are derived from five domains of NSQF Level namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Demonstrate knowledge and skills in carrying out various activities involving standard and non-standard practices in tool and die making.

PO2: Acquire knowledge of principles and procedures in the field of tool and die making.

PO3: Use skills to solve problems in the area of tool and die making**.**

PO4: Demonstrate skill in collecting and organizing information and logical communication.

PO5: Handle own work and learning along with others work.

PO6: Select multidisciplinary subjects of own interest from broader choices.

PO7: Perform Self Learning through Massive Open Online Courses (MOOCs).

5. DERIVING CURRICULUM SUBJECT AREAS FROM ADVANCE DIPLOMA PROGRAMME OUTCOMES

The following curriculum subject areas have been derived from Programme outcomes:

Sr. No.	Programme Outcomes	Curriculum Subject Areas
1.	Demonstrate knowledge and skills in carrying out various activities involving standard and non-standard practices in tool and die making.	• Engineering Drawing • Workshop Practice-I • Workshop Practice- II • Workshop Practice III • Applied Physics • Environmental Studies & Disaster • Management • Fundamentals of IT • Applied Mechanics and Strength of • Materials • Tool Design- I (Press Tools, Jigs and Fixtures) • Tool Design- II (Plastic Moulds) • Tool Design – III (Plastic Moulds) • Tool Design - IV (Forging & Casting Dies) • Computer Aided Design – I • Basics of Electrical and Electronics Engineering • Tool Room Machine Maintenance • Advance Manufacturing Techniques • On the Job Training (OJT)
2.	Acquire knowledge of principles and procedures in the field of tool and die making.	• Workshop Technology-I • Workshop Technology -II • Applied Physics • Engineering Metrology • Hydraulics and Pneumatics • Basics of Electrical and Electronics Engineering

		• Computer Aided Design and Manufacturing (CAD and CAM) • CNC Technology • Tool Room Machine Maintenance • Advance Manufacturing Techniques • On the Job Training (OJT)
3.	Use skills to solve problems in the area of tool and die making**.**	• Workshop Practice I • Workshop Practice II • Workshop Practice III • Engineering Drawing • Material Science and Heat • Treatment • Engineering Metrology • Tool Design- I (Press Tools, Jigs and Fixtures) • Tool Design- II (Plastic Moulds) • Tool Design – III (Plastic Moulds) • Tool Design - IV (Forging & Casting Dies) • Computer Aided Design – I • Hydraulics and Pneumatics • Computer Aided Design and Manufacturing (CAD and CAM) • CNC Technology • Tool Room Machine Maintenance • Advance Manufacturing Techniques • On the Job Training (OJT)
4.	Demonstrate skill in collecting and organizing information and logical communication.	• English and Communication Skills • Applied Mathematics • Fundamentals of IT • Environmental Studies & Disaster Management • Fundamentals of IT • Entrepreneurship Development and Life Skills

		• On the Job Training (OJT)
5.	Handle own work and learning along with others work.	• Workshop Practice I • Workshop Practice II • Workshop Practice III • Engineering Metrology • Entrepreneurship Development and Life Skills • On the Job Training (OJT)
6.	Select multidisciplinary subjects of own interest from broader choices.	• On the Job Training (OJT) • Project Work
7.	Perform Self Learning	• Open Elective (MOOCs^{+}/Offline) • On the Job Training (OJT) • Project Work

FIRST YEAR
NSQF LEVEL - 3

7. ADVANCE DIPLOMA PROGRAMME STUDY AND EVALUATION SCHEME
FIRST YEAR

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
1.1	English and Communication Skills	2	2	4+2=6	40	40	80	60	60	120	200
1.2	Applied Mathematics	4	-	8+0=8	40	-	40	60	-	60	100
1.3	Applied Physics	2	1	4+1=5	40	40	80	60	60	120	200
1.4	Workshop Technology- I	3	-	6+0=6	40	-	40	60	-	60	100
1.5	Engineering Drawing	-	4	0+4=4	-	40	40	60	-	60	100
1.6	*Environmental Studies & Disaster Management	1	-	2+0=2	40	-	40	60	-	60	100
1.7	*Fundamentals of IT	1	2	2+2=4	40	40	80	60	60	120	200
1.8	Workshop Practice - I	-	12	0+12 =12	-	40	40	-	60	60	100
#Student Centred Activities (SCA)		-	1	-	-	-	-	-	-	-	-
Total		**13**	**22**	**47**	**240**	**200**	**440**	**420**	**240**	**660**	**1100**

* Common with other diploma programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, etc, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby clubs e.g. Photography etc., Seminars, Declamation Contests, Educational field visits, NCC, NSS, Cultural Activities and Self-study etc.

ADVANCE DIPLOMA PROGRAMME HORIZONTAL AND VERTICAL ORGANIZATION OF SUBJECTS

Sr. No.	Subjects	Hours Per Week
		First Year
1.	English and Communication Skills	4
2.	Applied Mathematics	4
3.	Applied Physics	3
4.	Workshop Technology I	3
5.	Engineering Drawing	4
6.	Environmental Studies & Disaster Management	1
7.	Fundamentals of IT	3
8.	Workshop Practice -I	12
9.	Student Centered Activities	1
	Total	**35**

10. COMPETENCY PROFILE AND EMPLOYMENT OPPORTUNITIES

In government and private sectors related to Tool and Die Making, “Semi Skilled workers” are required to carry out a limited range of predictable tasks under close supervision. They are normally expected to communicate clearly in speech and along with knowledge of arithmetic and algebraic processes. They should know the basic facts, processes and principles applied in limited area of Tool and Die Making.

The NSQF Level – 3 pass out students are expected to recall and demonstrate practical routine and repetitive skills, in narrow range of tool and die making. They are expected to understand what constitutes quality in their job role. They are also expected to carry out the jobs given to them safely and securely. They have wide scope to work as semi-skilled employee on wage basis in various manufacturing industries engaged in making various dies and tools such as press tools, plastic moulds, forging and casting, dies, cutting tools and jigs and fixtures

They have also wide scope of employability in establishing small startups for manufacturing machine parts, tools and dies and their repair and maintenance.

11. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 3 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Carry out a task which may require limited range of predictable activities.

PO2: Acquire knowledge of basic facts, process and principles related to tool and die making for employment.

PO3: Demonstrate practical skill in narrow range of tool and die making.

PO4: Communicate in written and oral, with minimum required clarity along with skill of basic arithmetic and algebraic principles, personal banking and basic understanding of social and natural environment.

PO5: Perform task under close supervision with some responsibility for own work within defined limit.

ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be Assessed	Assessment Criteria for the Course Outcomes
PO1: Carry out a task which may require limited range of predictable activities.	• Comprehend media used for engineering drawing. • Select various scales, lines and lettering. • Draw simple and advance geometrical construction. • Draw view of different objects viewed from different angles (orthographic views). • Generate isometric (3D) drawing of different laminas and solids. • Comprehend the rules of geometrical tolerances and surface texture symbols. • Draw sectional views. • Draw different solids and develop their surfaces. • Interpret intersection of solids. • Prepare 2D drawings of components using AutoCAD. • Identify tools, equipment and materials used in preparing jobs. • Select materials, tools, and sequence of operations to make a job as per given specifications/drawing. • Prepare simple jobs independently. • Prepare basic components of press tools, moulds, jigs and fixtures. • Take measurements by using measuring instruments. • Comprehend store management practices. • Identify physical quantities, select their units and make measurements with accuracy.

	• Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications. • Elaborate scientific work, energy and power, forms of friction and solve problems related to them. • Comprehend properties of matter and effect of temperature on various matter and phenomenon. • Demonstrate the use of physical principles and analysis in various technical fields. • Differentiate between types of waves and their motion. • Illustrate laws of reflection and refraction of light. • Demonstrate competency in phenomena of electrostatics and electricity. • Characterize properties of material to prepare new materials for various technical applications. • Demonstrate a strong foundation on Modern Physics to use at various technical applications.
PO2: Acquire knowledge of basic facts, process and principles related to tool and die making for employment.	• Explain working principle of measuring instruments. • Describe the working of various metal working techniques. • Explain the working of various machining operations. • Calculate machine parameters for various machining operations. • Take safety measures for prevention of accidents.

	• Identify physical quantities, select their units and make measurements with accuracy. • Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications. • Elaborate scientific work, energy and power, forms of friction and solve problems related to them. • Comprehend properties of matter and effect of temperature on various matter and phenomenon. • Demonstrate the use of physical principles and analysis in various technical fields. • Differentiate between types of waves and their motion. • Illustrate laws of reflection and refraction of light. • Demonstrate competency in phenomena of electrostatics and electricity. • Characterize properties of material to prepare new materials for various technical applications. • Demonstrate a strong foundation on Modern Physics to use at various technical applications.
PO3: Demonstrate Practical skill in narrow range of tool and die making.	• Identify tools, equipment and materials used in preparing jobs. • Select materials, tools, and sequence of operations to make a job as per given specifications/drawing. • Prepare simple jobs independently. • Prepare basic components of press tools, moulds, jigs and fixtures.

	• Take measurements by using measuring instruments. • Comprehend store management practices. • Comprehend media used for engineering drawing. • Select various scales, lines and lettering. • Draw simple and advance geometrical construction. • Draw view of different objects viewed from different angles (orthographic views). • Generate isometric (3D) drawing of different laminas and solids. • Comprehend the rules of geometrical tolerances and surface texture symbols. • Draw sectional views. • Draw different solids and develop their surfaces. • Interpret intersection of solids. • Prepare 2D drawings of components using AutoCAD.
PO4: Communicate in written and oral, with minimum required clarity along with skill of basic arithmetic and algebraic principles, personal banking and basic understanding of social and natural environment.	• Identify the nuances of Communication, both Oral and Written. • Acquire knowledge of the meaning of communication, communication process and speaking skills. • Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication. • Communicate effectively with an increased confidence to read, write and speak in English language fluently. • Comprehend the importance of sustainable ecosystem. • Clarify interdisciplinary nature of environmental issues.

	• Describe corrective measures for the abatement of pollution. • Identify the role of non-conventional energy resources in environmental protection. • Recognize various types of disasters. • Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers • Handle the computer/laptop/mobiles/Internet Utilities and Install/Configure OS. • Assemble a PC and connect it to external Devices. • Manage and Use Office practiced Automation Tools. • Develop worksheets and Prepare presentations. • Understand the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry. • Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry. • Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem. • Explore the idea of location, graph, and linear relationships between two variables. • Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

PO5: Perform task under close supervision with some responsibility for own work within defined limit.	• Take measurements with the help of basic measuring tools/equipment. • Select materials, tools, and sequence of operations to make a job as per given specifications/drawing. • Prepare simple jobs independently and inspect the same. • Use safety equipment and Personal Protection Equipment (PPE). • Maintain good housekeeping practices.

11. SUBJECTS & DETAILED CONTENTS

FIRST YEAR

1.1	English & Communication Skills	24-27
1.2	Applied Mathematics	28-31
1.3	Applied Physics	32-37
1.4	Workshop Technology- I	38-42
1.5	Engineering Drawing	43-46
1.6	Environmental Studies and Disaster Management	47-49
1.7	Fundamentals of IT	50-53
1.8	Workshop Practice-I	54-56

1.1 ENGLISH & COMMUNICATION SKILLS

L	P
2	2

RATIONALE

Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life –personal, social and professional. This course is intended to break fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework. This course is designed to help students to acquire the concept of communication and develop an ability or skills to use them effectively to communicate with the individuals and community.

COURSE OUTCOMES

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

CO1: Identify the nuances of Communication, both Oral and Written.

CO2: Acquire knowledge of the meaning of communication, communication process and speaking skills.

CO3: Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication.

CO4: Communicate effectively with an increased confidence to read, write and speak in English language fluently.

CO5: Aware of the special features of format and style of formal communication through various modes.

CO6: Write a Report, Resume, Make a presentations, Participate in GDs and Face Interviews

CO7: Illustrate use of communication to build a positive self-image through self-expression and for developing more productive interpersonal relationships.

DETAILED CONTENTS

UNIT I

Reading

1.1 Techniques of reading: Skimming and Scanning

1.2 Extensive and Intensive Reading: Textual Study

1.3 Homecoming – R.N. Tagore

1.4 Life Sketch of Sir Mokshagundam Visvesvarayya

1.5 Life Sketch of Dr. Abdul Kalam

1.6 Narayan Murthy's speech at LBSNA, Dehradun

1.7 The Portrait of a Lady - Khushwant Singh
1.8 'The Doctor's Word' by R K Narayan
1.9 Speech by Dr. Kiran Bedi at IIM Indore2007 Leadership Concepts
1.10 The Bet - by Anton Chekov

Practice Exercises comprising unseen Comprehension Passages and vocabulary enhancement.

UNIT II

Fundamentals of Communication

2.1 Concept and Process of Communication,
2.2 Types of Communication (Verbal Communication)
2.3 Barriers to Communication
2.4 Speaking Skill: Significance and essentials of Spoken Communication
2.5 Listening Skill: Significance and essentials of Listening
2.6 Modern means of Communication (Video Conferencing, e- mail, Teleconferencing)
2.7 Effective Communication Skills: 7 C's of Communication
2.8 Non-verbal Communication – Significance, Types and Techniques for effective communication
2.9 Barriers and effectiveness in Listening Skills
2.10 Barriers and effectiveness in Speaking Skills

UNIT III

Grammar and Usage

3.1 Nouns
3.2 Pronouns
3.3 Articles
3.4 Verbs(Main and Auxiliary)
3.5 Tenses
3.6 Prepositions
3.7 Conjunctions
3.8 Punctuation
3.9 Pairs of words(Words commonly misused and confused)
3.10 Translation of Administrative and Technical Terms in Hindi or Mother tongue

UNIT IV

Writing Skills

4.1 Significance, essentials and effectiveness of Written Communication
4.2 Notice Writing
4.3 Official Letters and E-mails.
4.4 Frequently-used Abbreviations used in Letter-Writing
4.5 Paragraph Writing

4.6 Netiquettes
4.7 Correspondence: Enquiry letters, placing orders, complaint letters
4.8 Basics of Report Writing
4.9 Memos
4.10 Circulars
4.11 Press Release
4.12 Inspection Notes
4.13 Application for Job and Resume writing

PRACTICAL EXERCISES

1. Reading

Reading Practice of lessons in the Lab Activity classes.
Comprehension exercises of unseen passages along with the lessons prescribed. Vocabulary enrichment and grammar exercises based on the selected readings.
Reading aloud Newspaper headlines and important articles.

2. Fundamentals of Communication

Introducing oneself, others and leave- taking (talking about yourself)
Just a minute (JAM) sessions: Speaking extempore for one minute on given topics
Situational Conversation: Offering-Responding to offers; Congratulating; Apologising and Forgiving; Complaining; Talking about likes and dislikes, Self-introduction, Mock Interview
Situational Conversation: Requesting and Responding to requests; Expressing sympathy and condolence; Warning; Asking and giving information; Getting and giving permission; Asking for and giving opinions
A small formal and informal speech
Seminar
Debate
Group Discussion
Interview Skills: Preparing for the Interview and guidelines for success in the Interview and significance of acceptable body-language during the Interview.

3. Grammar and Usage

Written and Oral Drills will be undertaken in the class to facilitate holistic linguistic competency among learners.
Exercises on grammar topics.

4. Writing Skills

Students should be given Written Practice in groups so as to inculcate team-spirit and collaborative learning.

Group exercises on writing paragraphs on given topics. Opening an e-mail account, receiving and sending emailsPractice of Writing skills.

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 2", M/S Abhishek Publications, Chandigarh.
2. V Sasikumar & PV Dhamija, "Spoken English", Tata MC Graw Hills, New Delhi, Second Edition.
3. JK Gangal, "A Practical Course in Spoken English", PHI Learning Pvt. Ltd., New Delhi.
4. NK Aggarwal and FT Wood, "English Grammar, Composition and Usage", Macmillan Publishers India Ltd., New Delhi.
5. RC Sharma and Krishna Mohan, "Business Correspondence & Report writing", Tata MC Graw Hills, New Delhi, Fourth Edition.
6. Kavita Tyagi & Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.
7. Nira Konar, "Communication Skills for professionals", PHI Learning Pvt. Ltd., New Delhi.
8. Krishna Mohan & Meera Banerji, "Developing Communication Skills", Macmillan Publishers India Ltd., New Delhi, Second Edition
9. M. Ashraf Rizwi, "Effective Technical Communication", Tata MC Graw Hills, New Delhi.
10. Andrea J Rutherfoord, "Basic Communication Skills for Technology", Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced as exercises in the Lab regularly for development of communication skills in the students. The students should be involved in activities to enhance their personality skills. This subject contains four units of equal weightage.

1.2 APPLIED MATHEMATICS

L	P
4	-

RATIONALE

Contents of this course provide fundamental base for understanding engineering problems and their solution algorithms. It provides concept, principles and procedure of skill and analytical ability in analyzing the design of parts and components in Press Tool Design. It provides an essential base in CNC Programming, Computer aided design and cost estimation in Tool & Die Technology applications. Statistics is important for understanding of tolerances, quality assurance and quality control and it is also essential for data analysis.

COURSE OUTCOMES

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

CO1: Formulate engineering problems into mathematical format with the use of differential calculus, differential equations, matrices etc.

CO2: Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem.

CO3: Understand the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry.

CO4: Compute slope, velocity, the equation of tangent and approximate area under the curve by using differential calculus and integration.

CO5: Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

DETAILED CONTENTS

UNIT I

1 Algebra and Complex Numbers

1.1 Law of Indices, Formula of Factorisation and expansion i.e. $(a+b)^2$, (a^3+b^3) etc.

1.2 Partial fraction:- Definition of Polynomial fraction proper & improper fractions and definition of partial fractions. To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, only.

1.3 Complex numbers: definition of complex number, real and imaginary parts of a complex number, Polar and Cartesian Form and their inter conversion, Conjugate of a complex number, modulus and amplitude, addition subtraction, multiplication and division of complex number.

2. Logarithms, Determinants and Matrices

2.1 Logarithms and its basic properties.

2.2 Determinants and Matrices – Evaluation of determinants (up to 3 order) by laplace method. Solution of equations (up to 3 unknowns) by Cramer's Rule. Definition of Matrices and types, addition subtraction and multiplication of Matrices (up to 2 order).

2.3 Permutation, combination formula, Values of ${}^{n}P_{r}$ and ${}^{n}C_{r}$.

2.4 Binomial theorem for positive integral index , General term, simple problems.

UNIT II

3. Trigonometry

3.1 Concept of angle: measurement of angle in degrees, grades, radians and their conversions.

3.2 T-Ratios of standard angle (0^0,30^0,45^0etc) and fundamental Identities, Allied angles (without proof) Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa).

3.3 Applications of Trigonometric terms in engineering problems such as to find an angle of elevation, height, distance etc.

4. Co-ordinate Geometry

4.1 Point: Distance Formula, Mid Point Formula, Centroid of triangle and area of triangle.

4.2 Straight line: Slope of a line, equation of straight line in various standards forms (without proof); (slope intercept form, intercept form, one-point form, two-point form, normal form, general form), angle between two straight lines.

4.3 Circle: General equation of a circle and identification of centre and radius of circle. To find the equation of a circle, given:

4.4 Centre and radius

4.5 Coordinates of end points of a diameter

UNIT III

5. Differential Calculus

5.1 Definition of function; Concept of limits (Introduction only) and problems related to four standard limits only.

5.2 Differentiation of standard function (Only formulas), Differentiation of Algebraic function, Trigonometric functions, Exponential function, Logarithmic function

5.3 Differentiation of sum, product and quotient of functions.

6. Higher Differential Calculus

6.1 Successive differentiation (up to 2nd order)

6.2 Application of differential calculus in:

6.3 Rate measures

6.4 Maxima and minima

UNIT IV

7. Integral Calculus

7.1 Integration as inverse operation of differentiation with simple examples.

7.2 Simple standard integrals, Integrations by parts and related Simple problems

7.3 Evaluation of definite integrals with given limits.

Evaluation of $\int_0^{\pi/2} \sin^n x.\, dx$, $\int_0^{\pi/2} \cos^n x\, dx$, $\int_0^{\pi/2} \sin^m x\, \cos^n x\, dx$

using formulae without proof (m and n being positive integers only) using pre-existing mathematical models.

8. Application Integral Calculus and Numerical Integration

8.1 Applications of integration: for evaluation of area under a curve and axes (Simple problems where the limits are given).

8.2 Numerical integration by Trapezoidal Rule and Simpson's $1/3^{rd}$ Rule using pre-existing mathematical models.

UNIT V

9. Differential Equations

Definition, order, degree and linearity, of an ordinary differential equation. Solution of I^{st} order and I^{st} degree differential equation by variable separable method (Simple problems)

10. Statistics and Software

Statistics

10.1 Measures of Central Tendency: Mean, Median, Mode

10.2 Measures of Dispersion: Mean deviation from mean, Standard deviation

Software

10.3 SciLab software – Theoretical Introduction.

10.4 Basic difference between MATLAB and SciLab software.

10.5 Calculations with MATLAB or ScilLab –

(a) Representation of matrix (2×2 order),

(b) Addition, Subtraction of matrices (2×2 order) in MATLAB or SciLab

RECOMMENDED BOOKS

1. BS BS Grewal, "Elementary Engineering Mathematics", Khanna Publishers, New Delhi.
2. S Kohli, "Engineering Mathematics Vol. I & II", IPH, Jalandhar.
3. SS Sabharwal & Dr Sunita Jain, "Applied Mathematics Vol. I & II", Eagle Parkashan, Jalandhar.
4. V Sundaram et al, "Engineering Mathematics Vol. I, II & III", Vikas Publishing House (P) Ltd., New Delhi.
5. SS Sastry, "Engineering Mathematics Vol. I & II", Prentice Hall of India Pvt. Ltd.
6. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics – I", CBS Publisher, New Delhi.
7. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –II", CBS Publisher, New Delhi.
8. Srimanta Pal and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, New Delhi.
9. R. Pratap, "Getting Started with MATLAB 7", Oxford University Press, Seventh Edition.
10. E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://www.scilab.org

INSTRUCTIONAL STATREGY

This is theoretical subject and contains five units of equal weight age. By laying more stress on applied part, teachers can also help in providing continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts through multiple problem solving based on the topics that the industry requires. For example they need to know how to use mathematical models that use integration as opposed to learning how integration can be used. Useful authenticated software MATLAB or open source software SciLab can be taught theoretically by books/online literatures and basic operations can be shown practically with practical software laboratory or small mobile apps of these software or authentic Trial version of MATLAB/ SciLab software. Diploma students need to know which tools to use and how to do the job.

1.3 APPLIED PHYSICS

L	P
2	1

RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both byobservation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content.

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both byobservation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content to prepare students for various engineering applications.

COURSE OUTCOMES

After completing this subject, student should be able to:

CO1: Identify physical quantities, select their units and make measurements with accuracy.

CO2: Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications.

CO3: Elaborate scientific work, energy and power, forms of friction and solve problems related to them.

CO4: Comprehend properties of matter and effect of temperature on various matter and phenomenon.

CO5: Demonstrate the use of physical principles and analysis in various technical fields.

CO6: Differentiate between types of waves and their motion.

CO7: Illustrate laws of reflection and refraction of light.

CO8: Demonstrate competency in phenomena of electrostatics and electricity.

CO9: Characterize properties of material to prepare new materials for various technical applications.

CO10: Demonstrate a strong foundation on Modern Physics to use at various technical applications.

DETAILED CONTENTS

UNIT I

1. Unit and Dimensions

1.1 Definition of Physics, physical quantities- fundamental and derived

1.2 Units: fundamental and derived

1.3 System of units: CGS, FPS, MKS, SI

1.4 Dimension, dimensional formulae and SI units of physical quantities-distance, displacement, area, volume, density, velocity, acceleration, linear momentum, force, impulse, work, power, energy, pressure, surface tension, stress, strain)

1.5 Dimensional equations, principle of homogeneity of dimensional equation

1.6 Application of dimensional analysis: checking the correctness of physical equation, conversion of system of unit (force, work, acceleration)

2. Force and Motion

2.1 Scalar and vector quantities– definition and examples, representation of vector, types of vector (unit vector, position vector, co-initial vector, collinear vector, co-planar vector).

2.2 Vector algebra- addition of vectors, Triangle & Parallelogram law (statement and formula only).

2.3 Scalar and vector product (statement and formula only).

2.4 Force and its units, resolution of force (statement and formula only).

2.5 Newton's laws of motion (statement and examples).

2.6 Linear momentum, Law of conservation of linear momentum (statement and examples), Impulse.

2.7 Circular motion: definition of angular displacement, angular velocity, angular acceleration, frequency, time period; Relation between linear and angular velocity, centripetal and centrifugal forces (definition and formula only), application of centripetal force in banking of road.

2.8 Rotational motion: definition with examples.

2.9 Definition of torque, angular momentum, moment of inertia and its physical significance.

UNIT II

3. Work, Power and Energy

3.1 Work- definition, symbol, formula and SI unit, types of work (zero work, positive work and negative work) with example.

3.2 Friction– definition and its simple daily life applications.

3.3 Power- definition, formula and units.

3.4 Energy- definition and its SI unit, examples of transformation of energy.

3.5 5 Kinetic energy- definition, examples, formula and its derivation.
3.6 Potential energy- definition, examples, formula and its derivation.
3.7 Law of conservation of mechanical energy for freely falling bodies (with derivation).
3.8 Simple numerical problems based on formula of Power and Energy.

4. Properties of Matter

4.1 Elasticity and plasticity- definition, deforming force, restoring force, example of elastic and plastic body.
4.2 Definition of stress and strain, Hooke's law, modulus of elasticity.
4.3 Pressure- definition, atmospheric pressure, gauge pressure, absolute pressure, Pascal's law.
4.4 Surface tension- definition, SI unit, applications of surface tension, effect of temperature on surface tension.
4.5 Viscosity: definition, unit, examples, effect of temperature on viscosity.

UNIT III

5. Heat and Temperature

5.1 Definition of heat and temperature (on the basis of kinetic theory).
5.2 Difference between heat and temperature.
5.3 Principle and working of mercury thermometer.
5.4 Modes of transfer of heat- conduction, convection and radiation with examples.
5.5 Properties of heat radiation.
5.6 Different scales of temperature and their relationship.

6. Wave Motion and its Applications

6.1 Waves: definition, types (mechanical and electromagnetic wave).
6.2 Wave motion- transverse and longitudinal with examples, terms used in wave motion like displacement, amplitude, time period, frequency, wavelength, wave velocity; relationship among wave velocity, frequency and wave length.
6.3 Simple harmonic motion (SHM): definition, examples.
6.4 Cantilever: definition, formula of time period (without derivation).
6.5 Free, forced and resonant vibrations with examples.
6.6 Sound waves: types (infrasonic, audible, ultrasonic) on the basis of frequency, noise, coefficient of absorption of sound, echo.

UNIT IV

7. Optics

7.1 Reflection and refraction of light with laws, refractive index.
7.2 Lens: introduction, lens formulae (no derivation), power of lens and simple numerical problems.

7.3 Total internal reflection and its applications, critical angle and conditions for total internal reflection.

7.4 Superposition of waves (concept only), definition of Interference, Diffraction and Polarization of waves.

7.5 Introduction to Microscope, Telescope and their applications.

8. Electrostatics and Electricity

8.1 Electric charge, unit of charge, conservation of charge.

8.2 Coulomb's law of electrostatics.

8.3 Electric field, electric lines of force (definition and properties), electric field intensity due to a point charge.

8.4 Definition of electric flux, Gauss law (statement and formula).

8.5 Capacitor and capacitance (with formula and unit).

8.6 Electric current and its SI Unit, direct and alternating current.

8.7 Resistance, conductance (definition and unit).

8.8 Series and parallel combination of resistances.

8.9 Ohm's law (statement and formula).

UNIT V

9. Classification of Materials and their Properties

9.1 Definition of energy level, energy bands.

9.2 Types of materials (conductor, semiconductor, insulator and dielectric) with examples, intrinsic and extrinsic semiconductors (introduction only).

9.3 Introduction to magnetism, type of magnetic materials: diamagnetic, paramagnetic and ferromagnetic materials with examples.

9.4 Magnetic field, magnetic lines of force, magnetic flux.

9.5 Electromagnetic induction (definition).

10. Modern Physics

10.1 Laser: introduction, principle, absorption, spontaneous emission, stimulated emission, population inversion.

10.2 Engineering and medical applications of laser.

10.3 Fibre optics**:** introduction to optical fibers (definition, principle and parts), light propagation, fiber types (mono-mode, multi-mode), applications in medical, telecommunication and sensors.

10.4 Nanotechnology: introduction, definition of nanomaterials with examples, properties at nanoscale, applications of nanotechnology (brief).

PRACTICAL EXERCISES

1. Familiarization of measurement instruments and their parts (for example - vernier calliper, screw gauge, spherometer, travelling microscope etc.), and taking a reading. (compulsory to all students).
2. To find diameter of solid cylinder using a vernier caliper.
3. To find internal diameter and depth of a beaker using a vernier calliper and hence find its volume.
4. To find the diameter of wire using screw gauge.
5. To find thickness of paper using screw gauge.
6. To determine the thickness of glass strip using a spherometer
7. To determine radius of curvature of a given spherical surface by a spherometer.
8. To verify parallelogram law of force.
9. To determine the atmospheric pressure at a place using Fortin's Barometer.
10. To determine force constant of spring using Hooke's law.
11. Measuring room temperature with the help of thermometer and its conversion in different scale.
12. Familiarization with apparatus (resistor, rheostat, key, ammeter, voltmeter, telescope, microscope etc.)
13. To find the time period of a simple pendulum.
14. To study variation of time period of a simple pendulum with change in length of pendulum.
15. To determine and verify the time period of Cantilever.
16. To verify Ohm's laws by plotting a graph between voltage and current.
17. To study colour coding scheme of resistance.
18. To verify laws of resistances in series combination.
19. To verify laws of resistance in parallel combination.
20. To find resistance of galvanometer by half deflection method.
21. To verify laws of reflection of light using mirror.
22. To verify laws of refraction using glass slab.
23. To find the focal length of a concave lens, using a convex lens.

RECOMMENDED BOOKS

1. "Text Book of Physics for Class XI (Part-I, Part-II)", N.C.E.R.T., Delhi.
2. Dr. HH Lal, "Applied Physics, Vol. I and Vol. II", TTTI Publications, Tata McGraw Hill, Delhi.
3. AS Vasudeva, "Applied Physics – I", Modern Publishers, Jalandhar.
4. R A Banwait, "Applied Physics – I", Eagle Prakashan, Jalandhar.

5. N Subrahmanyam, Brij Lal and Avadhanulu, "A text book of OPTICS", S Chand Publishing, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.
7. M H Fulekar, "Nanotechnology: Importance and Applications", IK International Publishing House (P) Ltd., New Delhi.
8. C. L. Arora, "Practical Physics", S Chand Publication.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. The Physics Classroom
3. https://www.khanacademy.org/science/physics

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students. Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed. Working in different sets of units can be taught through relevant software.

1.4 WORKSHOP TECHNOLOGY - I

L	P
3	-

RATIONALE

This subject describes the facts, concepts, principles and procedures of using hand tools, machine tools and related techniques efficiently effectively to plan the manufacturing of tool and die parts to the specification considering safety and environment. It also useful in understanding technology and apply them in the areas such as workshop practice, tool design, production plan, estimation and supervisory management. It also describes the concept, principle and procedures to identify and report the maintenance requirement for corrective action. It also describes the procedures to derive the specification of hand tools, machine tools for tool and die making.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:
CO1: Explain working principle of measuring instruments.
CO2: Describe the working of various metal working techniques.
CO3: Explain the working of various machining operations.
CO4: Calculate machine parameters for various machining operations.
CO5: Take safety measures for prevention of accidents.

DETAILED CONTENTS

UNIT I

1.1 Introduction to Workshop Technology

Definition and Classification of industrial materials and processing methods, Identification, classification of major industrial material processing methods & Material processing Technique , Efficiency, Effectiveness and Productivity.

1.2 Hand Tools

Selection and use of Hand Tools, Design features, classification, description and design and construction of various hand tools, Types of files, Types of Chisel, Types of Marking tool Classification

1.3 Metal Joining Techniques

Introduction to metal joining techniques, Definition, Classification and Basic working of welding, Soldering, Brazing.

1.4 Measuring Instruments

Introduction of Measuring instruments, Use and application of basic measuring instruments, (Bench work related measuring instruments), Concept and classification of basic measuring instruments

1.5 Safety Precautions

Introduction, Use and application of safety precautions, safety rules, prevention of accidents, Concept of accidents, Classification of accidents, rules and safety precautions, Source of accident, Causes of accidents, Select safety rules and precautions

UNIT II

2.1 Drilling Operations and Drilling Machines (Level I)

Introduction: Definition, Classification, selection and use of Drilling operations and Drilling Machines, Understand different types of drilling machine and their Parts. Type of work holding devices: Vice, angle plate, 'V' block, 'C' clamp, Cutting tool holders for drilling machines: Drill Chucks, Reduction sleeves, Drifts, Tapping Attachments, Cutting Parameters: Calculation of Speed, Feed, Depth of cut, Operations: Drilling, Tapping, Reaming, Counter sinking, Counter boring, Cutting fluids and applying the standard practice and norms with respect to safety and maintenance.

2.2 Column Drilling Machines and Radial Drilling Machine

Introduction: Classification, selection and use of Column drilling machines and Radial drilling machine, Description of main parts of machine, drilling operation and their functions, Work holding devices: Step blocks, T bolts and clamps, Co-ordinate tables, Sine vice and sine table, Cutting Tools: Large size drills, Boring tools, Special reamers, Cutting tool attachments: Boring attachments, Cutting Parameters: Machine calculation, setting up, speed, feed, depth of cut, Operations: Drilling, Counter boring, Reaming, Step drilling, Spot facing, Cutting Fluid and applying the standard practice and norms with respect to safety and maintenance.

2.3 Grinding

Introduction and application of Grinding machine (Hand Grinder & Pedestal Grinder), Use and selection of grinding operation, Classification, Design, Construction, & Description, Factors of cutting tool, work material, machine, Identify the use and select the Hand grinding operation and Pedestal grinder by applying the standard practice and norms.

UNIT III

3.1 Sawing Operation and Power Hack Saw

Introduction, Use and selection of Sawing operations & power hack saw, Classification, and Description, Principles of working, Factors of cutting tool, work material, Identify the use and select the sawing operations & power hack saw by applying the standard practice and norms with respect to safety and maintenance.

3.2 Sawing Operation and Band Saw

Introduction, Use and selection of Sawing operation and Band Saw, Definition, Classification, Description, Factors of cutting tool, work material, machine, Identify the use and select the Sawing operation and Band Saw by applying the standard practice and norms with respect to safety and maintenance.

3.3 Shaping Operations and Shaper

Introduction, Use and selection of Shaping operation and shaper, Definition, Classification, Description. Factors of cutting tool, work material, machine, Identify the use and select the shaping operation and shaper by applying the standard practice and norms with respect to safety and maintenance.

3.4 Planning Operations and Planer

Introduction, Use and selection of Planning operations and Planer, Definition, Classification, Description, Factors of cutting tool, work material, machine, Identify the use and select the Planning operations and Planer by applying the standard practice and norms with respect to safety and maintenance.

3.5 Slotting Operations and Slotting Machine

Introduction, Use and selection of Slotting operation & Slotting machine, Definition, Classification, Design, Construction, Description, Factors of cutting tool, work material, Machine , Identify the use and select the Slotting operation & Slotting machine by applying the standard practice and norms with respect to safety and maintenance.

UNIT IV

4.1 Centre Lathe

Introduction, Classification, selection and use of turning operation and lathe, Definition, Description of main parts and functions of Machines: (Center Lathe).

Work Holding Devices: 3 Jaw Chuck, 4 - Jaw Chuck, Dead Center, Revolving center, Face plate, Dog carrier, Cutting Tools: Nomenclature and types of, Center Drills, H S S Tools (single point) for roughing and finishing, Knurling tools, Grooving, left hand, and right hand tools, Cutting tool holders: Drill chuck, Tool post, Cutting Parameters: Speed, Feed, Depth of cut, Tool geometry, Time calculations & Cutting fluids, Operations: Plain Turning, Shoulder turning, Grooving, Facing, Knurling, Eccentric Turning, Drilling, Chamfering , The operational principles of machines, parts and accessories, Safety and maintenance of machines and cutting tools and applying the standard practice and norms with respect to safety and maintenance.

4.2 Tool Room Lathe, Capstan Lathe, Turret Lathe:

Introduction: Classification, selection and use of turning operations and lathe, Definition & Description of main parts and functions of Machines: (Tool room lathe, Capstan lathe, Turret lathe), Work holding Devices: Collets, steady rest, follow rest, Taper Turning attachments, Thread Chaser, Cutting Tools: Boring, Threading form tools, Counter Boring tools, Parting tools, ISO nomenclature for brazed carbide tips, Taps and Dies, Cutting Tool holders Boring tool holders, Die holders, Special tool holders for capstan and turret lathe, Cutting parameters: Tool geometry with respect to operations, Time calculation, Operations: Boring, Threading- internal, external, Counter boring, Taper turning, Form Generation, The operational principles of machines, parts and accessories, Safety and maintenance of machines and cutting tools and applying the standard practice and norms with respect to safety and maintenance.

UNIT V

5.1 Vertical Milling Machine, Horizontal Milling Machine

Introduction: Classification, selection, use of Milling Operations & Milling M/c, Definition, Description of main parts and functions of Machine: (Vertical Milling Machine, Horizontal Milling Machine) , Safety and maintenance of the machine, Work holders and attachments: Vice, Parallel Bars, Clamps, Angle plates, Jacks, V-blocks, Cutting Tools : End mills, Shell and Mills, Slide face cutters, Angular cutters, Drills, Reamers etc, Cutting Tool Holders: Collets, Arbours, Adapters, Edge finder, Dial indicator, Cutting Parameters: Speed , Feed, Depth of cut, Tool Geometry, Cutting Fluids, Time calculations, Operations: Plane Milling, Face Milling, Side Milling, Straddle Milling, Angular Milling, Slot Milling, Operational principles of Machine and accessories,

5.2 Universal Milling Machine

Introduction, Classification, selection and use of Milling Operations and Milling Machines: (Universal Milling Machine), Work Holders and attachments: Universal vice, Sine vice, Rotary table, Cutting tools: Concave and Convex form cutters, T slot Cutters, Saws, Single point boring cutter, Introduction of carbide inserts and holders , Solid carbide Cutters, Cutting Tool Holders: Spring Collet, Long Arbor, Boring Head, Cutting Parameters: Machining Time, Calculation of number of teeth, Tool Geometry, Speed, feed, depth of cut, cutting fluids as per tables and charts, Operations: Profile Milling, Key ways, Sawing Slits and openings, T – slots, Operational Principles of machine parts and accessories,

Cutting and material removal, Safety and maintenance of machine, work piece. Cutting tools and accessories. Identify the milling machine, work holding device, cutting tool holder for operations by applying the standard practice and norms with respect to safety and maintenance.

RECOMMENDED BOOKS

1 J. Chapman, "Workshop Technology (Vol I, II & III)", Amol Publication, New Delhi, Fifth Edition, 2001.

2 S.K. Hazra and S.K. Choudhary, "Elements of Workshop Technology", Media Promotors & Publishers Pvt. Ltd., Mumbai, Fifteenth Edition, 2010.

3 A.B. Chattopadhyay," Machining & Machine Tools", Wiley India Pvt. Ltd, Noida, Second Edition, 2017.

4 R. N. Datta," Machine Tools (workshop Technology)", New Central Book Ahency, Kolkata, Third Edition, 2013.

5 Dr. Rajendra Singh," Introduction To Basic Manufacturing Process & Workshop Technology", New Age International Publisher, New Delhi, Second Edition, 2020.

6 B.S. Raghuwanshi "A Course in Workshop Technology Vol. 1 (Manufacturing Process)", New Heights, New Delhi, First Edition, 1998.

7 K.N. Gupta and J.P. Kaushish," Workshop Technology Vol I to II", New Heights, New Delhi, First Edition, 1998.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis in making students conversant with concepts and principles of manufacturing processes. This is theoretical subject and contains five units of equal weight age.

1.5 ENGINEERING DRAWING

L	P
-	4

RATIONALE

The subject aims to develop understanding of the scientific facts, concepts, principles & procedures of Engineering Drawing used in tool design, manufacturing, process planning, estimation, inspection & qc including supervisory management to express the ideas, conveying instructions for carrying out jobs in tool & die technology. It is also useful in understanding technology subject such as tool design, workshop practice, production planning & estimation, supervisory management, CAD by achieving basic drawing skills, utilization & interpreting drawings. It also describes the concepts, principles and procedures of drawing of machine elements to understand machine maintenance & service manuals and related technical catalogue.

COURSE OUTCOMES

At the end of the subject student will be able to:
CO1: Comprehend media used for engineering drawing.
CO2: Select various scales, lines and lettering.
CO3: Draw simple and advance geometrical construction.
CO4: Draw view of different objects viewed from different angles (orthographic views).
CO5: Generate isometric (3D) drawing of different laminas and solids.
CO6: Comprehend the rules of geometrical tolerances and surface texture symbols.
CO7: Draw sectional views.
CO8: Draw different solids and develop their surfaces.
CO9: Interpret intersection of solids.
C10: Prepare 2D drawings of components using AutoCAD.

DETAILED CONTENTS

UNIT I

1.1 Introduction

Introduction and observation of engineering drawing practices in the Tool Room environment and manufacturing industry, Definition of sketches, mechanical and computer generated drawings, Classification of drawing set and related information, Industrial drafting process from product conception to production, Integrate the flow of engineering drawing Tool Room. Select reference material and ISO norms, Sketch flow charts of engineering drawing process of Tool Room.

1.2 Media used for Engineering Drawing

Introduction: Introduction to drawing instruments, Definition & Concept of standard drawing sheets, conventional drawing instruments accessories and aids, reproduction, storage, retrieval, Principle of standard drawing sheets.

1.3 Scales, Lines & Lettering

Introduction to scales, lines and lettering, Definition, Types & RF, Classification of scales, full, reduce and large scale. Classification of lines and lettering, Choice and use of BIS norms for scale, lines & lettering, Factors for selection of various scales, lines & lettering

1.4 Geometric Constructions

Introduction to examples of simple and advanced geometrical construction**,** Straight lines, Angles, Polygons, Circle/ Arcs. Definition, principles, procedures, exercise of advance geometricalconstruction. Conic Section: Ellipse, Parabola, Hyperbola Other curves: Helix, Cycloid, Involute**.** Procedure for drawing, state line, angles, polygons, circle.

UNIT II

2.1 Orthographic Projections

Introduction and concept of Projection, Type and classification of Projection, orthographic projections, Definition of orthographic projections, Points, Lines, Planes, Solids, Principles of quadrants and planes, Principles of different views, Procedure for drawing different views of points, lines, and solids planes (in 1st and 3rd quadrants)

2.2 Orthographic Projections of Objects

Introduction to 1st angle and 3^{rd} angle projections, Definition & Concept of 1^{st} angle and 3^{rd} angles, Principles of 1^{st} angle and 3^{rd} angle projections according to BIS norms, Procedure for drawing different views of an object in 1^{st} angle and 3^{rd} angle.

2.3 Isometric projections

Introduction to isometric projection, Definition of isometric projections (axes, lines, planes), Principles: Principles of co-ordinates (x, y, z), Principles of isometric projections of planes, prisms, pyramids, cylinders, cones, irregular objects, Principles of dimensioning of isometric projections, Procedure for drawing isometric views of regular solids and irregular objects.

2.4 Dimensioning

Introduction to dimension, Functional dimension, Non functional dimension, Auxiliary dimension, Rules of dimensioning, Method of dimensioning, Indication of dimensioning, BIS norms, Procedure of dimensioning.

UNIT III

3.1 Sectional Views

Introduction: Introduction to section views, Types of sections, Sectional lines, Assembly sectioning. Principles of sectioning & BIS norms and Procedure for selecting and drawing of section views.

3.2 Surface Texture

Introduction to surface texture symbols, Definition & Classification of surface texture symbols, Surface texture value and location, and Procedure for drafting of symbols & location of symbol.

3.3 Geometric Tolerance Symbols and Characteristics

Introduction to geometrical tolerance symbols and characteristics, Definition of single and related features, Form tolerance (Straightness, flatness, circularity, cylindricity, profile of line and profile of surface), Orientation tolerances (Parallelism, Perpendicularity and angularity), Location tolerances (Position, coaxiality, symmetry), Run-out tolerances (Circular run-out, total run- out), Rules of geometrical tolerancing, Relationship of individual features from its ideal feature form and Procedure of drafting symbols, indicating tolerances and characteristics, interpreting symbols and indications

UNIT IV

4.1 Elements of Assembly

Introduction to Elements of assembly, Definition: Temporary joints, Screw threads, Bolts, Nuts, Dowels, Washers, Springs Permanent joints, Representation norms as per BIS to represent the elements being used for assembly, Selection and representation of different elements in engineering drawing used in assembly.

4.2 Elements of Joints

Introduction to rivet joints, welded joints and pipe joints, Definition: Temporary joints, Permanent joints, Rivet joints and types, Welded joints and types, Pipe joints and types, Principles of representation of different types of joints as per BIS norms and Procedure of drawing and dimensioning of different joints.

4.3 Assembly and Detail Drawings

Introduction: Introduction to assembly drawing and detail drawings, definition Detail Drawing, Title block, Bill of material block, modification block, Relationship of assembly drawing, detail drawing and bill of material, Procedures for drawing of assembly drawing and detail drawing and with bill of material etc. for the simple jobs.

UNIT V

5.1 Auto CAD

Introduction , application and benefit and necessity of Auto CAD in engineering industry, Operational Instructions of Various Commands, Use and application of Basic Tool Bar: DRAW MODIFY and ANOTATE etc., Coordinate system: Absolute and Relative, Making 2D Drawings of various Mechanical component/ Geometrical Figure.

RECOMMENDED BOOKS

1 N. D. Bhatt, "Elementary Engineering Drawing", Charotar Book Stall, Anand, Fifty-third Edition, 2014.

2 AC Parkinson, "Engineering Workshop Drawing", Sterling Book House, Mumbai, Second Edition, 1958.

3 PS Gill, "Engineering Drawing", SK Kataria & Sons., New Delhi, Thirteenth Edition, 2016.

4 PS Gill, "Machine Drawing", SK Kataria & Sons., New Delhi. Eighteenth Edition, 2013.

5 RK Dhawan, "Machine Drawing", S Chand & Co., New Delhi, Third Edition, 2019.

6 T Jeeyapoovan, "Engineering Graphics Using AUTOCAD", S Chand & Co., New Delhi, Seventh Edition, 2015.

7 NS Parthasarthi, "Engineering Drawing", Oxford University Press, UK, First Edition, 2015.

8 Cecil Jensen and Jay Helsel, "Engineering Drawing & Design", McGraw Hill Book Co., Seventh Edition, 2017.

INSTRUCTIONAL STRATEGY

This is hands-on practice based course for development of required skills in the students.

1.6 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

L	P
1	-

RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industrial and construction activities so that he/she may help in balancing the ecosystem and controlling pollution by various control measures. The course is intended to provide a general concept in the dimensions of environmental pollution and disasters caused by nature beyond the human control as well as the disasters and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery.

COURSE OUTCOMES

After undergoing the subject, the student will be able to:
CO1: Comprehend the importance of sustainable ecosystem.
CO2: Clarify interdisciplinary nature of environmental issues.
CO3: Describe corrective measures for the abatement of pollution.
CO4: Identify the role of non-conventional energy resources in environmental protection.
CO5: Recognize various types of disasters.

DETAILED CONTENTS

UNIT I
Introduction

1.1 Basics of ecology, eco system- concept, and sustainable development, Sources, advantages, disadvantages of renewable and nonrenewable energy.
1.2 Rain water harvesting
1.3 Deforestation – its effects & control measures

UNIT II
Air and Noise Pollution

2.1 Air Pollution: Source of air pollution. Effect of air pollution on human health, economy, Air pollution control methods.
2.2 Noise Pollution: Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimizing noise pollution.

UNIT III

Water and Soil Pollution

3.1 Water Pollution: Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of DO, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

3.2 Soil Pollution: Sources of soil pollution, Effects and Control of soil pollution, Types of Solid waste- House hold, Industrial, Agricultural, Biomedical, Disposal of solid waste, Solid waste management E-waste, E – waste management.

UNIT IV

Impact of Energy Usage on Environment

4.1 Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings, Concept of Carbon Credit & Carbon footprint.

UNIT V

Disaster Management

5.1 Different Types of Disaster:

Natural Disaster: such as Flood, Cyclone, Earthquakes and Landslides etc.

Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc.

5.2 Disaster Preparedness:

Disaster Preparedness Plan

Prediction, Early Warnings and Safety Measures of Disaster

Psychological response and Management (Trauma, Stress, Rumour and Panic)

RECOMMENDED BOOKS

1. S.C. Sharma & M.P. Poonia, “Environmental Studies”, Khanna Publishing House, New Delhi.
2. BR Sharma, “Environmental and Pollution Awareness”, Satya Prakashan, New Delhi.
3. Dr. RK Khitoliya, “Environmental Pollution”, S Chand Publishing, New Delhi.
4. Erach Bharucha, “Environmental Studies”, University Press (India) Private Ltd., Hyderabad.
5. Suresh K Dhamija, “Environmental Engineering and Management”, S K Kataria and Sons, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/BTE/NITTTR, Chandigarh.
7. Dr. Mrinalini Pandey, “Disaster Management”, Wiley India Pvt. Ltd.

8. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill Education (India) Pvt. Ltd.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies and Disaster Management like expert lectures, seminars, visits etc. may also be organized. This subject contains five units of equal weightage.

1.7 FUNDAMENTALS OF IT

L	P
1	2

RATIONALE

Information technology has great influence on all aspects of life. Almost all work places and living environment are being computerized. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concepts of information technology and its scope, operating a computer: use of various office management tools, using internet and mobile applications etc. This course is intended to make new students comfortable with computing environment - Learning basic computer skills, learning basic application software tools, Understanding Computer Hardware, Cyber security awareness.

COURSE OUTCOMES

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

CO1: Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers.

CO2: Handle the computer/laptop/mobiles/Internet Utilities and Install/Configure OS.

CO3: Assemble a PC and connect it to external devices.

CO4: Manage and Use Office practiced Automation Tools CO5: Develop worksheets and Prepare presentations.

DETAILED CONTENTS

UNIT I

Basics of Computer

Brief history of development of computers, Definition of Computer, Block diagram of a Computer, Hardware, Software, Booting: Cold and Hot Booting, Interaction between the CPU and Memory with Input/Output devices, Function of CPU and major functional parts of CPU. Memory, Bit, Nibble, Byte, KB, MB, GB, TB, PB, Functions of memory, Use of storage devices in a Computer, List types of memory used in a Computer, Importance of cache memory, CPU speed and CPU word length.

UNIT II

Basic Internet Skills

Understanding browser, Introduction to WWW, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals. Advantages of Email, Various email service providers, Creation of email id, sending and receiving emails, attaching documents with email and drive.

Effective use of Gmail, G-Drive, Google Calendar, Google Sites, Google Sheets, Online mode of communication using Google Meet & WebEx.

UNIT III

Basic Logic building

Introduction to Programming, Steps involved in problem solving, Definition of Algorithm, Definition of Flowchart, Steps involved in algorithm development, differentiate algorithm and flowchart, symbols used in flowcharts, algorithms for simple problems, flowcharts for simple problems, Practice logic building using flowchart/algorithms.

UNIT IV

Office Tools

Office Tools like LibreOffice/OpenOffice/MSOffice.

OpenOffice Writer – Typesetting Text and Basic Formatting, Inserting Images, Hyperlinks, Bookmarks, Tables and Table Properties in Writer

Introducing LibreOffice/OpenOffice *Calc*, Working with Cells, Sheets, data, tables, using formulaeand functions, using charts and graphics.

OpenOffice Impress – Creating and Viewing Presentations, Inserting Pictures and Tables, SlideMaster and Slide Design, Custom Animation.

UNIT V

Use of Social Media

Introduction to Digital Marketing – Why Digital Marketing, Characteristics of Digital Marketing, Tools for Digital Marketing, , Effective use of Social Media like LinkedIn, Google+, Facebook, Twitter, etc.: Features of Social media, Advantages and Disadvantages of Social Media.

PRACTICAL EXERCISES

1. Browser features, browsing, using various search engines, writing search queries
2. Visit various e-governance/Digital India portals, understand their features, services offered
3. Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognize various ports/interfaces and related cables, etc.
4. Using Administrative Tools/Control Panel Settings of Operating Systems

5. Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6. Explore features of Open Office tools and MS-Office, create documents, create presentation,create spread sheet, using these features, do it multiple times.
7. Working with Conversion Software like pdfToWord, WordToPPT, etc.
8. Working with Mobile Applications – Searching for Authentic Mobile app, Installation and Settings, Govt. of India Mobile Applications.
9. Creating email id, sending and receiving mails with attachments.
10. Using Google drive, Google calendar.
11. Create Flow chart and Algorithm for the following

a. Addition of n numbers and display result.
b. To convert temperature from Celsius to Fahrenheit.
c. To find Area and Perimeter of Square.
d. Swap Two Numbers.
e. find the smallest of two numbers.
f. Find whether given number is Even or Odd.
g. To print first n even Numbers.
h. find sum of series 1+2+3+…..+N.
i. print multiplication Table of a number.
j. generate first n Fibonacci terms 0,1,1,2,3,5…n (n>2).
k. sum and average of given series of numbers.
l. Factorial of number n (n!=1x2x3x…n).
m. Armstrong Number.
n. Find whether given number is Prime or not.

RECOMMENDED BOOKS

1. R.S. Salaria, “Computer Fundamentals”, Khanna Publishing House.
2. Ramesh Bangia, “PC Software Made Easy – The PC Course Kit”, Khanna Publishing House.
3. Online Resources, Linux man pages, Wikipedia.
4. Mokhtar Ebrahim, Andrew Mallett, “Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming”.
5. Vikas Gupta, “Comdex Hardware and Networking Course Kit”, Dream Tech press, New Delhi, 2008.
6. Sumitabha Das, “UNIX concepts and applications”, Tata McGraw Hill, New Delhi, 4th Edition, 2008.

SUGGESTED WEBSITES

1. https://nptel.ac.in/courses/106/106/106106222/ - NPTEL Course on Modern Application Development.
2. https://onlinecourses.swayam2.ac.in/aic19_de01/preview -.
3. https://spoken-tutorial.org/ - Tutorials on Introduction to Computers, HTML, LibreOffice Tools,etc.
4. NOTEPAD++.
5. https://tms-outsource.com/blog/posts/web-development-ide/.

INSTRUCTIONAL STRATEGY

This is a skill based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weight age.

1.8 WORKSHIP PRACTICE - I

L	P
-	12

RATIONALE

The purpose of this course is to enable the students to produce useful items by acquiring hand skill and selected machining skill in basic metal working and machine tool operations and by combining them with the knowledge of organization and safety regulations. The trainees also manufacture machine accessories and standard parts by integrating hand skill and machine tool operation skill.

COURSE OUTCOMES

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

CO1: Identify tools, equipment and materials used in preparing jobs.

CO2: Select materials, tools, and sequence of operations to make a job as per given specifications/drawing.

CO3: Prepare simple jobs independently.

C04: Prepare basic components of press tools, moulds, jigs and fixtures.

CO5: Take measurements by using measuring instruments.

CO6: Comprehend store management practices.

DETAILED CONTENTS CUM PRACTICALS

UNIT I

1.1 Introduction

Introduction to Organization / Institute (MSME Technology Centre) mandate, mission and policies, Introduction & Demonstration of 5S in the workshop.

1.2 Safety

Explain safety and environment, protection and guidelines. Identify and take charge of work place, tools, time table etc.

Workshop Safety Induction Session, Use of PPE (Personal Protection Equipment), Use of Safety Equipment like fire extinguishers etc.

1.3 Bench work

To make utility items such as parallel plates and bow for v block using the bench tools and covering the skills such as filing, sawing, punching, marking, center drilling, drilling, counter

boring, counter sinking, reaming and taping, Introduction, function and types of marking and measuring tools and instruments (surface plate, try square, calliper, steel rule, scriber etc.).

UNIT II

2.1 Fitting and Assembly

Basic fitting and assembly, Assembly of various Male and Female parts, Shearing, realigning and curving.

2.2 Dimensional Metrology

Fundamentals of dimensional metrology: Metric & inch system, Measuring with steel rule, vernier calliper, outside / Inside calliper, micrometer external / internal and depth angular measurements using universal bevel protector, Measuring errors, remedies and prevention

UNIT III

3.1 Lathe Machine:

Use and operate Lathe Machine, identification of Cutting tools, To make the exercise jobs and the parts of press tools such as bushes, pillars and utility items like central punch, studs, nuts to cover the skills like plane turning, facing, step turning, parting, recessing, undercutting, thread cutting, taper turning and eccentric turning.

UNIT IV

4.1 Milling Machine

Use and operate Milling Machine, identification of cutting tools, Making v block covering the following skills of face milling, step milling, profile milling, sawing on horizontal milling machines. Making step clamps to cover the skills of face milling, slot milling, step milling, groove milling and polygon milling on vertical milling machine.

UNIT V

5.1 Surface Grinding Machine

Grinding of exercises and utility items such as parallel plates, v blocks and step clamps (already made on bench and milling m/cs). On surface Grinding Machine.

5.2 Tool & Cutter Grinding

Basic Tool & Cutter Grinding and test single point tools, twist drills and milling cutters.

RECOMMENDED BOOKS

1. SK Hajra Choudhary and AK Choudhary, “Elements of Workshop Technology”, Media Promoters and Publishers Pvt. Ltd., Mumbai, Fifteenth Edition, 2010.
2. Dr. Rajendra Singh, “Introduction to Basic Manufacturing Process & Workshop Technology”, New Age International Publisher, New Delhi, Second Edition, 2020.
3. Kaushishk, “Manufacturing Processes”, Prentice Hall of India, New Delhi, Second Edition, 2013.
4. K.C. John, “Workshop Practice”, Prentice Hall of India, New Delhi, Second Edition, 2010.
5. Swaran Singh, “Workshop Practice”, S.K. Kataria and Sons, Second Edition, 2010.
6. Dr R. K. Singal, “Manufacturing Process (Workshop Practice)”, S.K. Kataria and Sons, First Edition, 2010.
7. H.S. Bawa, “Workshop Practice”, Tata McGraw Hill, Second Edition, 2017.

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students.

SECOND YEAR
NSQF LEVEL - 4

12. STUDY AND EVALUATION SCHEME

SECOND YEAR

Sr. No.	SUBJECTS	STUDY SCHEME *Periods/Week*		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
2.1	Applied Mechanics and Strength of Materials	2	-	4+0=4	40	-	40	60	-	60	100
2.2	Material Science and Heat Treatment	2	1	4+1=5	40	40	80	60	60	120	200
2.3	Engineering Metrology	1	1	2+1=3	40	40	80	60	60	120	200
2.4	Workshop Technology -II	2	-	4+0=4	40	-	40	60	-	60	100
2.5	Tool Design- I (Press Tools, Jigs and Fixtures)	2	3	4+3=7	40	40	80	60	60	120	200
2.6	Tool Design- II (Plastic Moulds)	2	3	4+3=7	40	40	80	60	60	120	200
2.7	Computer Aided Design - I	-	2	0+2=2	-	40	40	-	60	60	100
2.8	Workshop Practice- II	-	12	0+12=12	-	40	40	-	60	60	100
2.9	Open Elective (MOOCs^{+}/Offline)	1	-	2+0=2	40	-	40	60	-	60	100
# Student Centered Activities(SCA)		-	1	-	-	-	-	-	-	-	-
	Total	**12**	**23**	**46**	**280**	**240**	**520**	**420**	**360**	**780**	**1300**

\+ Assessment of Open Elective through MOOCs shall be based on assignments out of 100 marks.

\# Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

Industrial Training: After 2nd year, students shall undergo Industrial Training of 4 Weeks.

13. HORIZONTAL AND VERTICAL ORGANISATION OF SUBJECTS

Sr. No.	Subjects	Hours Per Week
		Second Year
1.	Applied Mechanics and Strength of Materials	2
2.	Material Science and Heat Treatment	3
3.	Engineering Metrology	2
4.	Workshop Technology -II	2
5.	Tool Design- 1 (Press Tools, Jigs and Fixtures)	5
6.	Tool Design- II (Plastic Moulds)	5
7.	Computer Aided Design -I	2
8.	Workshop Practice II	12
9.	Open Elective (MOOCs/Offline)	1
10.	Student Centered Activities(SCA)	1
	Total	**35**

14. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to Tool and Die Making require **skilled workers** to work in familiar, predictable, routine situations of clear choice. They are expected to have factual knowledge of Tool and Die Making field. They will be able to write and speak with required clarity. Students after passing level 4 shall have understanding of basic arithmetic, algebraic principles along with basic understanding of social and natural environment. They are expected to recall and demonstrate quality skill in narrow range of applications using appropriate rules and tools.

Skilled workers will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. They should know what constitutes quality in the occupation and should distinguish between good and bad quality in the context of their job roles. Skilled worker at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They should work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment.

Tool and Die Making NSQF Level – 4 pass out students are expected have the knowledge of properties, testing and heat treatment of materials. They are expected to have competency to use various measuring instruments. They are also expected to have good knowledge and skills in design of press tools, jigs, fixtures and plastic moulds. Level 4 pass out students should have good knowledge and skills regarding operation of various machines.

Tool and Die Making students have a wide scope to work in various manufacturing industries engaged in making various dies and tools such as press tools, plastic moulds, forging and casting, dies, cutting tools and jigs and fixtures. They have also wide scope of employability in establishing small startups for manufacturing machine parts, tools and dies and their repair and maintenance.

15. PROGRAMME OUTCOMES

The programme outcomes are derived from five domains of NSQF Level – 4 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Carry out a task which may require limited range of predictable activities.

PO2: Acquire knowledge of basic facts, process and principles related to Tool and Die Making for employment.

PO3: Demonstrate Practical skill in narrow range of Tool and Die Making applications.

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.

PO5: Perform task under close supervision with some responsibility for own work within defined limit.

PO6: Select open elective of own interest to develop self-learning through MOOCs.

16. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be Assessed	Assessment Criteria for the Course Outcomes
PO1: Carry out a task which may require limited range of predictable activities.	• Fabricate multifunctional tools by using skill of bench work, turning, milling, surface grinding and cylindrical grinding. • Demonstrate use of coordinate system for creating objects. • Draw on Auto CAD screen by using different line commands and editing commands. • Draw objects with snap & grid, auto snap, grid & ostro mode. • Draw curved objects using Auto CAD • Draw orthographic view of an object using commands. • Draw to dimension a component using Auto CAD commands.
PO2: Acquire knowledge of basic facts, process and principles related to Tool and Die Making for employment.	• Find resultant forces and resolution of force using law of forces and law of moment. • Explain terms related to friction and laws of friction. • Determine centroid/centre of gravity of basic shapes and solids. • Determine velocity ratio, mechanical advantage and efficiency of simple machines. • Interpret various terms related to strength of materials. • Calculate moment of inertia of beams under given loading. • Draw bending moment and shear force diagrams of beams under given loading.

	• Interpret concept of bending & torsion and calculate stresses on different sections of material. • Describe properties of various type of materials. • Analyze microstructure of a specimen. • Explain the properties & applications of advance materials. • Explain various steps in carrying out thermochemical treatment & surface hardening • Analyze chemical composition of different tools steals. • Check various geometrical parameters • Describe different types of limits, fits & tolerances. • Ensure quality by using QC methods & programs. • Interpret various terms & symbols connected with surface roughness measurement. • Explain the working of various grinding machines. • Explain the working of gear manufacturing processes. • Describe various steps performed in jig boring, jig grinding, profile grinding, pantograph operation, copy milling and single lip grinding. • Explain the principle of non conventional machining methods. • Describe the steps performed in finishing operations. • Describe the steps performed in press tool operations. • Explain the function of elements of press tool

	• Describe various steps performed in cutting die operations. • Identify design parameters for elements of press tools for various operations. • Select a press for specific press tool operations. • Explain material feeding and scrap handing mechanism in press operation. • Prepare process sheet, bill of material & material estimate for tool design. • Follow standard procedure for maintenance, safety and storage of press tools. • List specification of material, press tool & press for tool design. • Describe features and functions of jigs, fixtures parts and standard parts. • Take into account various design parameters for designing jigs and fixtures. • Design plain limit gauges by applying Taylor's principle. • Correlate material, equipment moulds and process in mass production of plastic components. • Explain the principle and working of moulding machines. • Describe the function and features of various elements of moulds. • Identify design parameters for mould, material and machine. • Comprehend pre moulding and post moulding operations. • Prepare estimate of plastic material requirement, bill of material for mould making

	• Describe procedure for safety, maintenance and storage of mould and machine. • List specifications of mould, material and machine. • Comprehend use of simulation packages.
PO3: Demonstrate Practical skill in narrow range of Tool and Die Making applications.	• Solve problems related to scalar and vector quantities and units. • Solve problems using laws of motion. • Solve problems on column and struts by applying Euler theory and Rankine formula. • Interpret iron-carbon diagram. • Describe the process of heat treatment of cast iron. • Use various instrument for linear & angular measurements. • Use gauges to check dimensions. • Carry out scream thread and gear measurement. • Use various advance instrument for linear, angular and profile measurement. • Draw tool design layout for a specific press tool. • Draw press tool parts and die sets. • Draw different strip layouts for components and blank development. • Prepare process sheet and worksheet for optimum press tool design. • Develop conceptual design using data sheet. • Draw assembly drawings of press tools. • Prepare tool data, bill of material and processing material list. • Design press tools using CAD software. • Design assembly and detail parts of jigs and fixtures. • Design plain limit gauges.

	• Draw mould parts, mould housing and bases, and standard elements. • Draw components and system layout. • Prepare data sheet for mould, material and machine. • Develop conceptual design using data sheet. • Draw assembly and detailed drawings of plastic mould. • Prepare bill of material and mould data. • Design 3D model of component using CAD. • Fabricate multifunctional tools by using skill of bench work, turning, milling, surface grinding and cylindrical grinding. • Handle CAD software by using different commands. • Make use of Auto CAD tutorials in learning assistance. • Demonstrate use of coordinate system for creating objects. • Draw on Auto CAD screen by using different line commands and editing commands. • Draw objects with snap & grid, auto snap, grid & ostro mode. • Draw curved objects using Auto CAD • Draw orthographic view of an object using commands. • Draw to dimension a component using Auto CAD commands.

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	• Solve problems using laws of motion • Determine velocity ratio, mechanical advantage and efficiency of simple machines. • Calculate moment of inertia of beams under given loading. • Communicate effectively with an increased confidence to read, write and speak in • English language fluently. • Aware of the special features of format and style of formal communication through various modes. • Write a Report, Resume, Make a presentations, Participate in GDs and Face Interviews • Illustrate use of communication to build a positive self-image through self-expression and for developing more productive interpersonal relationships.
PO5: Perform task under close supervision with some responsibility for own work within defined limit.	• Follow standard procedure for maintenance, safety and storage of press tools. • Describe procedure for safety, maintenance and storage of mould and machine. • Fabricate multifunctional tools by using skill of bench work, turning, milling, surface grinding and cylindrical grinding.

PO6: Select open elective of own interest to develop self-learning through MOOCs.	• State the basic concepts and principles about the subject of interest. • Perform in a better way in the professional world. • Select and learn the subject related to own interest. • Explore latest developments in the field of interest. • Develop the habit of self-learning through online courses.

17. SUBJECTS & CONTENTS

(SECOND YEAR)

SECOND YEAR

2.1	Applied Mechanics and Strength of Materials	68-71
2.2	Material Science and Heat Treatment	72-75
2.3	Engineering Metrology	76-79
2.4	Workshop Technology -II	80-82
2.5	Tool Design- 1 (Press Tools, Jigs and Fixtures)	83-90
2.6	Tool Design- II (Plastic Moulds)	91-97
2.7	Computer Aided Design -I	98-101
2.8	Workshop Practice II	102-103
2.9	Open Elective (MOOCs/Offline)	104-105

2.1 APPLIED MECHANICS & STRENGTH OF MATERIALS

L	P
2	-

RATIONALE

This subject is from Engineering Science group which deals with laws and principles of mechanics along with their applications in general engineering and tool & die technology problems. The knowledge of engineering mechanics & strength of material enables students to analyze problems encountered in core technology subjects like design, heat treatment, planning, workshop technology, workshop practice.

COURSE OUTCOMES

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

CO1: Solve problems related to scalar and vector quantities and units.
CO2: Find resultant forces and resolution of force using law of forces and law of moment.
CO3: Solve problems using laws of motion.
CO4: Explain terms related to friction and laws of friction.
CO5: Determine centroid/Centre of gravity of basic shapes and solids.
CO6: Determine velocity ratio, mechanical advantage and efficiency of simple machines.
CO7: Interpret various terms related to strength of materials.
CO8: Calculate moment of inertia of beams under given loading.
CO9: Draw bending moment and shear force diagrams of beams under given loading.
CO10: Interpret concept of bending & torsion and calculate stresses on different sections of material.

DETAILED CONTENTS

UNIT I

1.1 Scalar and Vector Quantity: Introduction to Scalar and vector quantity and application, fundamental system of units, scalar quantities, vector quantities and related problems on scalar and vector quantities.

1.2 Coplanar Concurrent Forces

System of forces and its application, Definition, Concept & Type of force, resultant of force, composition of force, resolution of force, Concept of Bow's notation and Related problems of system of forces.

UNIT II

2.1 Equilibrium of Coplanar Concurrent Forces

Introduction, Equilibrium of coplanar forces and its applications, Concept of condition of equilibrium, parallelogram law of forces, triangle law of forces, free body diagram, Lami's theorem, resolution and resultant, graphical methods, Newton's third law and related problems on equilibrium of coplanar concurrent forces.

2.2 Coplanar, Parallel and Non-Concurrent Force

Coplanar, parallel and non-concurrent force and application, Concept of parallel forces, unlike parallel forces, non- concurrent forces, couple, resultant force, condition of equilibrium. Lami's theory and related problems.

UNIT III

3.1 Centre of Gravity

Definition & Concept of center of gravity, centroid, Center of gravity and centroid for basic shapes and solids, symmetry consideration, theorem of moments, axes of symmetry and related problems on center of gravity or centroid of basic shapes or solids.

3.2 Moment of Inertia

Introduction, definition & Concept of Moment of inertia and its application, radius of gyration, Principle of moment of inertia, second moment, parallel axis theorem, perpendicular axis theorem, modulus of section and related problems.

UNIT IV

4.1 Simple Stresses and Strain

Introduction, Definition & Concept of Simple stress and strain, classification of load, stress & strain, types of stress and strain, Hooke's Law, Young modulus of elasticity, Nominal stress, Yield point, Principle of elasticity, deformation of body due to load, relationship of stress and strain and related problems on stresses and strain.

4.2 Tensile & Compressive Stresses & Strains

Introduction, Definition & concept of Tensile & compressive stresses & strains, ultimate strength and breaking stress, percentage elongation, Proof stress, working stress, factor of safety, Bars of varying cross section and related problems on shear stress and strain.

UNIT V

5.1 Principle of Shear Stress and Strain

Principle of shear stress and strain, Concept of shear stress, strain, Modulus of rigidity, Poisson‟s ratio, relationship between modulus of elasticity and rigidity, and related problems on shear stress and strain, modulus of elasticity and rigidity.

5.2 Strain Energy due to Direct Stresses

Strain energy due to direct stresses, Concept of strain energy. Resilience, proof resilience, modulus of resilience, Types of loading, Principle of strain energy and related problems on strain energy under direct stresses due to gradual, Sudden and falling load.

UNIT VI

6.1 Friction:

Introduction to Friction, definition and Concept of friction, limiting friction, coefficient of friction, angle of friction, angle of repose, laws of friction, Principle of friction and related Problems on friction

6.2 Moments

Definition & Concept of moment, types of moments, law of moments, Resultant force, Condition of equilibrium, Varignon's principle and related problem.

UNIT VII

7.1 Theory of Simple Bending (Bending Stresses)

Definition & Concept of simple bending, theory of simple bending, bending stresses, moment of resistance, bending equation, bending stress diagram and related problems on maximum bending stress in beams of rectangular, circular, I and T sections.

UNIT VIII

8. 1 Shear Force and Bending Moment Diagram (Beam)

Definition and Concept of Shear force and bending moment, Concept of beam, form of loading, end supports-roller, hinged and fixed, bending moment and shear force and related problem on bending moment and shear force diagram for cantilever and simple supported beams subjected to concentrated and uniformly distributed load (UDL).

UNIT IX

9.1 Torsion

Definition, Concept of torque and torsion, torsion equation and torsional rigidity, angle of twist, hollow and solid shaft, Principle of torque and torsion and related problem on torsion and torsional rigidity.

9.2 Shaft (Power Transmission)

Definition, Concept of torque, power transmitted, angular displacement, shaft size, Principle of torque, power transmitted, angular displacement, shaft size, determine size of shaft, and related problems.

UNIT X

10.1 Leaf Spring

Definition, Concept of Leaf spring, calculation of stresses, Concept of leaf spring, deflection, stiffness, strain energystored in leaf spring and related problems.

10.2 Helical Spring

Definition, Concept of Helical spring and calculation of stresses, Concept of helical spring, types of helical spring, deflection, stiffness, strain energy and shear stress developed in helical spring, and related problems.

RECOMMENDED BOOKS

1. Ramamrutham & Narayan R., "A Text Book of Engineering Mechanics", Dhanpat Rai & Sons Delhi.
2. R.S. Khurmi & J.K. Gupta, "Engineering Mechanics & Strength of Material", S. Chand & Co. Ltd.Delhi.
3. R.S. Khurmi, "A Text Book of Engineering Mechanics", S. Chand & Co. Ltd.Delhi.
4. Harry Parker & James Ambrose, "Simple Mechanics & Strength of Material", John Willey & Sons, Inc.
5. J.B. Prasad, "Applied Mechanics & Strength of Material", Khanna Publisher, Delhi.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis in making students conversant with concepts and principles. This is theoretical subject and contains units of equal weight age.

2.2 MATERIAL SCIENCE AND HEAT TREATMENT

L	P
2	1

RATIONALE

The subject is indented to teach basic materials classification, Structures, physical & Mechanical Property, industrial application of various materials and to know the facts, concepts, principles & procedures of Heat-treatment of ferrous metals, so that this knowledge can be applied in Material Science & Heat-treatment of components of Tools & Dies effectively & efficiently. This knowledge and skills are also useful in selection of proper metals for different elements of Tools & Dies and also useful in designing of Tools & Dies and Production Planning.

COURSE OUTCOMES

After undergoing this course, the students will be able to:
CO1: Describe properties of various types of materials.
CO2: Describe crystallography of materials.
CO3: Analyze microstructure of a specimen.
CO4: Interpret iron-carbon diagram.
CO5: Explain the properties and applications of advance materials.
CO6: Explain various steps in carrying out thermochemical treatment and surface hardening
CO7: Analyze chemical composition of different tool steels.

DETAILED CONTENTS

UNIT I

Introduction, Crystal System & Imperfections

Definition and concept of material Science, crystal (grain), Solidification process, Types of Solids: Crystalline and Amorphous, metals and non-metals, Structures of crystal, space lattice, bravais lattice, Miller indices, and unit cell (BCC, FCC, HCP), compounds, alloys, solid solution and its type, Classification of imperfections: Point, Line and Surface and impurities in solids.

UNIT II

Manufacturing and application of steel and cast Iron

Iron, iron ores and making of iron by different processes, Description of cast iron, Making of Cast iron, carbon content and types of cast iron, Description of plain carbon steel, making of Steel, Various grades and composition of Steel (Low, Medium, High Carbon), Specification and designation of steel with commercial aspect (BIS Standard),

Commercial use of cast iron and Steel in metal working industry, Concept of alloy steel and its classification as low and high alloy steel, Common alloying elements and Purpose of alloying elements and their effect on properties of steel.

Tool Steels - Types of tool steel, Composition of different type of tool steel and effects of alloying elements, DIN and BIS standards.

UNIT III

Mechanical properties and Deformation of Metals

Concept of stress & strain and their units, Study of stress-strain curve for steel and cast iron, Description of mechanical properties such as strength, elasticity, Plasticity, ductility and malleability, toughness, hardness, fatigue and Creep, Principle of deformation of metals and types of deformation processes: slip, twining, work hardening/ strain hardening.

UNIT IV

Non-ferrous metals and Alloys

Concept of ferrous and non-ferrous metals, brief description of manufacturing and application of Non-ferrous metal: Aluminum, zinc, copper and Nickel, description of common non-ferrous alloys as brass, bronze, duralumin, german silver, tin, concept of bearing metals and common alloys used as bearing materials.

UNIT V

Ceramics, Polymer, Composite materials and Powder metallurgy

Ceramics: Introduction and classification of ceramics, Common ceramics and their application, properties and application of refractories.

Polymer: Introduction to polymers and Process of polymerization, Concept of plastics and fibers, Common plastic: thermo plastic and thermosetting plastics.

Composite: Definition and concept of composite material, classification and application of composite material.

UNIT VI

Powder metallurgy, Oxidation and corrosion

Powder metallurgy: Concept and application of powder metallurgy, advantage and limitations of powder metallurgy.

Oxidation and Corrosion: Principle and concept of oxidation, reduction and corrosion, Specific types of corrosion based on environment and procedures to control and prevent corrosion.

UNIT VII

Heat Treatment and Phase Diagram of steels

Concept and principal of Heat Treatment, Purpose and application of Heat Treatment, Iron-carbon phase diagram and its application, Describe micro constituents of Iron & carbon system and phase structure, Describe constituents of Hypo eutectoid, hyper eutectoid & eutectoid steel, Time-temperature-transformation (TTT) diagram.

UNIT VIII

Heat treatment process of steel

Different processes of Heat Treatment of Steel, Annealing, Normalizing, Hardening, Tempering and classification of Tempering, Quenching and classification of quenching medium, Concept of Austempering, Martempering, Ausforming, Maraging, Temper brittleness in steel, Hardenability, Methods to determine hardenability: Jominy Test..

UNIT IX

Case hardening of steel

Thermo chemical Treatment and its application, Concept of different case hardening processes of steel such as Carburizing, Nitriding, Carbonitriding, cyaniding, Concept and application of Surface Hardening: Flame hardening and induction hardening.

UNIT X

Heat Treatment of Tool Steel and Heat Treatment Defects

Heat treatment of Carbon Tool Steel, HSS, Free Cutting Steel, Cold work Alloy tool steel, Hot work tool steel and describe Steps of heat treatment for tool steel

Heat treatment defects such as decarburization, quenching cracks, Excessive hardness, low hardness, soft spots, Distortion and warping, Concept of prevention and remedies.

PRACTICAL EXERCISES

1. Mechanical testing of metals: tensile & Compression.
2. Impact load testing on metals: Izod and Charpy.
3. Hardness testing: Rockwell and Brinell.
4. Analysis of Chemical Composition of carbon steel: (Low, Medium and high).
5. Analysis of Chemical Composition of Tool steel for Tool & Dies
6. Evaluation of Heat treatment process: Annealing such as Stress Reliving, Process Annealing, Spheroidizing and Full Annealing
7. Evaluation of Heat treatment process: Normalizing.
8. Evaluation of Heat treatment process: Hardening.
9. Evaluation of Heat treatment process: Tempering.
10. Evaluation of Heat treatment process: Surface Hardening.
11. Evaluation of non-destructive testing of metals: Dye Penetration, Magnetic and Ultrasonic.

RECOMMENDED BOOKS

1. O.P. Khanna, "A test book of Materials & Metallurgy", Dhanpat Rai Publications Pvt. Ltd. New Delhi.
2. T. V. Rajan "Heat Treatment - Principles & Techniques", PHI Learning Pvt. Ltd. New Delhi.
3. G.B.S. Narang, "Material Science", Khanna Publication Delhi
4. B.K. Agrawal, "Introduction to Engineering Material", Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. G.K. Narula, K.S. Narula, & V.K. Gupta, "Material Science", Tata McGraw Hill Publishing Co.Ltd., New Delhi.

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains units of equal weightage.

2.3 ENGINEERING METROLOGY

L	P
1	1

RATIONALE

This subject is intended to teach concepts, principles and procedure of Engineering Metrology to acquire skills in handling and maintaining the measuring instruments for effective use, maintaining standards of inspection and quality control. These skills are used in core technology subjects like work shop practice, manufacturing tools and dies, tool design practice, production planning and cost estimation.

COURSE OUTCOMES

After undergoing this course, the students will be able to:
CO1: Use various instrument for linear and angular measurements.
CO2: Check various geometrical parameters
CO3: Describe different types of limits, fits and tolerances.
CO4: Use gauges to check dimensions.
CO5: Carry out screw thread and gear measurement.
CO6: Use various advance instruments for linear, angular and profile measurement.
CO7: Carry out surface roughness measurement using Surface roughness tester
CO8: Explain the working principle of comparator and advance measuring equipment such as CMM and VMM.

DETAILED CONTENTS

UNIT I

1.1 Scope and need of metrology

Concept of metrology, Units, Sensitivity, Repeatability, Measurement, Accuracy, Precision, principles of physical measurement and need and scope of inspection, Advantages and disadvantages of inspection

UNIT II

2.1 Basic linear measurements

Introduction, definition & Concept of least count & measuring instrument: Steel rule, caliper, surface plate, angle plate, V block, try square, straight edge, radius gauge, feeler gauge, vernier caliper, micrometer and Classification of measuring instruments. Concept of linear parameters, alignment, deflection and environmental parameters, Principle of least count,

UNIT III

3.1 Basic angular measurements

Introduction & Definition of Basic angular measuring instruments, Concept of least count, angular measuring instruments (Bevel protector, combination set and screw pitch gauge), angular parameters, classification of various type of instrument and Principle of least count

UNIT IV

4.1 Source of errors

Errors and their effect on quality, Concept of errors, classification of errors, comparison, measurement, precision and accuracy, Principles of least count, parallax, alignment, environment, source of errors, effect of errors on accuracy,precautions to be taken in measurement.

4.2 Geometrical parameters and errors

Definition & Concept of Geometrical parameters, measurement of geometric parameters: straightness, flatness, parallelism, circularity, cylindricity, concentricity, co-axiality, ovality, lobbing, angularity, run out, concept of profile and representation of symbols.

UNIT V

5.1 Limits and Fits

Limits & fits and application, Concept of interchangeability, tolerances and allowances, classification of tolerances, limits and fits, assembly/ selective assembly, BIS standards, selection of limits, fits and tolerances.

5.2 Gauges

Plain limit gauges and application, Concept of gauges, Go and No Go Gauges, classification of gauges (plug gauge, snap gauge and ring gauge), material selection, design of gauge, Principle of Tayler's for designing of Plain limit gauges,

UNIT VI

6.1 Screw thread terminology & testing

Introduction to Screw thread measurement, Concept of screw thread, thread parameters, errors of

pitch, angle errors, Various thread types e.g. Metric & B.S.W, concept of measurement by thread micrometer and 2 & 3 wire method.

6.2 Gear tooth terminology and testing

Introduction & Concept of gear terminology, Spur gear profile testing, optical instruments, master profile, Gear tooth vernier, gear parameters measurement.

UNIT VII

7.1 Advance linear measuring instruments

Dial gauge, slip gauge and bore gauge, Concept of dial gauge and classification, slip gauge and classification, bore gauge and classification, zero error, Procedure for using above instruments for measurement.

7.2 Advance angular and profile measurement

Angular and taper measurements, Concept of angular measurement, taper measurement, sine bar, sine setting devices, angular gauge, Sine principle, working principle of sine bar, angle gauge and roller.

UNIT VIII

8.1 Calibration of instruments

Calibration and its application, Concept of calibration, precision, references, national and international, standards, maintainability of accuracy, Principle of calibration, accuracy, standards, and related clause of ISO standards and upkeep of instruments in the lab.

UNIT IX

9.1 Surface texture and related methods of measurement.

Surface texture measurement, Concept of surface roughness and classification, Roughness, measurement, stylus, Principle of electronic moduling, measurement, tracer type profilogram, surface irregularities, surface finish, symbols used in surface roughness.

UNIT X

10.1 Advance Measuring Instruments:

Tool maker's microscope, profile projector, Comparators, linear height master, Co-Ordinate measuring machine, Concept & working Principles of tool maker's microscope, Mechanical Comparators, profile projector, linear height master, VMM, C.M.M and Parts of above measuring equipment.

PRACTICAL EXERCISES

1. Linear measurement by vernier calliper (Digital, Analog and Dial type)
2. Linear measurement by micrometer.
3. Linear Measurement by height gauges (Digital and Analog type).
4. Diametrical Measurement: inside diameter by inside micrometer and depth of hole or recess by depth micrometer.
5. Angle and taper measurements by bevel protractor and Sine bar.
6. Gear Teeth Measurement: Finding Chordal addendum and height of spur gear by using Gear teeth vernier calipers
7. To find out the flatness of Surface plate by use of spirit level and optical flat.
8. Surface roughness measurement by roughness tester.
9. Measurement of inside diameter by dial bore gauge.
10. Measurement of micro threads (British , Acme, Matric) by use of profile projector
11. Measurement of 3D Components using Co-ordinate measuring Machine (CMM)

RECOMMENDED BOOKS

1. R. K. Jain, “Engineering Metrology”, Khanna Publishers.
2. W. Winchell, “Inspection & Measurement in Manufacturing”, Society of Manufacturing Engineers.
3. S. N. Mahajan, S. C. Shilwant, & N. M. Ambedkar, “Metrology & Quality control”, Nirali Prakashan, Budwar Peth, Pune.
4. Surender K., B. G. Rao Madhukar Puri, “Engineering Measurement”, Satya Prakashan, New Delhi.
5. I C Gupta “A Textbook Of Engineering Metrology” Dhanpat Rai Publications, New Delhi

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains units of equal weightage.

2.4 WORKSHOP TECHNOLOGY - II

L	P
2	-

RATIONALE

Understand the facts, concepts, principles and procedures of using machine tools and related techniques efficiently effectively to plan manufacturing of Tool & Die Parts to specification considering safety and environment. It is also useful in understanding technology and apply in areas such as Workshop Practice, Tool Design, Production Planning, Estimation and Industrial Management. It also describes concept, principle and procedures to identify and report maintenance requirement for corrective action**.**

COURSE OUTCOMES

After undergoing this subject, the students will be able to:
CO1: Explain the working of various grinding machines.
CO2: Explain the working of gear manufacturing processes.
CO3: Describe various steps performed in jig boring, jig grinding, profile grinding, pantograph operation, copy milling and single lip grinding.
CO4: Explain the principle of non-conventional machining methods.
CO5: Describe the steps performed in finishing operations.

DETAILED CONTENTS

UNIT I

Grinding Operations and Grinding Machines:

Introduction & Concept of grinding operations and grinding machines, main parts and functions of surface grinding, Cylindrical Grinding and Tool & Cutter Grinding machines, work holding attachments: Vices, Angle plate, V-block, Collets, Chucks and centers, Cutting tool holders, Cutting tools: Grinding wheel nomenclature, Common grinding wheels (abrasive), Dressers for grinding wheels, Cutting Parameters: Speed, Feed, and Depth of cut, Safety and maintenance of machine.

Special purpose grinding machines and Principal Grinding operations: Crankshaft Grinders, Piston Grinders, Roll grinders, Thread grinders, Cam grinder, Way grinders, tool post grinders

UNIT II

Gear Cutting Techniques

Introduction & Concept of Gear cutting techniques, Indexing and dividing heads, indexing method: Simple Compound, differential and angular.

Gear manufacturing: Spurgear, Rack and pinion, Helical and Bevel Gear,

UNIT III

Jig Boring and Jig Boring Machine

Introduction & Concept of Boring machine, Types of boring machine, Horizontal and vertical boring machine, size of Horizontal and vertical boring machines, functions of machine, work holding attachments, boring tool and mountings for horizontal & vertical boring, Jig Boring operation and working principles of Jig boring machine, Main parts and its function, methods of locating hole.

UNIT IV

Jig Grinding and Jig Grinding Machine

Introduction & Concept of Jig Grinding and Jig Grinder machine, main parts and functions of Machine, work holding attachments, Cutting tools, Cutting tool holders, Operational principles of machine and parts, Jig Grinding operations, methods of locating hole.

UNIT V

Copy Milling and Copy Milling Machine

Copy Milling, Copy Milling Machine: Introduction & Concept of Copy Milling and Copy Milling machine, main parts and functions of Machine, work holding attachments, Cutting tools, Cutting tool holders, Operational principles of machine.

UNIT VI

Pantograph

Introduction & concept of Pantograph machine and operations, main parts and functions of Machine, work holding attachments, Cutting tools, Cutting tool holders, Operational principles of machine.

UNIT VII

Polishing, Lapping, Honing

Introduction & Concept of Polishing, lapping & honing methods, function of polishing, lapping and honing machines, Operational Principles of polishing, lapping and honing technique, Selection of polishing, lapping, honing materials.

UNIT VIII

Electroplating and Hard Chrome Plating

Introduction & Concept of Electro plating technique, main functions, features of electro plating process, material used for process, working principles of Electroplating process, describe various steps performed in electroplating process.

Introduction & Concept of Hard Chrome Plating Technique, Main functions, features of hard chrome plating process, material used for process, working principles of process, describe various steps performed in hard chrome plating.

UNIT IX

Galvanizing, Metal spraying and Metallization

Introduction and concept of Galvanizing Technique, functions & features of galvanizing process, material used for process, working principle of process.

Introduction and concept of metal spraying and metallization, operational principal of metal spraying and Metallization process

UNIT X

Blackening and Shot Blasting

Introduction and concept of Blackening Technique, functions & features of blackening process, material used for process, working principles of process.

Introduction and concept of Shot Blasting Technique, functions & features of shot blasting process, material used for process, working principle of process.

RECOMMENDED BOOKS

1. A. J. Chapman, "Workshop Technology(Vol I, II & III)", New Delhi, Amol Publication.
2. S. K. Hazra & S. K. Choudhary, "Elements of Workshop Technology", Metropolitan Publishers, Bombay.
3. B. S. Raghuwanshi & Others, "Workshop Technology", New Heights, New Delhi.
4. K. N. Gupta & J. P. Kaushish, "Workshop Technology (Vol. I to II)", New Heights, New Delhi.
5. W. H. Atherton, "Workshop Practice Vol I to V", New Era Publishers, London.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis in making students conversant with concepts and principles of manufacturing processes. This is theoretical subject and contains units of equal weightage.

2.5 TOOL DESIGN – I (PRESS TOOLS, JIGS AND FIXTURES)

L	P
2	3

RATIONALE

Understand the facts, concepts, principles and procedures of Tool Design techniques so that this knowledge can be used in Tool Design Practice effectively and efficiently. It is also useful in understanding technology subjects and applies them in the areas such as Workshop Practice, CAD/CAM, Production Planning, Estimation, Industrial Management and Quality Assurance.

COURSE OUTCOMES

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

CO1: Explain the role of press tools for mass production of sheet metal component
CO2: Explain the function of elements of press tool
CO3: Describe the steps performed in press tool operations
CO4: Understand design parameters for designing of press tools for various operations.
CO5: Select a press for specific press tool operations.
CO6: Prepare process sheet, bill of material & material estimate for tool design.
CO7: Prepare process sheet and worksheet for optimum press tool design.
CO8: Describe features and functions of jigs, fixtures parts and standard parts.
CO9: Understand the various design parameters for designing jigs and fixtures and gauges.
CO10: Draw press tool parts and die sets.
CO11: Draw different strip layouts for components and blank development
CO12: Draw assembly drawings of press tools with BOM
CO13: Design plain limit gauges by applying Taylor's principle.
CO14: Follow standard procedure for maintenance, safety and storage of press tools.
CO15: Design press tools using CAD software.

DETAILED CONTENTS

UNIT I

Introduction

1.1 Overview of mass production of sheet material components

Overview of mass production of sheet material components, concept of sheet metal and tooling, common classification of tooling, Sheet metal press working tools, sheet metal components and application.

1.2 Presses- Classification & Specification

Presses for press tool operation, Types of presses, Classification & Specification of press, constructional feature of press for press tools, concept of shut height, die cushion, specification of presses and working principle of presses.

1.3 Introduction to tool design practices- Layout

Design layout practice for typical/ specific press tool, Concept of assembly drawing layout, bill of material and tool data, details drawing layout

UNIT II

Press Tool - Operation and Elements

2.1 Press Tool operation

Cutting operations: Shearing operation, principal & classification of shearing operations, Types of cutting operation: piercing, blanking cut off, strip layout, die and punch clearance, relation between pierced part/ slug and shearing operation.

Non Cutting Operations**:** Plastic deformation and forming, classification of forming operations, Types of press tool noncutting operation, spring back, strip layout and concept of clearance.

Integrated operations: Concepts of integrated operations, Principal & classification of integrated operations.

2.2 Press Tool Elements

Elements and parts of a typical press tool, material used for different elements of press tools, principle of alignment and guidance, clearance, stripping and ejection, mounting, standardization and interchangeability.

Die sets and application: Elements of die sets, classification of die set, concepts of feeding, clamping and component loading and material for die set.

2.3 Drawing of press tool parts and elements

Press tool design principles and their relationship with typical component, feature of a typical / specific press tool in relation with component and press, Standard catalogue and application, standard elements and representation and data sheets

UNIT III

Classification of Press Tools

3.1 Cutting Dies

Cutting dies and application, concept and classification of cutting dies such as Blanking dies, piercing dies, inverted and compound dies, operations such as notching, trimming, and shaving, construction of cutting dies, blank-through, inverted dies, chop off, parting, clearance, selection of die.

3.2 Non Cutting Dies

Non-cutting dies and application, concept and classification of non-cutting dies such as bending

dies, drawing dies, forming dies, concept of spring back, die cushion; selection of die and functions of different non-cutting dies.

3.3 Integrated Dies

Integrate dies and application, concept and classification of integrated dies such as Progressive die & Combination dies, Concept of multi station die, construction of integrated dies, blank though, chop off, parting, multi station and selection of operations.

UNIT IV

Design parameters - Strip Layout and Shearing

4.1 Design parameters: Concept and classification of design parameters with respect to press tool, material, press and operation, Principle of component geometry, dimensional tolerances, quality and quantity requirements, Study component specification, and use design parameters with respect to press tool, material and press, use standards for optimum selection of design parameters.

4.2 Design parameters for Strip Layout: Concept and classification of strip layouts Strip layout for optimum utilization and application, method for strip layout, draw different strip layouts for the component, Piloting and stopping, strip guiding, economy factor, material condition, Principle of grain direction, material utilization, work piece and stock strip, stopper and burr side consideration, feeding mechanism, guiding and locating.

4.3 Design parameters for Shearing

Concept of shearing, shearing force, stripping force, cutting clearance, angular clearance, die land, Concept of applying cutting clearance. concept of die life, shear angle, geometrical relationship between component, punch and die, derive design parameters by using data sheets, tables, formulae, select optimum design parameters.

UNIT V

Design Parameters for elements of Press Tools - Cutting and None cutting operations

5.1 Design Parameters for elements of Press Tools for cutting operations: Construction of press tool, classification of die sect, shut height, center of pressure, classification of elements of press tools such as functional elements, guiding and locating elements, supporting and clamping elements, ejecting elements and material selection

Design layout practice for typical/ specific press tool, concept of assembly drawing layout, bill of material and tool data and details drawing layout

5.2 Design Parameters for Bending

Bending and its classification, stripping force, blank development, spring back, grain direction, concept of applying clearances, principle of plastic deformation, bending and stripping forces, blank development, construction of press tool, classification of die sets, shut height, center of pressure, classification of elements such as: functional elements, guiding and locating elements, supporting & clamping elements, ejecting elements and material selection.

5.3 Design Parameters for Drawing

Concept of drawability, drawing and its classification such as drawing force, blank holding force, stripping force, blank development, spring back, die cushion, wrinkles, puckers and trimming, venting and lubricating, punch and die, classification of die sets, shut height, center of pressure classification of elements such as functional elements, guiding and locating elements, supporting and clamping elements, ejecting elements and material section.

UNIT VI

6.1 Design Parameters for elements of Press Tools for Integrated Operations

Classification of press tool for integrated operations: Progressive Dies, and Combination dies, Concept of construction of press tool, classification of die sets, shut height, center of pressure, classification of elements of press tools such as: functional elements, guiding and locating elements, supporting and clamping elements, ejecting elements, concept of material selection, Principle of shearing, bending and drawing operations, forming operations, strip layout, selection of die set, shut height, center of pressure, geometric and dimensional tolerances.

6.2 Elements of fine blanking operation

Concept of fine blanking operation with respect to sheet material and press, concept of construction of elements such as functional elements, guiding and locating elements, supporting and clamping elements, ejecting elements, material selection and main features of press for fine blanking operation

UNIT VII

Design of press tools

7.1 Draw assembly and detail drawings

Assembly and detail drawing for manufacturing of press tool, Concept of drawing and layout for assembly and details, verification of design, Principle of drawing layout for press tool, drawings norms and practices, Draw component drawing, draw blank development if required, design and draw strip layout if required, prepare process sheet and worksheet from design parameters, draw detail drawing with GD&T,

7.2 Press tool data and Process/ work sheet: Tool data, bill of material and application, concept of tool data, tool material selection, processing materials, handling and storage, process sheet and work sheet for optimum press tool design and try-out, concept of process sheet, work sheet principle of sheet material, press tool and press, design parameters, calculate design parameters with respect to sheet material, press tool and press, prepare process sheet and work sheet

UNIT VIII

8.1 Material, machine time and process estimation

Estimation methods in tool design and application, concept of estimation such as: sheet material, tool material, machine hours, process, principle of weight, volume, estimation of machine hours through process planning, material utilization, Study component drawing and prepare process sheet, prepare bill of material and estimate material, study detail drawings and calculate machine utilization per unit hour.

8.2 Die maintenance, safety and storage

Standard procedures for maintenance, safety and storage of press tool and machine, concept of safety, maintenance, and storage, Study press tool/ Die safety, machine safety and personal safety, standard check list for maintenance of machine and press tool, standard procedure for storage of press tool.

UNIT IX

9.1 Introduction to design of press tools using CAD software

CAD software for design and development, Concept of 2D drawing and 3D modeling, design parameter, software package, Principle of product design and development, design parameters and modeling, assembly modeling, data exchange, Design and develop 3D model of component and strip layout, design and develop assembly model and detail model, prepare bill of material. Analyze parts for interference, data transfer for machining.

UNIT X

Jigs & Fixtures and Gauges

10.1 Introduction to Jigs & Fixtures

Jigs & Fixtures in a manufacturing process and their application, concept, functions and features of a Jig & Fixture, classification and application of jigs & fixtures, features concept of jig & fixture in batch and mass production in a manufacturing industry, standard parts and devices in assembly of jig & fixture, concept of locating elements, clamping elements, guiding elements, supporting elements, loading and unloading and standard parts, 3-2-1 pin concept of location.

10.2 Design parameter for jigs & fixtures

Design parameter for designing jig & fixtures, Concept of components, component material, designing parameter, standard parts, assembly of jig & fixtures, Study component and its function, analyze steps in designing, consider various parameters, Assembly for use in a manufacturing process, Understand design and drawing of assembly and detail partsof jigs & fixtures.

10.3 Design and drawing of assembly and detail parts of jigs & fixtures

Understand design and drawing of assembly and detail parts of jigs & fixtures, concept and classification of jigs & fixtures, various types of jigs & fixtures, design parameters, standard practice of design, assembly and detail drawing.

10.4 Gauges design: Understand design and drawing of plain limit gauges, concept of limit gauges, types of gauges, design parameters, GO & NOT-GO concept. Taylor's principle for designing limit gauges, design procedure of gauges, material selection, GO & NOT-GO ends of gauge, draw and design plain gauge limit

PRACTICAL EXERCISES

1. Design and Drawing of Press tool parts and die sets with BOM
2. Design and Drawing of Strip layout and blank development
3. Design and Drawing of Blanking / piercing tool with BOM
4. Design and Drawing of Compound tool with BOM
5. Design and Drawing of Bending tool (U & V -Type) with BOM
6. Design and Drawing of Combination tool with BOM
7. Design and Drawing of Progressive tool with BOM
8. Design and Drawing of a progressive tool with fixed stop with BOM
9. Design and Drawing of a progressive tool with side cutter with BOM
10. Design and Drawing of an open type Drill Jig Fixture design with BOM
11. Design and Drawing of an indexing type Drill Jig with BOM
12. Design and Drawing of a single component holding milling fixture with BOM
13. Design and Drawing of a plain limit gauges / Go-No Go type Gauge with BOM
14. Design and Drafting of a Press tool using CAD Software
15. Design and drafting of a Jigs & Fixture using CAD Software

Note:

1. **Final Assessment of practical work will be done by preparing drawing sheets and/or preparing the CAD model with the help of CAD Software.**
2. **List of Design parameters and flow chart appended for reference.**

A. LIST OF DESIGN PARAMETERS – HINTS

I - COMMON DESIGN PARAMETERS: (Cutting, Non- Cutting, Integrated Operations)

1. Die Sets, Punches, Dies, Stripper Tunnel, Pilots and stoppers and Punch holders
2. Material selection & Heat treatment

II - DESIGN PARAMETERS - CUTTING OPERATIONS

1. Shear force, cutting clearance, Burr side consideration, Angular clearance & land, Strip-layout economy factor and Die life considerations.
2. Stripping force and Springs selection
3. Calculation of plate thicknesses – die, stripper, Punch holder, Top plate, Bottom plate.
4. Shut height , punch length calculation and Shank location calculation (Centre of Pressure)

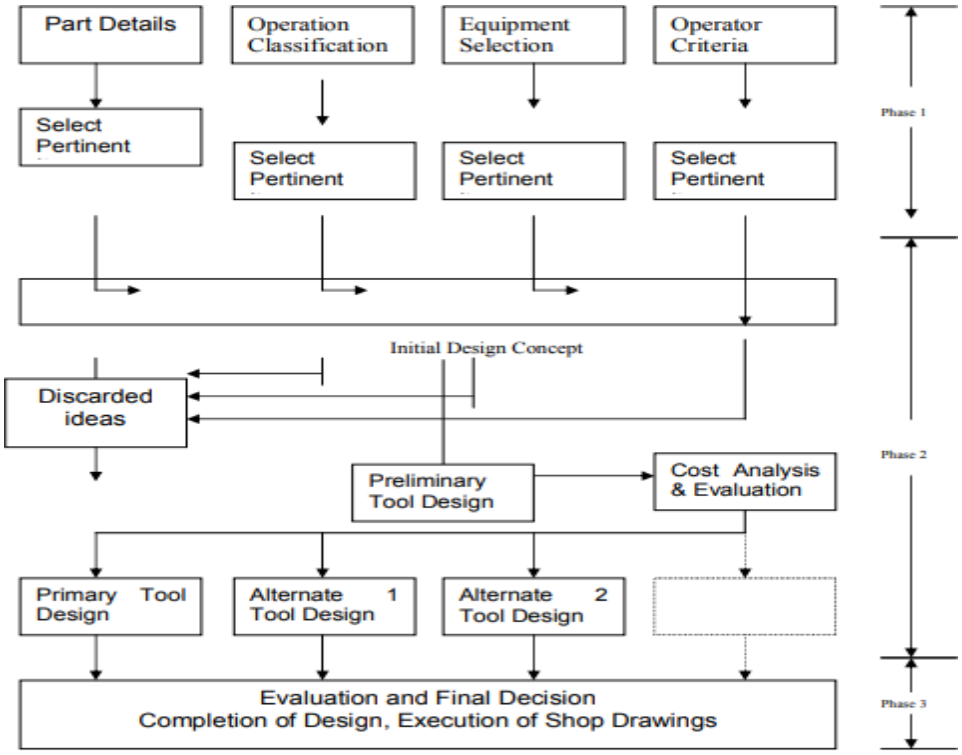
III - DESIGN PARAMETERS - BENDING OPERATIONS

1. Bending force, Ejection force and Blank holding force
2. Blank Development and Spring back calculation

IV - DESIGN PARAMETERS - DRAWING OPERATIONS

1. Drawing force, Ejection force and Blank holding force
2. Blank development and No. of draws

B. FLOW CHART FOR DEVELOPMENT OF DESIGN SOLUTIONS – HINTS



RECOMMENDED BOOKS

1. A. Kumar, “Fundamentals of Tool Design”, Dhanpat Rai & Co. Publishers
2. Prakash H. Joshi, “Press Tools Design & Construction“, S Chand & Company Publishers
3. Donaldson, George H. Lecain V.C. Goold, “Tool Design”, Tata McGraw Hill Publishers
4. Prakash H. Joshi “ Jigs and Fixtures” Tata McGraw Hill Publishers
5. G.R. Nagpal “Tool Engineering and Design” Khanna Publishers
6. V.Balachandran “Design of Jigs, Fixtures and Press Tools” Notion Press publishers

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis in making students conversant with concepts and principles. This subject contains units of equal weightage.

2.6 TOOL DESIGN-II (PLASTIC MOULDS)

L	P
2	3

RATIONALE

This subject is intended to know the facts, concepts, principles and procedures of Tool Design Techniques so that this knowledge can be used in Tool Design Practice effectively and efficiently. It is also useful in understanding subject and apply them in the areas such as Workshop Practice, CAD/CAM, Production Planning, Estimation, Industrial Management and Quality Assurance.

COURSE OUTCOMES

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

CO1: Correlate material, equipment moulds and process in mass production of plastic components.
CO2: Explain the principle and working of moulding machines.
CO3: Describe the function and features of various elements of moulds.
CO4: Identify design parameters for mould, material and machine.
CO5: Comprehend pre moulding and post moulding operations.
CO6: Prepare estimate of plastic material requirement, bill of material for mould making
CO7: Describe procedure for safety, maintenance and storage of mould and machine.
CO7: List specifications of mould, material and machine.
CO8: Comprehend use of simulation packages.
CO9: Draw mould parts, mould housing and bases, and standard elements.
CO10: Draw components and system layout.
CO11: Prepare data sheet for mould, material and machine.
CO12: Develop conceptual design using data sheet.
CO13: Draw assembly and detailed drawings of plastic mould.
CO14: Prepare bill of material and mould data.
CO15: Design 3D model of component using CAD.

DETAILED CONTENTS

UNIT I

Plastics material and plastic processing

Introduction: Overview of mass production of moulded plastic components, plastics and classification of plastics: Thermoplastic and Thermosetting, Types of Thermoplastic and Thermosetting plastic, Properties of plastic material, industrial application of plastics, Define fillers, Plasticisers, pigments and dyes, stabilizers, Plastics processing method: Casting and Moulding, Advantages, disadvantages and application of Moulding.

UNIT II

Moulding Operation

Definition and concept of Injection moulding Machine and Process, Compression Moulding process, classification of compression moulding, Transfer moulding process, classification of transfer moulding, Blow moulding process, Classification of blow moulding process, Rotational moulding process, classification of rotational moulding, Thermoforming process, Concept of thermoforming sheet, classification of thermoforming Process.

UNIT III

Elements of Injection mould & their functions

Basic tooling terminology and mould base, Concept of shrinkage, allowances, Mould impression, Understand core and cavity, sprue bush, Register ring, Guide pillars and bushes, spacer or parallel block, top and bottom plate, feeding system (sprue, runner, gate and cold wall slug, classification of runner and gate), sprue puller, classification of sprue puller, cooling system, classification of cooling system, ejection system (Ejector plate, ejector pin, ejector back plate, return pin), types of ejector pin, core & cavity retainer plates, Classification and functions of core & cavity.

Material used for mould base such as core & cavity, ejection system, core & cavity retainer plates, Guide pillar and bushes, Runner and gating system layout, balanced runner layout, cooling & heating circuit in moulds, Mould housing, bases and their application, Layout of mould base with bill of material.

UNIT IV

Classificationof moulds

4.1 Injection Moulds: Injection moulds classification based on Day light, ejection and feed system, Concept of two plate mould, three plate mould, stripper plate mould, stack mould, definition and concept of undercut, types of undercut, split mould, lifter mould, unscrewing

mould, Concept of ejection and feed system in mould, Principle of parting surface, Describe functions and construction of various types of moulds based on daylight, ejection, feed system, Mould ventilation.

4.2 Blow Moulds: Classification of blow moulds: Injection blow mould, extrusion blow mould, mould parts, Construction and function of blow mould

UNIT V

Design parameters for Injection Mould, material& machine

5.1 Design Parameter for Injection Mould: Drafts & tapers, projected area of cavities, no. of cavities Calculation, Gate size, Runner size, Sprue size, Guide Pillar size Calculation, Mould shut height, Venting dimension, Solidifying time (incl. Mould temp), Heat to be transferred per hr, Amount of water to be circulated/hr, Length & location of cooling channel, Cooling period, Determining total cycle time, Split movement related calculations, Calculations related to establishment of hot runner system, , Calculation related to unscrewing mechanism, Understand design parameters for optimum mould design. Use recommended data, formula and table, Layout of mould design, Bill of material, Detail Drawing Layout, application of designs in manufacturing of moulds, Assembly & detailed drawings for manufacturing of mould, Principle of material selection, selection of machine,processing parameters.

5.2 Design Parameter for Material: Shrinkage value, Specific gravity, Specific heat, Moulding temperature, Heat content –cal/gm.

5.3 Design Parameter for Injection Machine: Clamping force, Plasticising capacity, Injection pressure, Shot capacity, Clamping area, Cylinder temperature, Distance between tiebars, Platen layout, Register ring bore size, Nozzle data, Machine daylight, Nature of ejection mechanism.

5.4 Design Parameter for Blow Moulds: Blow time, Cooling Period, Pinch – off selection from standards, Venting, Clamping area, Shrinkage, Blow Temperature, Clamping Force, Parison Design, Die Swell, Cycle time.

UNIT VI

Mould polishing and surface treatment

Introduction: Understand polishing surface treatment of mould parts, Classification of polishing equipment: manual polishing kits, power assisted polishing kits, Classification of surface finishing: electro plating, etching, Classification of surface roughness values, surface texture requirement, polishing requirement and technique.

UNIT VII

Pre & Postmoulding operations

7.1 Pre moulding technique

Introduction: Pre moulding techniques, Classification of polishing equipment: manual polishing kits, power assisted polishing kits, Classification of surfacefinishing: electro plating etching.

7.2 Post moulding technique

Introduction: Post moulding technique, Classification of post moulding techniques: trimming, use of fixtures, coating, surface decoration, selection of related equipment.

UNIT VIII

Estimation, parameters of mould, machine and process

Introduction: Estimation parameters of mould, machine and process, Material estimation for plastic and mould, Machine time estimation for mould making, cycle time estimation (for injection, compression and blow mould), Estimation of material weight and volume, Study component drawing and estimate plastic material requirement, bill of material and estimate plastic for mould, detail drawing and calculate hours for making of mould, Describe procedure for estimating moulding cost per unit.

UNIT IX

Maintenance, Safety and Storage with respect to mould and machine

Introduction: Maintenance, safety and storage with respect to mould and machine, Principle of safety, maintenance, storage, Study and observe mould safety, machine safety and operator safety, Study standard check list for maintenance of machine and mould, Describe standard procedures for storage of moulds.

UNIT X

Design of moulds with CAD

Introduction: CAD software for mould design, Concept of 3D model, assembly modeling, use of data books, Design and develop the 3D model of the component, Design and develop the Mould base in CAD, design and develop the assembly model, detail model and prepare the bill of material.

PRACTICAL EXERCISES

1. Design and Drawing of simple mould for injection moulding with BOM
2. Design and Drawing of simple mould for Blow moulding with BOM
3. Design and Drawing of Mould bases
4. Design and Drawing of Conventional two plate mould for injection moulding for single cavity with BOM
5. Design and Drawing of Conventional two plate mould for injection moulding for Multy cavity with BOM
6. Design and Drawing of Moulds for injection (external and internal undercuts, threaded component) with BOM
7. Design and Drawing of 3-Plate moulds for injection moulding with BOM
8. Design and Drawing a Runner-less-insulated, hot runner
9. Design and Drawing a Runner and Gating system layout
10. Design and Drawing a Cooling layout for injection mould
11. Design and Drafting of a Core and Cavity of an injection mould using CAD Software
12. Design and Drafting of simple mould for injection moulding using CAD Software
13. Design and Drafting of 3- Plates mould for injection moulding Using CAD Software
14. Design and Drafting of a mould for blow moulding Using CAD Software
15. Design and Drafting of a multi cavity mould for blow moulding using CAD Software

RECOMMENDED BOOKS

1. A. Kumar, “Fundamentals of Tool Design”, Dhjanpat Rai & Co.
2. Sanjay K Nayak, Pratap Chandra Padhi, Y. Hldayathullah "Fundamentals of Plastic Mould Design ",Tata McGraw Hill Education Private Limited
3. R.G.W Pye “Injection Mould Design” Longman
4. Dominick V. Rosato & Donald V. Rosato, “Injection Molding Handbook”, CBS Publishers & Distributors, New Delhi.
5. A. S. Athalye “ Moulding of Plastics” Multi-tech Publishing co.
6. A. S. Athalye “Injection Moulding :Multi-tech Publishing co.

Note:

1. Final Assessment of practical work will be done by preparing drawing sheets and/or preparing the CAD model with the help of CAD Software.
2. List of Design parameters and flow chart appended for reference.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis in making students conversant with concepts and principles. This subject contains units of equal weightage.

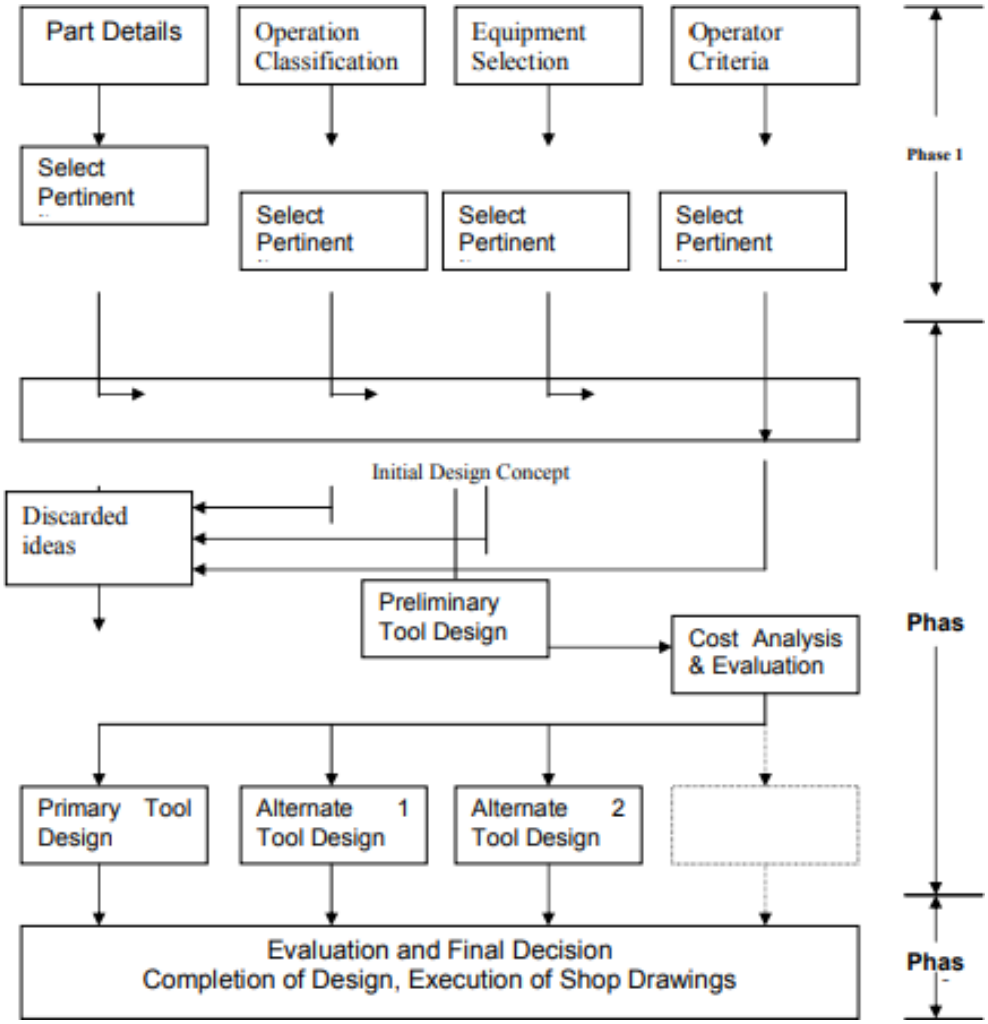
A. DESIGN PARAMETERS:
INJECTION MOULD (THERMOPLASTICS)

MOULD	MATERIAL	MACHINE
1. Detail no. of cavities 2. Injection pressure 3. Clamping force 4. Gate size 5. Runner size 6. Sprue size 7. Shot weight 8. Projected area of cavities 9. Solidifying time (incl. Mould temp) 10. Ejection force 11. Heat to be transferred per hr 12. Amount of water to be circulated/hr 13. Length & location of cooling channel 14. Cooling period 15. Determining total cycle time 16. Drafts & tapers 17. Venting dimension 18.Split movement related calculations 19.Calculations related to establishment of hot runner system. 20. Mould shut height. 21. Calculation related to unscrewing mechanism	1.Shrinkage value 2. Specific gravity 3. Specific heat 4. Moulding temperature 5. Heat content –cal/gm	1. Clamping force 2. Plasticising capacity 3. Injection pressure 4. Shot capacity 5. Clamping area 6. Cylinder temperature 7. Distance between tiebars 8. Platen layout 9. Register ring bore size 10. Nozzle data 11. Machine daylight 12. Nature of ejection mechanism

BLOW MOULD

MOULD	MATERIAL	MACHINE
1. Blow time 2. Cooling Period 3. Pinch – off selection from standards 4. Venting 5. Clamping are	1. Shrinkage 2. Blow Temperature	1. Clamping Force 2. Parison Design 3. Die Swell 4. Cycle time

B. PLASTIC MOULDS-FLOW CHART FOR DEVELOPMENT OF DESIGN SOLUTIONS



2.7 COMPUTER AIDED DESIGN - I

L	P
-	2

RATIONALE

This practice-oriented subject describes the facts, concepts, principles and procedures of computer aided drafting and design used in tool design practice, manufacturing and quality control to express the ideas, convey instructions through drafting and design for carrying out jobs in tool and die technology. It is also useful in understanding technology subjects such as tool design practice, workshop practice, CNC technology. It also describes the concepts, principles and procedure of developing models and designs using CAD software.

COURSE OUTCOMES

After undergoing this subject, the students will be able to

CO1: Understand the use and application of CAD software

CO2: Demonstrate the use of coordinate system for creating objects.

CO3: Draw objects with snap & grid, auto snap, grid & Ortho mode

CO4: Utilize the AutoCAD software as a drafting and design tool for Tool & Die making.

CO5: Apply basic CAD concepts to develop and construct 2D geometry through creation of basic geometric constructions.

CO6: Create, manipulate and edit 2D drawings in Auto Cad.

CO7: Apply elements of mechanical drafting such as layers and dimensions.

CO8: Construct orthographic Projections by giving proper dimensioning using appropriate Command for any geometrical figure in Auto CAD

CO9: Create 2D geometric sketches by using Auto CAD Software.

CO10: Develop 3D modeling by using advanced command in Auto CAD

DETAILED CONTENTS

UNIT I

Introduction

1.1 Review of computer fundamentals (lab talk)

Review of computer fundamentals and functions in CAD, instructions with respect to computer lab, handling computers and peripherals, hardware and software in the lab.

1.2 Application of CAD

Understand use of computer and CAD software in area of design and drawing, Concept of convention design process, computer operation and control, CAD software in Tool Room/ engineering industries, types of cad software.

1.3 Auto CAD Interface

Quick tour and application, Concept of AutoCAD, quick tour, tool bars in AutoCAD, Capability of Auto Cad, feature of AutoCAD Starting AUTOCAD, Various Visualization commands, Creating and Accessing documentation, Layout and plotting, Concept of hardware & software, Design criteria, Geometric modeling, Drawing entities, comparison of Auto Cad with various CAD Software, Tutorials and application.

UNIT II

Co-ordinate systems and drawing Creation

2.1 Co-ordinate systems

Understand co-ordinate systems in AutoCAD, Using co-ordinate system to specify points, shifting and rotating the coordinate system,drawing objects in different co- ordinate systems.

2.2 Creation of Lines

Understand and use line commands for line types of geometric construction, different line commands/ buttons, lines used in AutoCAD, line command, P Liine, M Line, X Line, Ray, Hidden, Centre line, dash dot, zig zag line.

2.3 Creation of Curves

Understand Curves, drawing curved objects, creating point objects, changing drawing order of objects, creating solid filled areas and regions, different types of curve and create various curved objects by use of Auto CAD command

UNIT III

Editing of drawing and Orthographic Projection

3.1 Editing of drawing

Understand and use editing command as required for construction, Types of different editing commands , Scale, erase, copy, stretch, lengthen, and explode, create the replica of model using copy, array, work with models in the modify toolbar, work with Erase, Trim, Break, Break at point, Create mirror, fillet & chamfer, Execute dimensions through dimension style option Understand design intent & edit the design intent, Identify Sketch Entities line arc, rectangle,

circle etc., Use sketch settings, Use of Style toolbar (text style, Multilayer style etc.), Concept of creating single entity object, Perform Revision cloud and wipe out command

3.2 Orthographic Projection

Understand orthographic projection using AutoCAD, orthographic views of objects: Front, top, left side, right side, principle of orthographic views, draw orthographic view of an object using commands.

3.3 Geometric dimensioning & Tolerance.

Understand the concept of tolerance, Classification of tolerance, describe Dimensional and Geometrical tolerance, GD&T Symbols, Modifiers, Datum feature symbols, Feature Control Frame (FCF), Use of GD& T in detailed drawing.

UNIT IV

Layer Management and Basic Dimensioning

4.1 Layer management

Edit objects using the object property tool bar and various method, Concepts of layers, Create the layers by various line property., Extract the layers from the saved file by design Centre option, Application of layers on/off, Use of layers for block, text, dimension, freeze, lock. Work with snap & Grid alignment using Ortho modes, Define Attributes for variable text of block, Use of purge to eliminate the unused layers, blocks, Create title block using table option.

4.2 Dimensioning- Scale, Dimension and Text

Understand the concept of drawing to scale, dimensioning and text, Use of linear dimensioning (Linear, Align, and Ordinates), Use of circular dimensioning (Radius, Diameter, Arc length), Create Baseline dimension & continuous dimensions for linear & angular dimension, add text with various engineering symbols, deform the object by scale, lengthen, stretching, extend, Change the orientation of the object by align, offset, rotate, Concept of standard dimension, Use of angular dimension, use of leader with text, block reference, concepts of block, create the block, write block & extract the block from saved block and modifying dimensions.

4.3 Sectioning and hatching

Understand commands for sectioning and hatching, sectional views: types of sections, section planes, assembly sectioning, and hatching, sectioning plane, hatch pattern/ style, hatching sectioned drawing

UNIT V

Working in 3D space

Concept of Isometric Drawing, axes and planes, circles, defining the paper setting, basic modeling workflow, defining 3D Drawing, differences between 2D & 3D Drawing, overview of 3D model, 3D Drawing vs 3D Modeling, 3D Drawing & Modeling Workflow, UI & Layout, 3D Tools & Features, Solid modeling in Auto CAD (creating technique), Solid modeling in AutoCAD (editing and modification technique, converting wire frame models in to surface mode,

RECOMMENDED BOOKS

1. Linkan Sagar "AutoCAD Training Guide", BPB Publisher
2. Cadfolks "AutoCAD for Beginners", Kishore
3. Seyi Sunday "AUTOCAD 2023: Beginners & Intermediate Users", Guide Kindle Edition

INSTRUCTIONAL STRATEGY

The teachers should first demonstrate then assist the students to prepare drawing. The student should be motivated to use Auto CAD software in preparing details drawing and drafting.

Note:

1. The related theory will be imparted to students in practical class. Only practical and viva-voce will be conducted for practical examination.

2.8 WORKSHOP PRACTICE II

L	P
-	12

RATIONALE

At the end of 2nd year, the student will be able to acquire skills in the precision machining processes, various machining operations and assembly of press tools, injection moulds and jigs & fixtures. The trainee will learn concepts, principles and procedures for making precisions parts and assembly of components of press tools, plasticmoulds, jigs & fixtures.

COURSE OUTCOMES

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

CO1: Fabricate multifunctional tools by using skill of bench work, turning, milling, surface grinding and cylindrical grinding Machine

PRACTICAL EXERCISES

Make multifunctional tool by integrating skills of Bench work, Turning, Milling, Surface grinding and Cylindrical grinding (Internal & External)

1. Make and assemble the guided press tools
2. Make and assemble the parts of press tools for the Blanking and Piercing tool
3. Make and assemble the parts of press tool for the Compound and Progressive tool
4. Make and assemble the standard parts of injection mould for Single and multi-cavity injection mould
5. Make and assemble the Standard parts of jigs & fixtures for Locating and Clamping device

RECOMMENDED BOOKS

1. J. Chapman, “Workshop Technology (Vol I, II & III)”, Amol Publication.
2. Kishore, “Tool & Die Maker”, Saurabh & Co., Delhi.
3. S. K. Hazra & S. K. Choudhary, “Elements of Workshop Technology”, Metropolitan Publishers
4. S. Raghuwanshi et al. “Workshop Technology”, New Heights, New Delhi.
5. W. H. Atherton, “Workshop Practice Vol I to V”, New Era Publishers, London.

Note:

The related theory will be imparted to students @ 3 periods Shoptalk per week which is included in the total number of hours in practical class. Only Practical Test and viva-voice will be conducted for practical examination.

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students.

2.9 OPEN ELECTIVE

L	P
1	-

RATIONALE

Open electives are very important and play major role in implementation of National Education Policy. These subjects provide greater autonomy to the students in the curriculum, giving them the opportunity to customize it to reflect their passions and interests. The system of open electives also encourages cross learning, as students pick and choose subjects from the different streams.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:

CO1: State the basic concepts and principles about the subject of interest.

CO2: Perform in a better way in the professional world.

CO3: Select and learn the subject related to own interest.

CO4: Explore latest developments in the field of interest.

CO5: Develop the habit of self-learning through online courses.

LIST OF OPEN ELECTIVES

(The list is indicative and not exhaustive)

1. Computer Application in Business
2. Introduction to NGO Management
3. Basics of Event Management
4. Event Planning
5. Administrative Law
6. Introduction to Advertising
7. Moodle Learning Management System
8. Linux Operating System
9. E-Commerce Technologies
10. NCC
11. Marketing and Sales
12. Graphics and Animations

13. Digital Marketing
14. Human Resource Management
15. Supply Chain Management
16. TQM

GUIDELINES

Open Elective shall be offered preferably in online mode. Online mode open elective shall preferably be through Massive Open Online Courses (MOOCs) from Swayam, NPTEL, Upgrad, Udemy, KhanAcademy or any other online portal to promote self-learning. A flexible basket of large number of open electives is suggested which can be modified depending upon the availability of courses at suggested portals and requirements. For online open electives, department coordinators shall be assigned to monitor and guide the group of students for selection of minimum 20 hours duration online course of their choice. For offline open electives, a suitable relevant subject shall be offered by the respective department to the students with minimum 40% of the total class strength as per present and future requirements.

Assessment of MOOCs open elective shall be based on continuous evaluation by the respective coordinator. The coordinator shall consider the submitted assignments by the students from time to time during the conduct of MOOCs. The MOOCs assessment shall be conducted by the coordinator along with one external expert by considering submitted assignments out of 100 marks.

In case, no suitable open elective is available online, only then the course may be conducted in offline mode. The assessment of offline open elective shall be internal and external. The offline open elective internal assessment of 40 marks shall be based on internal sessional tests; assignments etc. and external assessment of 60 marks shall be based on external examination at institute level.

NOTE

The students enrolled under NCC will compulsorily undertake NCC as an open elective subject.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://www.udemy.com/
3. https://www.upgrad.com/
4. https://www.khanacademy.org/

THIRD YEAR
NSQF LEVEL - 5

18. STUDY AND EVALUATION SCHEME

THIRD YEAR

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
3.1	Industrial Training	-	1	0+1=1	-	40	40	-	60	60	100
3.2	Hydraulics and Pneumatics	1	1	2+1=3	40	40	80	60	60	120	200
3.3	Basics of Electrical and Electronics Engineering	2	-	4+0=4	40	-	40	60	-	60	100
3.4	Computer Aided Design and Manufacturing (CAD and CAM)	-	6	0+6=6	-	40	40	-	60	60	100
3.5	CNC Technology	2	-	4+0=4	40	-	40	60	-	60	100
3.6	Tool Design – III (Plastic Moulds)	2	2	4+2=6	40	40	80	60	60	120	200
3.7	Tool Design - IV (Forging & Casting Dies)	2	4	4+4=8	40	40	80	60	60	120	200
3.8	Workshop Practice III	-	12	0+12=12	-	40	40	-	60	60	100
#Student Centered Activities(SCA)		-	-	-	-	-	-	-	-	-	-
	Total	**9**	**26**	**44**	**200**	**240**	**440**	**300**	**360**	**660**	**1100**

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

19. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week
		Third Year
1.	Industrial Training	1
2.	Hydraulics and Pneumatics	2
3.	Basics of Electrical and Electronics Engineering	2
4.	Computer Aided Design and Manufacturing (CAD and CAM)	6
5.	CNC Technology	2
6.	Tool Design – III (Plastic Moulds)	4
7.	Tool Design - IV (Forging & Casting Dies)	6
8.	Workshop Practice III	12
9.	Student Centred Activities	-
Total		**35**

20. COMPETENCY PROFILE AND EMPLOYMENT OPPORTUNITIES

Government and private sectors related to **Advance Diploma in Tool and Die Making** require **supervisors and technician engineers,** having well developed skills with clear choice of procedures. They are expected to have complete knowledge and practical skills related to tool and die engineering. They shall be able to communicate clearly with others. Diploma holders after passing level 5 shall have understanding of desired mathematical skills and understanding of social and natural environment. They are expected to collect, organize and communicate information effectively.

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning.

Individuals employed to carry out these jobs will be expected to be able to communicate clearly in speech and writing and may be required to apply mathematical processes. They should also be able to collect and organise information to communicate about the work. They will solve problems by selecting and applying methods, tools, materials and information. They will be expected to have previous knowledge and skills in the occupation, and to know and apply facts, principles, processes and general concepts in the occupation. They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise. In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

They are expected have the knowledge of Hydraulics and Pneumatics, Basics of Electrical and Electronics Engineering, Computer Aided Design and Manufacturing (CAD and CAM), CNC Technology, Tool Design (Plastic Moulds), Tool Design (Forging & Casting Dies) and Advance Workshop and Industry Practices. They might find work with a manufacturing company and spend time maintaining, or even designing, the machines. They might also work in relevant laboratories for any institute, university or even a private companies. They are expected to have good exposure of

humanities, life skills, entrepreneur development and management to establish small start-ups in the area of Marketing, Sales, Repair and Maintenance etc**.**

They have wide scope to work as supervisory technical employee on wage basis in following organizations: In manufacturing industries primarily in private sector and to some extent in public sector Maintenance department of tool and die making industries, Instructor in Technical Institutions

They have wide scope in establishing small start-ups in the area of Marketing and Sales, Manufacturing Units and Repair and Maintenance units etc.

21. PROGRAMME OUTCOMES

The programme outcomes are derived from five domains of NSQF Level – 5 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Perform task that require well developed skills with clear choice of procedures.

PO2: Acquire knowledge of facts, principles and processes related to advances in tool and die making.

PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems.

PO4: Develop skills to collect, organize and communicate information.

PO5: Accomplish own work and supervise others work.

22. ASSESSMENT OF PROGRAM AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Perform task that require well developed skills with clear choice of procedures.	• Compare pneumatic system with hydraulic system. • Explain fundamentals of AC and DC circuits. • Define Ohm's law, Kirchhoff's current and voltage law. • Explain the concept of electromagnetic induction. • Explain the basic components of CNC Machines. • Classify CNC machines • Correlate material, equipment moulds and process in mass production of plastic components. • Identify design parameters for mould, material and machine. • Correlate material, equipment dies and process in mass production of metallic components.
PO2: Acquire knowledge of facts, principles and processes related to advance diploma in tool and die making	• Define and explain kinematics and dynamics of fluids. • Define the properties of fluids. • Explain the working of pressure measuring devices. • Describe hydraulics machines such as turbine and pump. • Explain the working of pneumatic system and its elements. • Explain the working of Hydraulic system and its elements. • Describe construction and working of various electrical machines like transformer, motor, generator etc. • Explain the concept of DIODE, transistors, amplifier etc. • Explain different types of CAD/CAM software.

	• Explain tooling and construction of CNC machines. • Describe CNC lathe, CNC milling, CNC EDM, CNC grinding and CNC machining operations. • Explain the principle and working of moulding machines. • Describe the function and features of various elements of moulds. • Explain the principle and working of forging machines. • Describe the function, features and design parameters of various elements of forging dies and casting dies. • Explain procedure for safety, maintenance and storage of dies
PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems.	• Analyse hydraulic and pneumatic circuits. • Design fluid power circuits for industrial applications. • Apply fundamentals of servo and stepper motor. • Apply digital and analog principles. • Create 2D geometric sketches using high end CAD Software • Develop 3D modeling by using advanced command. • Draw and develop assembly design using CAD/CAM Software's. • Design generative and interactive drafting. • Generate Tool Path and create 2D-Toolpath in CAM. • Create 3D-Toolpath Generation for rough machining and finish machining. • Create advanced modeling and creative/innovative solutions.

	• Perform Post-processing. • Execute and generate various milling and turning operations in CAM • Generate CNC program using CAM Software • Execute part-programming of CNC machining operations. • Execute pre-moulding and post moulding operations. • Prepare estimate of plastic material requirement and bill of material for mould making. • Draw mould parts, mould housing and bases, and standard elements. • Draw components and system layout. • Prepare data sheet for mould, material and machine. • Develop conceptual design using data sheet and draw assembly and detailed drawings of plastic mould. • Prepare estimate of raw material requirement and bill of material for die making. • Draw mould parts, mould housing, bases and standard elements. • Prepare data sheet for die, material and machine. • Develop conceptual design, using data sheet. • Draw assembly and detailed drawings of die-casting and forging dies. • Execute, operate and do programming of CNC machines through practical exercises. • Apply CNC machining techniques to real-world scenarios and projects. • Use CNC machines independently and efficiently. • Demonstrate proficiency in the manufacturing of jigs, fixtures, press tools and moulds, using various machining and fabrication techniques.

	• Apply principles of tool and die making to produce functional and precise components that meet industry standards and specifications. • Identify common issues in tools and dies and implement effective troubleshooting and repair strategies to maintain optimal functionality. • Utilize advanced repair techniques such as welding, grinding, and re-machining of worn-out tool and die components.
PO4: Develop skills to collect, organize and communicate information.	• List specifications of mould, material and machine. • Write the specifications of forging and die casting machine. • Write specifications of CNC machines and various accessories in CNC machines • Develop writing, speaking and presentations skills
PO5: Accomplish own work and supervise others work.	• Describe procedure for safety, maintenance and storage of mould and machine. • Collaborate with peers to tackle machining challenges and share best practices. • Observe safety and common hazards in CNC operations. • Explain the working environment of industries • Take necessary safety precautions and measures. • Describe present and future requirement of industries. • Work in team for solving industrial problems • Develop competencies and skills required by relevant industries.

23. SUBJECTS & CONTENTS

(THIRD YEAR)

THIRD YEAR

3.1	Industrial Training	115-116
3.2	Hydraulics and Pneumatics	117-121
3.3	Basics of Electrical and Electronics Engineering	122-125
3.4	Computer Aided Design and Manufacturing (CAD and CAM)	126-130
3.5	CNC Technology	131-134
3.6	Tool Design – III (Plastic Moulds)	135-140
3.7	Tool Design - IV (Forging & Casting Dies)	141-146
3.8	Workshop Practice III	147-150

3.1 INDUSTRIAL TRAINING

L	P
-	1

RATIONALE

Industrial training will help the students to understand the working environmentof relevant industries. The student will learn to work in team to solve the industrial problems. It willalso give exposure about the present and future requirements of the relevant industries. This trainingis very important for development of required competencies and skills for employment and start– ups.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Explain the working environment of industries
CO2: Take necessary safety precautions and measures.
CO3: Describe present and future requirement of industries.
CO4: Work in team for solving industrial problems
CO5: Develop competencies and skills required by relevant industries.
CO6: Develop writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.

GUIDELINES

Students will be evaluated based on Industrial training report and their presentation using Power Point about the knowledge and skills gained during the training. The Headof the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final presentation. The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	**Weightage**
i	Industrial assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

3.2 HYDRAULICS AND PNEUMATICS

L	P
1	1

RATIONALE

Diploma holders in advance diploma in tool and die making are required to deal with properties of fluid and use of hydraulics and pneumatics in power generation and industries. Low cost automation, using pneumatics & hydraulic machines and presses, are very common in automobile and die casting industries. Studying the fundamentals of hydraulics and pneumatics facilitates better understanding of their applications in the area of tool and die Making and widens the employment opportunities of the students.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1 Define and explain kinematics and dynamics of fluids.
CO2 Define the properties of fluids.
CO3 Explain the working of pressure measuring devices.
CO4 Describe hydraulics machines such as turbine and pump.
CO5 Explain the working of pneumatic system and its elements.
CO6 Explain the working of Hydraulic system and its elements.
CO7 Compare pneumatic system with hydraulic system.
CO8 Analyse hydraulic and pneumatic circuits.
CO9 Design fluid power circuits for industrial applications.

DETAILED CONTENTS

UNIT I

Introduction to Hydraulics & Pneumatics

Overview of Hydraulics & Pneumatics and its application, Concept of Hydraulic & Pneumatic system in tool engineering, **Application of hydraulic systems in** jigs & fixtures, plastic moulds, die casting dies & forging dies, machine tools. **Applications of Hydraulic and Pneumatic systems**

UNIT II

Fundamental Properties

Fluid-Definition-Classification of fluids-Ideal and real fluids-Newtonian and non-Newtonian-Properties of fluids-Density, Specific weight, Specific volume, Specific gravity, Compressibility, Viscosity, Surface tension Dynamic Viscosity, Kinematic Viscosity and capillarity, Vapour Pressure, Compressibility, Specifications of Hydraulic oil and its desirable properties.

Properties of air and its applications, Concept of pressure, pressure head, pressure drop, force, power, work, flow though pipes, expansion and compression of gases, Introduction to gas laws- Charle's & Boyles pressure laws.

UNIT III

Fluid Pressure & Pressure Measurement

Pressure-Unit of pressure, Atmospheric pressure, gauge pressure, Vacuum pressure and Absolute pressure, Pascal's law-Proof Applications of Pascal's law-Hydraulic press, Hydraulic jack.

Pressure Measurement -Piezometer tube-Simple U-tube manometer- Differential U- tube manometer-Inverted differential U-tube manometer, Mechanical Pressure gauge- Bourdan tube pressure gauge-Diaphragm pressure gauge-Dead weight pressure gauge. Simple Numericals.

UNIT IV

Kinematics and Dynamics of Fluid Flow:

Types of fluid flow – steady and unsteady – uniform and non-uniform flow – laminar and turbulent – compressible and incompressible flow – concept of rotational and irrotational flow – one, two dimensional flow, rate of flow or discharge, equation of continuity of liquid flow, energy of a liquid in motion, potential energy, kinetic energy, pressure energy, total energy, total head of liquid in motion. Bernoulli's equation – assumptions – applications. Venturi meter (Simple Numericals), Orifice meter, Pitot tube.

UNIT V

Hydraulic Machines

Introduction to Hydraulic machines, classification of pumps – construction and working of Centrifugal pump- Need for priming of centrifugal pump–multistage centrifugal pump. Reciprocating pump-types construction and working.

UNIT VI

Hydraulic systems Hydraulic system and its elements-Merits, Demerits and applications of hydraulic system. Basis of system – oil reservoir pump unit, Hydraulic Pumps: principle of working of positive

displacement pump and non - positive displacement pumps, classification of pumps – gear pump, screw pump, vane pumps, lobe pump, simple piston pumps, Hydraulic actuators, classification of actuators- rotary, semi-rotary, Linear motion type, Hydraulic motors, Hydraulic cylinder types – single acting, double acting. ISO symbols for hydraulic components.

UNIT-VII

Hydraulic Control Elements and Components

Control valves – functions, classification of valves, relief valves, poppet valves, direction control **(DC)** valves, Types- sliding spool type valves, check valves, solenoid control valves, Flow control valves and its types – gate, globe, butterfly valves, non return valves, intensifier, Hydraulic accumulators – Uses, types – weight loaded, spring loaded, gas loaded. **Filter**s.

UNIT-VIII

Hydraulic Circuits

Hydraulic circuits-Operation of double acting cylinder using metering-in control and metering-out control, Operation of Hydraulic motor using metering-in and metering out- control, Hydraulic circuit using sequence valves and counter balance valves.

UNIT IX

Pneumatic systems, Control Elements and Components

Basic pneumatic systems, pneumatic symbols, air filter, pressure regulator, lubricator, mufflers. Comparison of pneumatic & hydraulic system

Control Elements and Components: Control valves, directional control valves, solenoid valves, Cam operated flow control valves, Flow control valves-Throttle valve, Shuttle valve, Quick exhaust valve, Time delay valve.

Concepts, types and applications of air cylinders.

Concepts, types and applications of Pneumatic actuators, ISO symbols of Pneumatic components.

UNIT X

Pneumatic Circuits:

Introduction to basic pneumatic circuits, Pneumatic Circuits-Direct operation of single acting cylinder, Operation of double acting cylinder with metering-in and metering-out control.

Introduction to hydro pneumatic System.

PRACTICAL EXERCISES (Minimum 10 experiments to be performed):

1. Measurement of pressure head using, Piezometer tube, Simple U-tube manometer, Bourdon's tube pressure gauge.

List of exercises in Hydraulic System

2. Study of hydraulic System and its elements.
3. Direct operation of a Double Acting Cylinder.
4. Direct operation of a Hydraulic motor.
5. Controlling the speed of a Double Acting Cylinder using metering-in and metering-out type control.
6. Controlling the speed of hydraulic motor using metering-in and metering-out control.
7. Sequencing of two cylinders using Sequence Valve.

List of exercises in Pneumatic System:

8. Study of Pneumatic System and its elements.
9. Direct operation of a Single Acting Cylinder and Double Acting Cylinder.
10. Operation of a Single Acting Cylinder controlled from two different positions using Shuttle Valve.
11. Operation of a Double Acting Cylinder with quick return using quick exhaust valve.
12. Controlling the speed of a Double Acting Cylinder using metering –in and metering –out controls.
13. Automatic operation of a Double Acting Cylinder in single cycle using limit switch and memory valve.

RECOMMENDED BOOKS

1. S.S.Rattan,"FluidMechanics&HydraulicMachines",KhannaPublishingHouse,NewDelhi.
2. KLKumar,"FluidMechanics",S ChandandCoLtd., RamNagar,NewDelhi.
3. RKBansal,"ATextbookofFluidMechanicsandHydraulicMachines",LaxmiPublication,New Delhi.
4. AndrewParr,"HydraulicsandPneumatics:ATechnician'sandEngineer'sGuide",Butterworth-Heinemann.

5. R.Srinivasan, Hydraulic and Pneumatic controls, Vijay Nicole Imprints PVT.LTD, second edition, Chennai
6. S.Majumdar,"PneumaticSystems:PrinciplesandMaintenance",McGrawHill.

SUGGESTED WEBSITES

1. https://onlinecourses.nptel.ac.in/noc21_me51/preview
2. http://www.howstuffworks.com/search.php?terms=hydraulics
3. http://hyperphysics.phy-astr.gsu.edu/hbase/fluid.html#flucon
4. http://www.youtube.com/watch?v=FVR7AC8ExIM
5. http://www.youtube.com/watch?v=iOXRoYHdCV0
6. http://www.youtube.com/watch?v=qDinpuq4T0U
7. http://www.youtube.com/watch?v=xxoAm3X4iw0

INSTRUCTIONAL STRATEGIES

This subject contains ten units of equal weightage. This is hands on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills among the students. Teaches should take the students to industry and explain the details of various systems and their components. While imparting instructions, focus should be on conceptual understanding. Training slides and videos should be used to supplement the classroom teaching. During practice work, it should be ensured that students get opportunity to individually perform practical tasks. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Some industrial and field visit may also be arranged. Teachers should utilize a combination of instructional methods to accommodate different learning styles, including lectures, demonstrations, discussions, group projects and hands-on lab work. Integrate multimedia resources such as videos, simulations, and interactive tutorials to enhance understanding and engagement. Encourage active learning through problem-solving exercises, quizzes, and practical demonstrations. Develop a variety of assessment tools to evaluate student comprehension and mastery of the subject matter, including quizzes, exams, lab reports and project. Incorporate real-world examples, case studies, and guest lectures from industry professionals to demonstrate the practical applications of hydraulics and pneumatics in various engineering fields.

3.3 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

L	P
2	-

RATIONALE

Study of Magnetic and Electric Circuits are essential for the students of advanced diploma in tool and die making. Study of elements of electrical engineering constitutes the basic and fundamental aspect of the functioning and analysis of electrical network, instruments and machineries. The subject also integrates the basic knowledge electronics so the students can apply the fundamentals in tool and die making. The basic principles involved and their applications of electrical and electronics engineering are included in the syllabus.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1	Explain fundamentals of AC and DC circuits.
CO2	Define Ohm's law, Kirchhoff's current and voltage law.
CO3	Explain the concept of electromagnetic induction.
CO4	Describe construction and working of various electrical machines like transformer, motor, generator etc.
CO5	Explain the concept of DIODE, transistors, amplifier etc.
CO6	Apply fundamentals of servo and stepper motor.
CO7	Apply digital and analog principles.

DETAILED CONTENTS

UNIT I

Alternating Current Fundamentals

Alternating currents, peak and RMS value of alternating current/voltage; reactance and impedance, resonance, power in AC circuits, power factor, wattless current. Concept of single phase and three phase system.

UNIT II

DC circuits

Fundamental of DC circuit: Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, V-I characteristics (linear and nonlinear), electrical energy and power, electrical resistivity and conductivity, temperature dependence of resistance, Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel, Kirchhoff's rules, Wheatstone bridge.

UNIT III

Electromagnetic Induction

Electromagnetic induction; Faraday's laws, induced EMF and current; Lenz's Law, Self and mutual induction, Fleming's Right Hand Rule, Lenz's Law Induced E.M.F: Self Induced E.M.F., Mutually Induced E.M.F., direction of Induced E.M.F. and currents, Energy Stored in Magnetic Field.

UNIT IV

Electrical Machines: Transformer

Concept and principal of mutual induction in single phase and three-phase transformer, EMF equation of transformer, specification of transformer. Describe working, construction of single phase and three phase transformer, methods of cooling of transformer, maintenance and earthing of transformer.

UNIT V

Electrical Machines: D.C. Motor & Generator

Introduction to of DC generator, motor and application, Concept of back EMF, EMF equation of generator, specification of DC generator and motor, Working and construction of DC motor and generator. Applications of DC motor and generator. Safety measures.

UNIT VI

Electrical Machines: Three phase and single phase induction motor and Alternator

Introduction single phase and three phase induction motor and applications, Concept of induction motor, specification of induction motor. Principle of working and construction of three phase induction motor and single phase induction motor, starting of induction motor. Safety measures.

Alternator, types and application, Concept of energy conversion from Mechanical to Electrical, EMF equation, working principle of alternator, construction of alternator, applications of alternator. Safety measures.

UNIT VII

Basic Electronics

Concept of semiconductor diodes, P.N. Junction Diodes, working principle & circuit diagram of Characteristic of PN junction diode, Static & dynamic resistance, specification, forward voltage drop, maximum forward current, power dissipation.

Introduction to transistors, Principle, working, types and characteristics of BJT (Bi-junctional transistor), FET (Field effect transistor), UJT (Uni-junctional transistor) & thyristor family.

UNIT VIII

Rectifiers and filters

Introduction, working principle of rectifier, filters half wave and full wave rectifiers, bridge rectifiers. High pass, low pass and band pass filter.

UNIT IX

Servo motor and stepper motor

Introduction to Servo motor and stepper motor and application. Principle working principle, construction of servo motor, stepper motor**.**

UNIT X

Digital and Analog principles

Introduction to Operational amplifier and logic gates Working principle of operational amplifier, logic gates, truth table.

RECOMMENDED BOOKS

1. Edward Hughe “Electrical and Electronic Technology”, 10th Edition, Pearson Education Asia, 2019.
2. P. Kothari, I J Nagrath, “Electric Machines”, 5th Edition, Tata McGraw Hill, 2017.
3. P. Malvino, “Electronic Principles”, 7th Edition, Tata McGraw Hill, 2007.S. K. Bhattcharya, “Basic Electrical and Electronics Engineering”, Pearson, 2012.
4. Vincent Del Toro, “Electrical Engineering Fundamentals”, Prentice Hall of India Private Limited, 2nd Edition, 2003.
5. David Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2008.

6. Michael Tooley A., “Electronic circuits: Fundamentals and Applications”, 3rd Edition, Elsevier Limited, 2006.

RECOMMENDED WEBSITES

1. https://archive.nptel.ac.in/courses/108/101/108101091/
2. https://onlinecourses.nptel.ac.in/noc19_ee35/preview
3. https://nptel.ac.in/courses/122106025
4. https://nptel.ac.in/courses/108108076
5. http://electrical4u.com/
6. www.electronics-tutorials.ws

INSTRUCTIONAL STRATEGY

This subject contains ten units of equal weightage. While imparting instructions, focus should be on conceptual understanding. Training slides and videos should be used to supplement the classroom teaching. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Teachers should utilize active learning methods like interactive lectures, hands-on activities, group projects and case studies. Blend traditional and digital resources for diverse learning styles should be practiced. Emphasize practical applications of theoretical concepts though industry visits and internships. Assess student progress with formative quizzes, exercises, and summative exams, projects, and reports. Integrate technology tools such as simulation software and virtual labs for enhanced learning experiences. Teachers should continuously gather feedback for improvement and stay updated on industry trends.

3.4 COMPUTER AIDED DESIGN AND MANUFACTURING (CAD AND CAM)

L	P
-	6

RATIONALE

This subject is a completely practice-oriented and helps the students in deeper understanding of underlined facts, concepts, principles and procedures of computer aided design and computer aided manufacturing used in tool and die making. The students express the ideas through drafting and design for carrying out jobs maintaining geometrical dimensioning and tolerances (GD&T) standards in tool and die manufacturing. The subject also helps students in understanding CNC technology and CAM programming. It also describes the concepts, principles and procedure of developing models and generating part-program using CAD/CAM.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1 Explain different types of CAD/CAM software.
CO2 Create 2D geometric sketches using high end CAD Software
CO3 Develop 3D modeling by using advanced command.
CO4 Draw and develop assembly design using CAD/CAM Software's.
CO5 Design generative and interactive drafting.
CO6 Generate Tool Path and create 2D-Toolpath in CAM.
CO7 Create 3D-Toolpath Generation for rough machining and finish machining.
CO8 Create advanced modeling and creative/innovative solutions.
CO9 Perform Post-processing.
CO10 Execute and generate various milling and turning operations in CAM
CO11 Generate CNC program using CAM Software

DETAILED CONTENTS

UNIT I

Introduction : **Concept of CAD:** Capability of CAD Software and Introduction to various CAD software used in manufacturing industry, Description of the feature that have been added or changed since new

Release CAD. Criteria for selection of CAD workstations, Design criteria, Geometric modeling, entities, 2D & 3D Primitives.

Application of CAD: Different Types of cad software and their application in industry specific, comparison of various CAD Software, CAD software features and concept of hardware & software.

UNIT II

Sketching and Constrains

Drawing Tools: Drawing curve objects (Circle, Arc, Ellipse, elliptical arcs), Creating solid filled areas-Regions, Hatch, Dot-nut, DD type, drawing line object like line, polyline, multiline etc. Drawing curve objects like Circle, Arc, Ellipse, elliptical arcs etc.

Editing of Sketch: Editing objects using the object property tool bar and various method & Controlling Drawing Display, (Carry, Lengthen, Stretching, Offset, Align, Trim, Extend, Array and Dimensioning

Sketching Constrains: Types of constrains: Dimensional constrains and geometric constrains and their importance in CAD. Tools available for introducing constrains in sketch.

UNIT III

Part Design & Surface Modeling

Part Design: Working with block & defining block attributes, concept of Isometric Drawing, Layout & Plotting and Creating of solid modeling / 3d modeling and editing, and modification technique and tools in CAD.

Surface Modeling: Creating of surface model using creating, Editing, and modification technique.

UNIT IV

Assembly

Assembly types: Bottom Up, Top Down, Component placement, Mate relationships.

Assembly Structure and Modification: Creating sub-assemblies and grouping related components together, Modification tools available in assembly.

Special features: Motion Studies of generated assembly, Exploded Views.

Unit V

Drafting

Bill of Materials, Assembly Drawings, Drafting generate standard three views, model view, and predefined view, standard section views, crafting drawings, creating dimensions, annotations, notes and

surface finish symbols, add geometric tolerance to the drawing views, add center marks and center lines to the drawing views, add center marks and center lines to the drawing views.

UNIT VI

Introduction to CAM

Understanding CAM & Its Application

Capability of CAM Software and Introduction to various CAM software used in manufacturing industry, description of the feature that have been added or changed since new Release software, criteria for selection of workstations, Design criteria, Geometric modeling, entities, 2D & 3D Primitives CAM software features and comparison of various CAM Software.

UNIT VII

Sketcher & Solid Modeling in CAM

Creating Sketch: Drawing sketches for solid models, creating sketches in the Sketch task environment & Modeling Environment. Understand Various Sketching Tool, Adding Geometric & Dimensional Constraint to sketches.

Generating models and editing Tools: Tools used for generating model from sketch, editing processes and tools available.

UNIT VIII

CAM Terminology

Terms used in CAM: Understanding Toolpath Operation, Toolpath Strategy, Toolpath Parameters, Tool path Simulation, Stock, Cutting Tool, Toolpath Verification ,Post-Processing, Fixture, Tool Library & Machine Simulation.

UNIT IX

Tool Path Generation

Concept of CAM: Introduction to CAM environment, review of Modeling, Introduction to CAM, Master model concept, Machining environment, Operation Navigator and Re-entering into the Manufacturing application.

Tools and Operations: Manufacturing Tools, Creating new operation, manufacturing applications, saving part file, closing part file.

UNIT X

CAM Program Generation

Understand Various Milling and Turning operations: Perform various Milling and Lathe operations using CAM software, point to point machining, creating drilling & reaming operation and hole making, planner mill overview Profiling, Single level, Multi-level, Multi region, Creation of boundaries, Setting Custom Boundary Member Data Setting Drive Cutting Method, Ramping method. Cut types, Trim boundary, and Uncut Region boundary, Creating Cavity Milling operation, Blank Geometry and offset, uses of cutting option. Creating fixed contour operation. Lathe cross section, common turning parameters.

RECOMMENDED BOOKS

1. Mikell P. Groover "Computer-aided Design and Manufacturing" Mcgraw-Hill
2. Ibrahim Zeid , R Sivasubramanian "CAD/CAM : Theory and Practice" McGraw Hill Education
3. Ibrahim Zeid , " Mastering CAD/CAM " McGraw Hill Education
4. Jaecheol Koh. "Siemens NX 8 Design Fundamentals -A Step by Step Guide" ONSIA Inc

RECOMMENDED WEBSITES

1. https://archive.nptel.ac.in/courses/112/102/112102101/
2. https://www.youtube.com/channel/UCZCoSXS4znBo3imIaWe0NKg
3. https://www.youtube.com/@CADCAMSOLUTIONSMEERUT
4. https://www.youtube.com/watch?v=vO1lc75jtiM&list=PLLvBXFAV-DeLYJkmexmAEo-qb2miY97C_
5. https://drive.google.com/file/d/19nDytnSqwPMay_uyFOLBu0KKwJllaxm8/view

INSTRUCTIONAL STRATEGY

This subject contains ten units of equal weightage. This is hands on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills among the students. The teachers should first demonstrate then assist the students to prepare drawing and generating CNC programme, using CAD/CAM software. The student should be motivated to use high end CAD/CAM software such as NX-CAD/CAM, Solidworks, CREO, Master CAM etc. in preparing details drawing and CAM Programming. The related theory will be imparted to students in practical class, only practical on CAD/CAM software and viva-voce will be conducted for practical examination.

This is hands on practice based subject and students should be given opportunities to conduct experiments lab regularly for development of required skills among them. During practice work, it should be ensured that students get opportunity to individually perform practical tasks. Field and industrial visits should be arranged at intervals to enable the students understand fault-diagnosis and trouble-shooting techniques being followed in the world of work.

3.5 CNC TECHNOLOGY

L	P
2	-

RATIONALE

Diploma holders are required to supervise and handle specialized machines and equipment like CNC machines. For this purpose, knowledge and skills about NC machines, part-programming in NC machines and tooling for CNC machines are required to be imparted to enable the students to perform various functions. This subject aims at development of knowledge and skills about CNC machines, tools, equipment and use of high-tech machines for increased productivity and quality.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1 Explain the basic components of CNC Machines.
CO2 Classify CNC machines.
CO3 Explain tooling and construction of CNC machines.
CO4 Write specifications of CNC machines and various accessories in CNC machines
CO5 Describe CNC lathe, CNC milling, CNC EDM, CNC grinding and CNC machining operations.
CO6 Execute part-programming of CNC machining operations.
CO7 Observe safety and common hazards in CNC operations.

DETAILED CONTENTS

UNIT-I
Introduction

Introduction to NC, CNC & DNC, their advantages, disadvantages and applications.
Basic components of CNC machines, Machine Control Unit, input devices, selection of components to be machined on CNC machines, Classification of NC system-based on feedback control, control system feature, co-ordinate system, axis identification.

UNIT-II

Construction and Tooling

Design features, specification of CNC machines, use of slideways, balls, rollers and coatings, motor and lead screw, swarf removal, safety and guarding devices, Work holding devices various, cutting tools for CNC machines, Concept of CNC tool holder, different pallet systems and automatic tool changer system.

UNIT-III

Part-Programming

Introduction to Part-programming

Manual part-programming and application- Concept of NC codes, programming format, G&M codes. Point-to-Point, straight line, curved surface programming,

Computer aided part-programming and application-Concept of NC programming on computer, part-programming formats, simple programming for rational components, part-programming using canned cycles, subroutines and do loops, tool off sets, cutter radius compensation and tool wear compensation. Comparison of various controller programming codes.

UNIT IV

CNC Lathe

Definition and importance of CNC Lathe in modern manufacturing. Comparison between manual and CNC Lathe operations Overview of major components (e.g., bed, spindle, chuck, tool turret, tailstock). Work holding methods (e.g., chucking, collet, centres), Explanation of CNC programming fundamentals (e.g., toolpath generation, tool offsets, feed rates).Importance of safety in CNC Lathe operations.

UNIT-V

CNC Milling

Definition and importance of CNC Milling in modern manufacturing. Types of CNC milling machines (vertical, horizontal, gantry, etc.), Overview of major components (bed, spindle, tool holder, table, etc.),Work holding methods (e.g., vices, clamps, fixtures).Explanation of CNC milling programming fundamentals (e.g., toolpath generation, tool offsets, feed rates), Overview of common milling operations (e.g., facing, contouring, pocketing, drilling).

UNIT VI

CNC-EDM-Spark erosion

Definition and basic principles of Electrical Discharge Machining (EDM) and Spark Erosion process. Overview of machine components: Power supply, Electrode, Dielectric fluid system, Control system, Function of each component in the machining process. Introduction to G-code programming for CNC-EDM-Spark Erosion. Applications of CNC-EDM-Spark Erosion.

UNIT-VII

CNC EDM Wirecut

Overview of EDM Wirecut technology, Overview of machine components:
Power supply, Wire feed mechanism, Work holding table, Control system. Basic machining operations, Machining parameters (current, voltage, pulse duration), Introduction to G-code programming for EDM-Wirecut. Applications of CNC EDM-Wirecut.

UNIT-VIII

CNC Grinding

Introduction to CNC Grinding machine and grinding operations. Concept of machine control unit, construction details, design of grinding features and grinding variables. Explanation of CNC grinding programming fundamentals

UNIT-IX

CNC Machining Centre

Introduction to CNC machining center and various operations. Concept of Milling, Drilling, Reaming, Tapping. Accessories and attachments for various operations, construction features. Principle of accessories and attachments for various operations on machining center.

UNIT-X

Safety in CNC Operations

Common Hazards in CNC Operation Mechanical hazards (e.g., rotating parts, cutting tools), Electrical hazards (high voltage components), Chemical hazards (e.g., coolant fluids), Ergonomic hazards (repetitive motion injuries).
Personal Protective Equipment (PPE)-Types of PPE required for CNC operations (e.g., safety glasses, gloves, ear protection).
Tooling Safety, Maintenance and Housekeeping of CNC machines.

RECOMMENDED BOOKS

1. 1. CNC Machines and Automation by M.S. Sehrawat and J.S. Narang; Dhanpat Rai and Co., New Delhi.
2. CNC Technology And Programming Krar, Steve Mcgraw-Hill Inc.
3. CNC Technology (Basic Course) Biswas, P.K. All India Council Of Tech. Education
4. CNC Technology (Lathe & Milling) IGTR
5. CNC Technology : Lathe And Milling IGTR,AHM Indo-German Tool Room
6. CNC Technology Programming And Operating (M) Dhotre, Mahesh Saitech, Ahmednagar
7. CNC Machines – Programming and Applications by M Adithan and BS Pabla; New Age International (P) Ltd., Delhi.

RECOMMENDED WEBSITES

1. https://archive.nptel.ac.in/courses/112/105/112105211/
2. https://www.youtube.com/watch?v=_5r2XR1h1aQ
3. https://www.digimat.in/nptel/courses/video/112105211/L01.html
4. https://onlinecourses.nptel.ac.in/noc19_me46/preview
5. https://www.practicalmachinist.com/](https://www.practicalmachinist.com/
6. https://www.haascnc.com/resources/online-training.html

INSTRUCTIONAL STRATEGY

This subject contains five units of equal weightage. While imparting instructions, focus should be on conceptual understanding. Teachers should deliver structured lectures supplemented with multimedia presentations, real-world examples and include demonstrations to facilitate learning. Practical workshops will provide participants with valuable hands-on experience, allowing them to master part-programming, tool selection, setup, and operation of CNC machines. Additionally, case studies and problem-solving exercises will challenge participants to apply their knowledge to real-world scenarios, fostering critical thinking and collaboration. Assessment methods such as quizzes, assignments, and project work will be used to evaluate participants' understanding and track their progress throughout the course. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Some industrial and field visit may also be arranged. It is expected that by the end of the course, students will emerge with a solid foundation in CNC machining and the practical skills needed to succeed in the dynamic field of advanced manufacturing.

3.6 TOOL DESIGN III (PLASTIC MOULDS)

L	P
2	4

RATIONALE

This subject is intended to make the diploma holders in advance diploma in tool and die making understand and apply the facts, concepts, principles and procedures of tool design techniques, so that they are able to work in the industries efficiently and effectively. It is also helpful in understanding other subject and apply the knowledge and skills in various areas such as workshop practice, CAD/CAM, production planning, estimation and costing, maintenance and quality assurance.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Correlate material, equipment moulds and process in mass production of plastic components.

CO2: Explain the principle and working of moulding machines.

CO3: Describe the function and features of various elements of moulds.

CO4: Identify design parameters for mould, material and machine.

CO5: Execute pre-moulding and post moulding operations.

CO6: Prepare estimate of plastic material requirement and bill of material for mould making.

CO7: Describe procedure for safety, maintenance and storage of mould and machine.

CO8: List specifications of mould, material and machine.

CO9: Draw mould parts, mould housing and bases, and standard elements.

CO10: Draw components and system layout.

CO11: Prepare data sheet for mould, material and machine.

CO12: Develop conceptual design using data sheet and draw assembly and detailed drawings of plastic mould.

DETAILED CONTENTS

UNIT I

Review of Moulding Operation-I: Introduction: Overview of mass production of moulded plastic components, Plastics and classification of plastics: Thermoplastic and Thermosetting, Properties of plastic material, Industrial application of plastics, Mould material,

Definition and concept of Injection moulding Machine and Process, application of Injection moulding Process, Mould Base Elements, Compression Moulding process, Classification & Application of compression moulding, Transfer moulding process, Classification and application of transfer moulding.

UNIT II

Review of Moulding Operation-II

Definition and concept of Blow moulding Machine and Process, Parts and function of blow moulding machines such as clamping, heating, ejection, Blow moulding process, Classification of blow moulding process such as Extrusion blow molding and injection blow molding, Rotational moulding process, classification of rotational moulding, Thermoforming process, Concept of thermoforming sheet, classification of thermoforming Process.

UNIT III

Classification of Moulds

Compression Moulds: Flash mould: open flash mould, closed flash mould, inclined flash mould, Positive mould, semi positive mould, Landed plunger mould.

Transfer Moulds: Plunger type transfer mould: a) Top plunger type b) Bottom plunger type c) Side plunger type. Screw type transfer mould**.**

Rotational Moulds Types of rotation mould: Sheet metal rotational mould, light metal rotational mould, electro forming or electroplated mould.

UNIT IV

Elements of Moulds & their Functions.

Compression Mould: Types of compression moulds and their elements, Functions of Plunger & cavity, Heater, Stop Pad feeding system, cooling system, ejection system, core & cavity retainer plates, Material used for core & cavity, mould base, feeding system, ejection system (Ejector plate, ejector pin, ejector back plate, return pin), types of ejector pin, core & cavity retainer plates, cooling system, classification of cooling system, heating system, cooling & heating circuit in moulds, Layout of mould base with bill of material, Describe function and feature of various elements of compression mould, Material used for core & cavity, mould base, feeding system, ejection system, core & cavity retainer plates.

Transfer Mould: Types of transfer mould and its elements, heating elements, temperature control, parting surface, ejection system, Describe elements of transfer mould and its functions

Rotational and Thermoforming Mould: Classification and function of various rotational mould and their parts, Describe elements of rotational mould and their functions, Principle of thermoforming process, Classification of Thermoforming process, ejection, cooling and feeding.

UNIT V

Design parameters for Moulds

Design Parameters of Mould: Depth of Cavity Well or Loading Space, Drafts & tapers, projected area of cavities, no. of cavities Calculation, Gate size, Runner size, Sprue size, Guide Pillar size Calculation, Mould shut height, Venting dimension, Solidifying time (incl. Mould temp), Length & location of cooling channel, Cooling period, Determining total cycle time, Transfer Pot Calculation : Total area of pot, Depth of pot, Volume of pot, Use recommended data, Layout of mould design, Detail Drawing Layout, application of designs in manufacturing of moulds, Assembly & detailed drawings for manufacturing of mould, Principle of material selection, selection of machine, processing parameters. Principle of bill of material, selection of material,

Design Parameters of Material: Bulk Factor, Weight of Moulding, Total Volume of Loose Powder, Moulding Temperature, Preheating, Shrinkage.

Design Parameters of Machine: Machine Shut height, Clamping Force, Ejection, Platen Layout, Cycle time, Temperature control.

UNIT VI

Mould Polishing and Surface Treatment

Introduction: Understand polishing surface treatment of mould parts, Classification of polishing equipment: manual polishing kits, power assisted polishing kits, Classification of surface finishing: electro plating, etching, Classification of surface roughness values, surface texture requirement, polishing requirement and technique.

UNIT VII

Pre & Post Moulding Techniques

Pre Moulding Technique: Introduction: Pre moulding techniques, Classification of polishing equipment: manual polishing kits, power assisted polishing kits, Classification of surface finishing: electro plating etching.

Post Moulding Technique: Introduction: Post moulding technique, Classification of post moulding techniques: trimming, use of fixtures, coating, surface decoration, selection of related equipment.

UNIT VIII

Estimation Parameters of Mould

Introduction: Estimation parameters of mould, machine and process, Material estimation for plastic and mould, Machine time estimation for mould making, cycle time estimation (forcompression and Transfer mould), Estimation of material weight and volume, Study component drawing and estimate plastic material requirement, bill of material and estimate plastic for mould,detail drawing and calculate hours for making of mould, Describe procedure for estimating moulding cost per unit.

UNIT IX

Maintenance, Safety and Storage with Respect to Mould and Machine

Introduction: Maintenance, safety and storage with respect to mould andmachine, Principle of safety, maintenance, storage, Study and observe mould safety, machine safety and operator safety, Study standard check list for maintenance of machine and mould, Describe standard procedures for storage of moulds.

UNIT X

Design of moulds with CAD

Introduction: CAD software for mould design, Concept of 3D model, Concept of Single Cavity and Multi Cavity Mould, assembly modeling, use of data books, Design and develop the 3D model of the component, Design and develop the Mould base in CAD, designand develop the assembly model, detail model and prepare the bill of material.

PRACTICAL EXERCISES

1. Design and Drawing of simple mould for Compression moulding with BOM.
2. Design and Drawing of simple mould for Transfer moulding with BOM.
3. Design and Drawing of Mould bases.
4. Design and Drawing of Conventional two plate mould for Compression moulding for single cavity with BOM
5. Design and Drawing of Conventional two plate mould for Compression moulding for Multi cavity with BOM
6. Design and Drawing of Multi Cavity moulds for Transfer moulding with BOM
7. Design and Drawing a Runner and Gating system layout
8. Design and Drawing a Cooling layout for injection mould

9. Design and Drafting of a Core and Cavity of an injection mould using CAD Software
10. Design and Drafting of simple mould for injection moulding using CAD Software
11. Design and Drafting of 3- Plates mould for injection moulding Using CAD Software
12. Design and Drafting of a mould for blow moulding Using CAD Software

RECOMMENDED BOOKS

1. A. Kumar, “Fundamentals of Tool Design”, Dhjanpat Rai & Co.
2. Sanjay K Nayak, Pratap Chandra Padhi, Y. Hldayathullah "Fundamentals of Plastic Mould Design ",Tata McGraw Hill Education Private Limited
3. R.G.W Pye “Injection Mould Design” Longman
4. Dominick V. Rosato & Donald V. Rosato, “Injection Molding Handbook”, CBS Publishers & Distributors, New Delhi.
5. A. S. Athalye “Moulding of Plastics” Multi-tech Publishing co.
6. A. S. Athalye “Injection Moulding: Multi-tech Publishing co.

RECOMMENDED WEBSITES

1. https://www.sciencedirect.com/topics/engineering/transfer-molding
2. https://en.wikipedia.org/wiki/Rotational_molding
3. https://en.wikipedia.org/wiki/Compression_molding
4. https://www.youtube.com/watch?v=RDmvwAPdmNw
5. https://www.youtube.com/watch?v=PYTiD0S-ixU
6. https://www.youtube.com/watch?v=sus8arkJOeA&t=17s
7. https://www.youtube.com/watch?v=is4hg6OfgS4
8. https://www.youtube.com/watch?v=we_kWA8KKgc

INSTRUCTIONAL STRATEGY

This subject contains ten units of equal weightage. This is hands on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills among the students. Teaches should take the students to industry and explain the details of various systems and their components. While imparting instructions, focus should be on conceptual understanding. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Some industrial and field visit may also be arranged. Teachers should utilize a combination of instructional methods to accommodate

different learning styles, including lectures, demonstrations, discussions, group projects and hands-on lab work. Integrate multimedia resources such as videos, simulations, and interactive tutorials to enhance understanding and engagement. Encourage active learning through problem-solving exercises, quizzes, and practical demonstrations. Develop a variety of assessment tools to evaluate student comprehension and mastery of the subject matter, including quizzes, exams, lab reports and project. Incorporate real-world examples, case studies, and guest lectures from industry professionals to demonstrate the practical applications of hydraulics and pneumatics in various engineering fields. During practice work, it should be ensured that students get opportunity to individually perform practical tasks. Teachers should lay emphasis in making students conversant with concepts, principles and procedure of Tool Design (Plastic Mould). This subject contains ten units of equal weightage. Final Assessment of practical work will be done by preparing drawing sheets and/or preparing the CAD model with the help of CAD Software.

3.7 TOOL DESIGN IV (FORGING AND CASTING DIES)

L	P
2	4

RATIONALE

This subject is intended to impart knowledge of the facts, concepts, principles and procedures of tool design techniques and develop relevant skill among the students, so that they can use these competencies in designing and manufacturing of forging and casting dies effectively and efficiently. The subject will also enable the students in better understanding of other subjects of advance diploma in tool and die making.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1 Correlate material, equipment dies and process in mass production of metallic components.
CO2 Explain the principle and working of forging machines.
CO3 Describe the function, features and design parameters of various elements of forging dies and casting dies.
CO4 Prepare estimate of raw material requirement and bill of material for die making
CO5 Explain procedure for safety, maintenance and storage of dies.
CO6 Write the specifications of forging and die casting machine.
CO7 Draw mould parts, mould housing, bases and standard elements.
CO8 Prepare data sheet for die, material and machine.
CO9 Develop conceptual design, using data sheet.
CO10 Draw assembly and detailed drawings of die-casting and forging dies.

DETAILED CONTENTS

UNIT I

Overview of Metal Forming & Forging: Definition & Concept of metal forming, Metal forming process, Temperature in metal forming, Classification & types of metal forming process, Bulk deformation: Forging, Rolling, Extrusion and Drawing.

Concept of mass production of forged components, definition, concept & types of Forging process, forging equipment: Forging hammers and Forging Press, specification and working principles of forging equipment, forged materials.

UNIT II

Forging Operations & Defects

Closed die hammer forging operation: Introduction to closed die hammer forging operations, different forging operations such as fuller, edger, blocker, finisher, bender, Study & observe forging process for various forged components using closed die forging hammer concept & application of trimming tool.

Closed die press forging operation: Introduction to closed die press forging operations, different forging operations such as reduce rolled form, blocker, finisher, bender, principles of metal flow in press forging, Study & observe forging process for forged components using closed die & forging press.

Upsetting die forging and cold forging operation: Introduction to Upsetting die & cold forging operations, concept of upsetting forging and cold forging, die elements and forging equipment, principles of metal flow in upsetting and cold forging, study & observe upsetting operations and describe various steps in cold forging operation

Forging defects & remedies: Concept & types of forging defects, classification of defects during processing, principle of defects & causes in forged components and remedies, use of check lists to identify defects and remedies, factors causing die failure.

UNIT III

Forging Dies and Elements of Forging Dies

Introduction of forging die, Types of Forging die, concept and classification of forging die such as open die, closed die, upsetting dies, cold forging dies and extrusion dies, Principle & selection of die construction, study and observe construction of dies, features and functions of various forging dies, Specification of dies, material and machine.

Elements of forging dies & die impressions such as fuller, edger, bender, blocker, finisher, Concept of top die, bottom die. (Fixed die & movable die in upsetter dies), Impressions and operations, Alignment of dies and reference edges, Principle of plastic deformation (elongation, gathering, filling the cavities) and sequence of operations.

UNIT IV

Tool design parameters (Forging Dies): Design of component drawing: Concept of machining allowances, parting line position, balancing of parting line. Draft angle, web dimensions, rib dimensions, corner, fillet & other radii, forging tolerances, Design of component Drawing.

Design of forging tools: Concept of designing parameters of forging tools such as fuller, edger, blocker and finisher, Principle of metal flow, dimensions and tolerance, Selection of optimal design parameters for forging tools.

Design of trimming tool: Design of trimming tool, Concept of hot shearing, trimming equipment, trimming load and trimming tool, Principle of load calculation, selection of trimming equipment, selection of design parameter.

UNIT V

Forging Die design & Estimation

Introduction to typical die design and drawing of forging die, Bill of material, concept & Principle of die layout and detail drawing, drawing of component, data sheet and bill of material, study and observe typical tool design layout, detail and assembly drawing of forging die and tool, design of standard parts of dies, Component & layout, Work data sheet for forging die, material and equipment, Sketching conceptual designs, Design & drawing fuller, edger, blocker, bender, finisher & trimming tool.

Estimation of forging dies material and machine: Estimation of material, machining hours and process (cycle time), concept of material, forging die, machine time estimation for die making, cycle time estimation for forging process, principle of material weight and volume, study component drawing, estimate material requirement, bill of material and material for forging die, detail drawing and machining hours for making forging die and describe procedure for estimating die forging cost.

UNIT VI

Introduction to Casting Dies and Die Casting Operation

Introduction: Concept of Metal casting, Cartable materials, definition and concept of pressure die casting, types of die casting process, machines, casting dies, principle of mass production of die casting component, concept of gravity dies casting, metal moulds casting process and setup data,

Cold and hot chamber die casting process and application, Concept of parts and functions of cold and hot chamber die casting machines, Die casting cycle, Clamping, heating and feeding, ejection system, introduction to furnaces used in Die casting, Die casting defects, caused and their remedies.

UNIT VII

Elements of Die casting & Design parameters

Introduction: Elements of feeding, cooling and ejection systems, definition, concept and classification of feeding, cooling and ejection system, principle of feeding, cooling and ejection system, describe cooling, feeding and ejection system for die casting dies.

Concept of design parameters for pressure die casting dies, machine and parts, Concept of quality and quantity, construction of die, Properties of material for die casting, Concept of design parameters for gravity die casting and material, concept of quality and quantity, construction of die, Identify design parameter for pressure die casting, material and machine, understand gravity die casting dies, concept of design parameters for gravity die casting and material, properties of material for gravity die casting, draw assembly and detail drawing of die casting dies.

UNIT VIII

Specification & Estimation Die Casting Die

Introduction: Die casting data and its use, concept of machine set-up, processing parameters, and principle of material selection and machine, specification of die, material and machine and use, principles of specification of die casting die, material and machine.

Introduction: Estimation of die, material and machine and use, concept of material, casting die, machine time estimation for die making, cycle time for casting process, principle of material weight and volume, principle for estimation of time using process analysis for die making and cycle time, study component drawing and estimate material, bill of material and material for casting die, and describe procedure for estimating die casting cost.

UNIT IX

Die Maintenance, Safety and Storage

concept of safety, maintenance, and storage of a Dies, standard procedures for maintenance, safety and storage of Forging and Die casting die, Study forging & casting die safety, machine safety and personal safety, standard check list for Die maintenance, describe procedure for storage of die casting & Forging dies.

Handling of dies and material, pre and post forging techniques, pre and post casting techniques, concept and classification of pre and post techniques for forging and casting

UNIT X

Draw & Design of Components / Dies using CAD

Introduction: Software packages and application, concept and classification of software packages, principle of processing of Ferrous and non-ferrous metal using software package, design of die casting with CAD, concept of using software package, 3D modeling, assembly modeling, principle of 3D

modeling, assembly modeling, selection of design parameters, design and develop 3D model of component, assembly and detail drawing and prepare bill of material.

PRACTICAL EXERCISES

1. Design and Drawing of simple Forging Die for upsetting operation with BOM
2. Design and Drawing of Forging Die for double ended spanner (some standard size) with BOM.
3. Design and Drawing of Forging Die for reducing socket of some standard size with BOM.
4. Design and Drawing of Trimming tool for double ended spanner or reducing socket with BOM
5. Design and Drawing of Pressure die casting Die – single & multi-cavity cold chamber process with BOM
6. Design and Drawing of Pressure die casting Die – single & multi-cavity hot chamber process with BOM
7. Design and Drawing of Die sets / bases for pressure die casting die and standard parts
8. Design and drafting the elements of a forging dies using CAD software
9. Design and Drafting of a Core and Cavity of a forging die using CAD Software
10. Design and Drafting of double ended spanner with BOM using CAD Software
11. Design and Drafting of simple die casting design for Al based alloy using CAD Software
12. Design and Drafting of multi cavity Zinc Die casting die Using CAD Software

RECOMMENDED BOOKS

1. A. Kumar, “Fundamentals of Tool Design”, Dhjanpat Rai & Co.
2. R. Sharan S.N. Prasad N.P. Saxena “Forging Die Design & Practice” S. Chand & Co. New Delhi
3. Meswani,N.V “Design and Manufacture of Forging dies” All india council of tech. Education
4. P N Rao “Manufacturing technology Vol-1” McGraw Hill Education Pvt. Ltd.
5. E.A. Hermen “Die casting dies designing” The Society of Die Casting Engineer

RECOMMENDED WEBSITES

1. https://www.youtube.com/watch?v=A3ImvaCtwUE
2. https://www.youtube.com/watch?v=r5FXtKoThj4&list=PLLy_2iUCG87AMeXL_nGl5_6-L-hD8IK6i&index=16

3. https://www.youtube.com/watch?v=7ppYSi3nee8&list=PLLy_2iUCG87AMeXL_nGl5_6-L-hD8IK6i&index=18
4. https://www.youtube.com/watch?v=P1G2EwbRnw0
5. https://www.youtube.com/watch?v=TBzKT7_fY2c&list=PLSGws_74K01__iWAP4lwiDf7jQVCndMi2
6. https://archive.nptel.ac.in/courses/112/107/112107083/
7. https://en.wikipedia.org/wiki/Die_casting

INSTRUCTIONAL STRATEGY

This subject contains ten units of equal weightage. This is hands on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills among the students. Teaches should take the students to industry and explain the details of various systems and their components. While imparting instructions, focus should be on conceptual understanding. Training slides and videos should be used to supplement the classroom teaching. During practice work, it should be ensured that students get opportunity to individually perform practical tasks. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Some industrial and field visit may also be arranged. Teachers should utilize a combination of instructional methods to accommodate different learning styles, including lectures, demonstrations, discussions, group projects and hands-on lab work. Integrate multimedia resources such as videos, simulations, and interactive tutorials to enhance understanding and engagement. Encourage active learning through problem-solving exercises, quizzes, and practical demonstrations. Develop a variety of assessment tools to evaluate student comprehension and mastery of the subject matter, including quizzes, exams, lab reports and project. Teachers should incorporate real-world examples, case studies, and guest lectures from industry professionals to demonstrate the practical applications. Final Assessment of practical work will be done by preparing drawing sheets and/or preparing the CAD model with the help of CAD Software.

3.8 WORKSHOP PRACTICE-III

L	P
-	12

RATIONALE

This is an entirely practical workshop course, which is designed exclusively for third year students of diploma holders in advance diploma in tool and die making. This course focuses on providing practical experience in operating and programming CNC (Computer Numerical Control) machines, including lathe, milling, electrical discharge machining (EDM) and grinding. Through hands-on exercises and classroom instruction, students will learn programming techniques, tooling setup and safe machine operation practices. In addition, the course aims to immerse students in hands-on exercises focused on the manufacture of jigs and fixtures, press tools, moulds along with troubleshooting and repair of tools and dies. Through guided practical sessions, students will develop proficiency in various fabrication techniques and gain valuable experience in real-world tool and die design scenarios.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Master the operation and programming of CNC machines through practical exercises.
CO2: Apply CNC machining techniques to real-world scenarios and projects.
CO3: Collaborate with peers to tackle machining challenges and share best practices.
CO4: Use CNC machines independently and efficiently.
CO5: Demonstrate proficiency in the manufacturing of jigs, fixtures, press tools and moulds, using various machining and fabrication techniques.
CO6: Apply principles of tool and die making to produce functional and precise components that meet industry standards and specifications.
CO7: Identify common issues in tools and dies and implement effective troubleshooting and repair strategies to maintain optimal functionality.
CO8: Utilize advanced repair techniques such as welding, grinding, and re-machining of worn-out tool and die components.

DETAILED CONTENTS

UNIT I

Introduction to CNC Machining

- Overview of CNC machining technology with a focus on practical applications
- Safety procedures and hands-on demonstrations of safety equipment
- Introduction to basic CNC programming concepts with immediate application on the machines.

UNIT II

CNC Lathe Operations

- Turning tools and tooling setup
- Programming basic turning operations (facing, turning, grooving, etc.)
- Hands-on operations of CNC lathe machines
- Practical exercises on various operations such as facing, turning, step-turning, taper turning, profile turning, grooving, threading,etc

UNIT III

CNC Milling Operations

- Tooling selection for milling operations
- Programming 2D and 3D milling operations
- Hands-on operation of CNC milling machines
- Practical exercises on milling operations such as face milling, contour milling, cavity milling, etc

UNIT IV

CNC EDM Operations

- EDM-specific programming considerations.
- Programming wire EDM and EDM -die sinking operations.
- Hands-on operation of CNC electrical discharge machining (EDM) machines
- Troubleshooting common issues encountered during EDM operations.

UNIT V

CNC Grinding Operations

- Hands-on operation of CNC grinding machines

- Practical exercises on surface grinding and cylindrical grinding techniques
- Group projects to manufacture precision components using CNC grinding machines

UNIT VI

Jigs & Fixtures Fabrication

- Fabrication of simple jigs and fixtures using CNC machine tools (lathe, milling machine)
- Task: Fabrication of a basic drilling jig for precise hole alignment.

UNIT VII

Press Tools Fabrication

- Fabrication of press tool components (e.g., punches, dies) using CNC milling machines and surface grinders
- Task: Fabricate a simple blanking or piercing die for sheet metal components.

UNIT VIII

Moulds Fabrication

- Fabrication of mould inserts and cavities using CNC machining and EDM
- Task: Fabricate a basic injection mould for a small plastic part

UNIT IX

Tool & Die Troubleshooting

- Diagnosis and repair of common tool and die issues (e.g., wear, misalignment)
- Task: Troubleshoot and repair a malfunctioning press tool or mould, focusing on precision and efficiency.

UNIT X

Tool & Die Repair

- Diagnosis and repair of common tool and die issues (e.g., wear, misalignment)
- Task: Troubleshoot and repair a malfunctioning press tool or mould, focusing on precision and efficiency.

RECOMMENDED BOOKS

1. CNC Technology And Programming Krar, Steve Mcgraw-Hill Inc.

2. CNC Technology (Basic Course) Biswas, P.K. All India Council Of Tech. Education
3. CNC Technology (Lathe & Milling) IGTR
4. CNC Technology : Lathe And Milling IGTR,AHM Indo-German Tool Room
5. CNC Technology Programming And Operating (M) Dhotre, Mahesh Saitech, Ahmednagar

.

RECOMMENDED WEBSITES

1. https://archive.nptel.ac.in/courses/112/105/112105211/
2. https://nptel.ac.in/courses/112105211
3. https://www.youtube.com/watch?v=vOo2MCYPsm4

INSTRUCTIONAL STRATEGY

This subject contains ten units of equal weightage. Instructional Strategy employs hands-on learning approach with progressive skill development. Provide clear instructions and guided practice for practical exercises, contextualizing tasks within real-world tool and die design scenarios. Daily programming and machining sessions should be conducted in dedicated workshop environment. Individual and group exercises focusing on CNC programming and machining tasks should be given. Continuous feedback and guidance from teachers is expected, during practical sessions, so that the student develop appropriate competencies. Field and industrial visits should be arranged at intervals to enable the students understand fault-diagnosis and trouble-shooting techniques being followed in the world of work.

FORTH YEAR
NSQF LEVEL - 6

24. STUDY AND EVALUATION SCHEME

FORTH YEAR

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
4.1	Entrepreneurship Development and Life Skills	1	-	2+0=2	40	-	40	60	-	60	100
4.2	Industrial Engineering and Management	1	-	2+0=2	40	-	40	60	-	60	100
4.3	Tool Room Machine Maintenance	1	1	2+1=3	40	40	80	60	60	120	200
4.4	Advance Manufacturing Techniques	1	-	2+0=2	40	-	40	60	-	60	100
4.5	*On the Job Training (OJT)	-	20	0+20=20	-	200	200	-	300	300	500
4.6	**Project Work	-	10	0+10=10	-	40	40	-	60	60	100
	Total	**9**	**26**	**39**	**160**	**280**	**440**	**240**	**420**	**660**	**1100**

*On the Job Training will be assigned to all students and the working areas will consist of Consultancy and Marketing, Design, Production Planning and Control, Production and Quality Control, Maintenance and Safety etc. for duration of 20x30 = 600 hrs, before starting the project work.

**Project Work has been allocated a total duration of 10x30 = 300 hrs. and this assignment will be started soon after completion of On the Job Training.

25. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week
		Third Year
1.	Entrepreneurship Development and Life Skills	1
2.	Industrial Engineering and Management	1
3.	Tool Room Machine Maintenance	2
4.	Advance Manufacturing Techniques	1
5.	On the Job Training (OJT)	20
6.	Project Work	10
Total		**35**

26. COMPETENCY PROFILE AND EMPLOYMENT OPPORTUNITIES

Government and private sectors related to **Advance Diploma in Tool and Die Making** require **supervisors and technician engineers,** having well developed skills with clear choice of procedures. They are expected to have complete knowledge and practical skills related to tool and die engineering. They shall be able to communicate clearly with others. Diploma holders after passing level 5 shall have understanding of desired mathematical skills and understanding of social and natural environment. They are expected to collect, organize and communicate information effectively.

Work requiring knowledge, skills and aptitudes at level 6 will require the use of both standard and nonstandard practices. Job holders will carry out a broad range of work which will require a wide range of specialised technical skills backed by clear factual and theoretical knowledge. Individuals in jobs which require level 6 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They are likely to have full responsibility for others' work and learning. People carrying out these jobs may be described as "master technicians" and "trainers".
Individuals employed to carry out these job roles will be expected to be able to communicate clearly in speech and writing and may be required to carry out mathematical calculations. They should also be able to collect data, organise information, and communicate logically about the work. They will solve problems by selecting and applying methods, tools, materials and information.

They will solve problems by selecting and applying methods, tools, materials and information. They will be expected to have previous knowledge and skills in the occupation, and to know and apply facts, principles, processes and general concepts in the occupation. They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise. In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

They are expected have the knowledge of Industrial Engineering, Tool Room Machine Maintenance, Advance Manufacturing Techniques, Repair and other practices being followed in the tool and die making engineering and Industry Practices. They might find work with a manufacturing company and spend time maintaining, or even designing, the machines. They might also work in relevant laboratories for any institute, university or even a private companies. They are expected to have good

exposure of humanities, life skills, entrepreneur development and management to establish small start-ups in the area of Marketing, Sales, Repair and Maintenance etc**.**

They have wide scope to work as supervisory technical employee on wage basis in following organizations: In manufacturing industries primarily in private sector and to some extent in public sector Maintenance department of tool and die making industries, Instructor in Technical Institutions

They have wide scope in establishing small start-ups in the area of Marketing and Sales, Manufacturing Units and Repair and Maintenance units etc.

27. PROGRAMME OUTCOMES FOR LEVEL - 6

The programme outcomes are derived from five domains of NSQF Level – 6 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Perform task that require a wide range of specialized technical skills backed by clear factual and theoretical knowledge.

PO2: Acquire knowledge of facts, principles and processes related to advances in tool and die making.

PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems by selecting and applying methods, tools, materials and information.

PO4: Develop skills to communicate clearly in speech and writing and may be required to carry out mathematical calculations. They should also be able to collect data, organise information, and communicate logically about the work.

PO5: Responsible for the completion of their own work and expected to learn and improve their performance on the job. They are likely to have full responsibility for others' work and learning.

28. ASSESSMENT OF PROGRAM AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Perform task that require a wide range of specialized technical skills backed by clear factual and theoretical knowledge.	• Use industrial engineering concepts to improve productivity • Define different types of Production. • Use techniques of method study and work measurement. • Apply the concepts of production planning and control. • Enlist and explain different types of plant layout. • Describe working and use of electrical equipments like Motor, Pump, Transformer, etc.
PO2: Acquire knowledge of facts, principles and processes related to advances in tool and die making.	• Explain the various types of maintenance performed on Tool Room Machine. • Explain various Modern machining process • List types of Non-Conventional Machining Process • Explain the concept and significance of Additive Manufacturing Technology. • Describe the concept, basic principle, need and application of Rapid Prototyping • Explain significance and applications of CAD for Additive Manufacturing. • Explain various applications of Additive Manufacturing, Functional prototyping and their need, depending upon the application. • Explain concept, basic principle, need and application of Rapid Prototyping and Reverse Engineering in Tool & Die manufacturing processes.
PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems by selecting and applying methods, tools, materials and	• Apply the SWOT Analysis • Observe electrical safety, safety precautions and different electrical safety devices • Demonstrate use of different electrical measuring

information.	instruments as voltmeter, ammeter, frequency meter, power factor meter, watt meter etc. • Carry out Preventive, Breakdown and Plant maintenance. • Maintain Hydraulic power pack, Pneumatic compressor, Centrifugal pump etc. • Perform maintenance activities on CNC machines. • Demonstrate Liquid based, Solid based and Powder based Additive Manufacturing processes. • Identify the best suitable material as per the process and application. • Set the best parameters as per the process requirement.
PO4: Develop skills to communicate clearly in speech and writing and may be required to carry out mathematical calculations. They should also be able to collect data, organise information, and communicate logically about the work.	• Explain the concept and need of entrepreneurship. • Explore the avenues for getting beneficial promotional schemes for the establishment for new enterprises. • Identify business opportunities. • Define and prepare a feasible project proposal. • Work on the budgeting and accounting. • Communicate effectively in different contexts and situations. • Estimates the cost of production processes. • Use PERT and CPM and other network techniques. • Execute Inventory control and Store management • Acquire interpersonal skills and work as a team member. • Apply the communication skills in writing and presenting the technical report. • Define the problem statement of the Project Work according to the need of industry. • Write the project report effectively. • Present project work report using PPT.

PO5: Responsible for the completion of their own work and expected to learn and improve their performance on the job. They are likely to have full responsibility for others' work and learning.	• Acquire and reflect professional and life skills in career advancement Work effectively in a team. • Use principles of management. • Follow industrial safety norms while performing plant maintenance activities. • Define the problem statement of the Industrial training as per industry need. • Develop the problem-solving skills in finding solutions to the problems in the world of work. • Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the industry • Work as a team member for successful completion of project work.

29. SUBJECTS & CONTENTS

(FORTH YEAR)

FORTH YEAR

3.1	Entrepreneurship Development and Life Skills	159-163
3.2	Industrial Engineering and Management	164-166
3.3	Tool Room Machine Maintenance	167-171
3.4	Advance Manufacturing Techniques	172-175
3.5	On the Job Training (OJT)	176-178
3.6	Project Work	179-180

4.1 ENTREPRENEURSHIP DEVELOPMENT AND LIFE SKILLS

L	P
1	-

RATIONALE

In the present-day scenario, it has become imperative to impart entrepreneurship and management concepts to students, so that a significant percentage of them can be directed towards setting-up and managing their small own enterprises. It may be further added that an entrepreneurial mind-set with managerial skills helps the student in the job market, as well. The students can also be introduced to the Start-up and Smart Technology concepts, which shall radically change the working environment in the coming days in the face of Industry 4.0.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1 Explain the concept and need of entrepreneurship.

CO2 Explore the avenues for getting beneficial promotional schemes for the establishment for new enterprises.

CO3 Identify business opportunities.

CO4 Define and prepare a feasible project proposal.

CO5 Work on the budgeting and accounting.

CO6 Acquire and reflect professional and life skills in career advancement.

CO7 Communicate effectively in different contexts and situations.

CO8 Work effectively in a team.

DETAILED CONTENTS

UNIT I

Introduction to Entrepreneurship

Entrepreneurship: Concept and definitions, classification and types of entrepreneurs, entrepreneurial competencies, Traits / Qualities of entrepreneurs, manager v/s entrepreneur, role of Entrepreneur,

barriers in entrepreneurship, Sole proprietorship and partnership forms of business organisations, small business vs startup, critical components for establishing a start-up.

UNIT II

Entrepreneurial support agencies.

Entrepreneurial growth in India; sources of entrepreneurship in India; Institutions conducting entrepreneurial development programmes in India;Definition of MSME (micro, small and medium enterprises), significant provisions of MSME Act, importance of feasibility studies, technical, marketing and finance related problems faced by new enterprises, major labour issues in MSMEs and its related laws, Obtaining financial assistance through various government schemes like Prime Minister Employment Generation Program (PMEGP) Pradhan Mantri Mudra Yogna (PMMY) , Make in India, Start-up India,Stand up India , National Urban Livelihood Mission (NULM); Schemes of assistance by entrepreneurial support agencies at National, State, District level: NSIC, NRDC, DC:MSME, SIDBI, NABARD, Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP).

UNIT III

Market Survey and Opportunity Identification

Market survey concept, need and methods, scanning of the business environment.Types and conduct of the market survey, Assessment of demand and supply in potential areas of growth, Identifying a business opportunity, Considerations in product selection, Converting an idea into a business opportunity

UNITIV

Project Appraisal and Project Report

Objectives of project appraisal, Types of Risk: Marketing risk, Liquidity Risk, Credit Risk, Operational Risk. Need and Benefits of Risk Management.

Meaning and Purpose of Project Report, Formulation of Business Report, Characteristics of a Successful Business Report.

UNIT V

Budgeting and Accounting.

Introduction to Financial accounting. Concept of Budget / Accounting, Budget preparation, Procedure of accounting/expenditure, Concept of Balance sheet, Profit and Loss Account.

UNIT VI

Professional ethics and values

Introduction to morals, values and ethics. Need for professional ethics, codes of ethics- concept and significance, Principles of Professional Ethics. Introduction to Universal Human Values.

Workplace Ethics: Ethics in changing domains of Research - academic integrity - intellectual honesty - Role of Engineers and Manager

Workplace Ethics: Ethics in changing domains of Research - academic integrity - intellectual honesty - Role of Engineers and Manager

Workplace Ethics: Ethics in changing domains of Research - academic integrity - intellectual honesty - Role of Engineers and Managers

UNIT VII

Developing Professional Skills

Importance of professional skills in the workplace, self-assessment and goal-setting.

Career Skills: Introduction and significance of Resume, Difference between A Resume, CV, and Bio-data, Essential Components and format of a Good Resume.

Group discussions: concept, fundamentals and group dynamics.

Preparation for interviews, Types of Interviews, STAR Approach for Facing an Interview, Common pitfalls, tips to crack Interview.

UNIT VIII

Effective Communication

Introduction to communication, creativity, adaptability and resilience.

Verbal and non-verbal communication skills, Barriers to effective communication, listening actively and empathetically, and assertive communication techniques.

UNIT IX

Interpersonal and Life Skills

Building and maintaining professional relationships, conflict resolution and negotiation skills.

Time management: setting goals and priorities. Techniques for effective time blocking and scheduling, networking strategies for entrepreneurs.

UNIT X

Leadership

Leadership styles and their impact, Leadership qualities. Team building: concept, skills and dynamics.

Motivation: need for motivation and factors affecting motivation. Delegation and empowerment. Problem-solving and decision-making, risk assessment and management.

RECOMMENDED BOOKS

1. Entrepreneurship & Venture - Clifford and Bombak, Joseph R. Management Momanso.
2. Planning an Industrial unit - J. N. Vyas.
3. Small Industries management - Karmakar M.B.
4. Manual for the preparation of industrial - UNIDO feasibility studies
5. Entrepreneurship Development and Management by Dr. Pooja Sharma, Ranjana Verma by Anant Publication, Ambala City.
6. Premvir Kapoor, "Professional Ethics and Human Values", Khanna Book Publishing, New Delhi, 2022.
7. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics
8. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
9. "Entrepreneurship Development and Management" by JS Narang, Krishan Lal, Dhanpat Rai & Sons, New Delhi.
10. "English & Communication Skills-II" Dr. Sangeeta, Jashanpreet kaur & Dr. Pooja by Anant Publication, Ambala City.

RECOMMENDED WEBSITES

1. Knowledge at Wharton. (2008, April 3). APJ Abdul Kalam:"A Leader should know how to manage failure". https://www.youtube.com/watch?v=laGZaS4sdeU.
2. https://onlinecourses.nptel.ac.in/noc21_mg70/preview
3. https://onlinecourses.swayam2.ac.in/ntr22_ed08/preview
4. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
5. https://www.youtube.com/watch?v=3De0HuRyqpQ

INSTRUCTIONAL STRATEGY

This subject contains ten units of equal weightage. Some of the topics may be taught using question/answer, assignment or seminar method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and life skill in the students. While imparting instructions, focus should be on conceptual understanding. Training slides and videos should be used to

supplement the classroom teaching. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organizations on visit. Approach extracted reading and handouts may be provided. In addition, different activities like conduct of entrepreneurship awareness camp extension lecturers by outside experts, interactions sessions with entrepreneurs and industrial visits may also be organized.

4.2 INDUSTRIAL ENGINEERING AND MANAGEMENT

L	P
1	-

RATIONALE

The aim of this subject is to teach the students/trainees, the concepts, principles and procedures of work study (method study, work measurement etc.) in order to increase productivity. It also aims to teach principle of plant location and plant layout. CPM and PERT and other network techniques are intended to make the students understand project planning and time estimation to project planning and execution process.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1	Use industrial engineering concepts to improve productivity
CO2	Define different types of Production.
CO3	Use techniques of method study and work measurement.
CO4	Apply the concepts of production planning and control.
CO5	Enlist and explain different types of plant layout.
CO6	Estimates the cost of production processes.
CO7	Use principles of management.
CO8	Apply the SWOT Analysis.
CO9	Use PERT and CPM and other network techniques.
CO10	Execute Inventory control and Store management

DETAILED CONTENTS

UNIT-1

Introduction to Industrial Engineering

Concept of Industrial Engineering. Concept of Production system. Production and Methods of production; Concept of production system, inputs, manufacturing process, output; Principle of production system, job production, batch production, mass production;

Concept of productivity, factors affecting productivity, productivity measures. Principles of productivity, methods of increasing productivity.

UNIT II

Method Study

Concept of work study and its advantages, method study or motion study, objectives. Procedure of method study. Recording techniques for method study-charts and diagrams. Symbols used in Method study. Concept of flow process chart, operation process chart, Man-Machine chart, Therblings, SIMO chart, flow diagram, string diagram.

UNIT III

Work Measurement

Concept of work measurement and its objectives, techniques of work measurement (Time study -stop watch technique, Synthesis, Work sampling, predetermined motion and time study.)

Steps of Time study, normal time, Types of allowances, performance rating, Calculation of Standard Time, simple numerical.

Ergonomics: principles of designing tasks and workspaces for performance efficiency and safety.

UNIT IV

Production Planning and Control

Production and its types- job order, batch type and continuous type of productions. Objectives and components (functions) of P.P.C, Advantages of production planning and Production Control, stages of P.P.C, process planning, routing, scheduling, dispatching and follow up, routing purpose, route sheets, scheduling – purpose, machine loading chart, dispatching – purpose, and procedure, follow up – purpose and procedure. Structure and function of PPC Department. Gantt charts.

UNIT V

Plant Layout and Material Handling Equipment.

Plant layout: Definition and concept. Types of plant layout, their applications, advantages and limitations. Role of material handling systems in industries. Material handling equipment-Classification, types, specifications, applications.

UNIT VI

Cost Estimation

Definition, Importance and Aims, Constituents of Estimation; Difference between costing and estimating- Depreciation and obsolescence.

Elements of costs: Material cost, Labour cost, Overhead Expenses with examples.
Components of cost - prime cost, factory cost, Manufacturing cost, total cost –Ladder of Cost diagram, Determination of selling price. Basic Concept of break-even analysis.

UNIT VII

Introduction to Management

Introduction to Management, Principles of management (Henri Fayol, F.W. Taylor), different functions of management: Planning, organizing, Staffing ,directing and controlling, Levels of management. Structure of organization.Types of industrial organizations, (Line organization, staff organization Line and staff organization & Functional Organization, concept of Strategic management, SWOT analysis.

UNIT VIII

Project Management Techniques.

Introduction PERT and CPM, objectives, Difference between PERT and CPM– terms used in CPM, PERT– CPM operations, earliest Start time(EST), EFT , Latest Finish Time (LFT), LST, construction of network diagrams with simple examples.

UNIT IX

Inventory Control and Stores Management

Introduction to Inventory control, Meaning and importance of inventory control, ABC Analysis, Safety stock, Reorder level, Economic ordering quantity,

Principle of store layout and store management, Stores equipment, Stores records, purchasing procedures, bin cards. Concept of JUST IN TIME (JIT) -Master production scheduling (MPS), Definitions of ERP and SAP.

UNIT X

Quality Control

Concepts of quality, factors affecting quality of a product.
Statistical Quality Control, Control Charts-X bar chart, R chart, P chart, NP chart
Acceptance Sampling, Inspection plan format.
Introduction to ISO 9000, Quality management system, TQM

RECOMMENDED BOOKS

1. Production and costing by GBS Narang; Khanna Publishers, New Delhi.
2. Production management by MS Sehrawat and JS Narang, Dhanpat Rai& Sons, New Delhi.
3. Industrial Engineering and Management by O.P. Khanna, DhanpatRai and Sons, Delhi.
4. Work Study and Ergonomics by S Dalela and Sourabh
5. Industrial Engineering and Management by M. Mahajan; DhanpatRai and Sons, New Delhi.
6. Introduction to Work Study, ILO Publication
7. Operations Management, J.G Monks., McGraw Hill,1985
8. Principles of Management by Philip Kotler, TEE Publication.
9. Industrial Organisation and Management by Tara Chand, Nem Chand and Brothers, Roorkee

RECOMMENDED WEBSITES

1. https://www.digimat.in/nptel/courses/video/112107292/L01.html
2. https://archive.nptel.ac.in/courses/110/105/110105094/
3. https://www.youtube.com/watch?v=4Vs3xcEEU84
4. http://www.digimat.in/nptel/courses/video/110105094/L05.html
5. http://nitttrc.edu.in/nptel/courses/video/112107143/L40.html
6. https://digimat.in/nptel/courses/video/112107143/L08.html
7. http://swayam.gov.in

INSTRUCTIONAL STRATEGY

This subject contains ten units of equal weightage. While imparting instructions, focus should be on conceptual understanding. Utilize a combination of instructional methods to accommodate different learning styles, including lectures, demonstrations, discussions, group projects and exposure to industrial work. Integrate multimedia resources such as videos, simulations, and interactive tutorials to enhance understanding and engagement. Encourage active learning through problem-solving exercises, quizzes, and practical demonstrations. Develop a variety of assessment tools to evaluate students' comprehension and mastery of the subject matter, including regular quizzes and assessment and end term examinations.

4.3 TOOL ROOM MACHINE MAINTENANCE

L	P
1	1

RATIONALE

The subject is intended to develop competencies among the student so that they are able plan and implement routine maintenance and preventive maintenance programs of equipment and machinery. In addition, regular monitoring of equipment is required to identify and detect visually faults, impending equipment or production failures, before they occur. In a production or manufacturing environment, good maintenance engineering is necessary for smooth and safe daily plant operations. Good maintenance engineering is vital to the success of any manufacturing or processing operation, regardless of size and the advance diploma holder in tool and dies making is responsible for the efficiency of daily operations and for discovering and solving operational problems in the production.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1	Explain the various types of maintenance performed on Tool Room Machine
CO2	Observe electrical safety, safety precautions and different electrical safety devices
CO3	Demonstrate use of different electrical measuring instruments as voltmeter, ammeter, frequency meter, power factor meter, watt meter etc.
CO4	Describe working and use of electrical equipments like Motor, Pump, Transformer, etc.
CO5	Carry out Preventive, Breakdown and Plant maintenance.
CO6	Maintain Hydraulic power pack, Pneumatic compressor, Centrifugal pump etc.
CO7	Perform maintenance activities on CNC machines.
CO8	Follow industrial safety norms while performing plant maintenance activities.

DETAILED CONTENTS

UNIT I

Introduction to Maintenance

Significance of maintenance, Importance & Objectives of maintenance, Types of maintenance, Maintenance systems, Planned and unplanned maintenance, Breakdown maintenance, Corrective maintenance, Routine maintenance, Preventive maintenance, Predictive maintenance, Condition based maintenance systems.

UNIT II

Maintenance Planning

Maintenance planning and scheduling, maintenance plan, Maintenance procedure, Guidelines for matching procedures to items, Documenting maintenance operations, Record keeping, Data collection and analysis, , Replacement policies, spares planning. Total productive maintenance: Basic systems of TPM, Procedures and steps

.

UNIT III

Basic Electrical safety

Fundamental of safety, Electrical safety rules, Safety precaution kit and tools. PPE in Industrial Safety, common hand tools, Basic injury prevention, Hazard identification and avoidance, Safety signs for Danger, Warning, and Caution & Personal safety.

Single phase & three phase, Different types of electrical safety fuses, Earthling methods, Electrical protective devices as MCB, MCCB, RCCB, ELCB, OLR, MPCB.

UNIT IV

Measuring instruments for Electrical parameters: Measuring instrumentfor electrical parameters as Voltmeter, Ammeter, Frequency meter, Power factor meter, Watt meter, Lux meter, Tachometer, Clamp meter, Anemometer, Flux meter. Meggering methods, Earthing test, Cable test, Insulation testing, Body short circuit testing. Active & Passive electronic components, measuring instruments

UNIT V

Plant maintenance Planning: Industrial supply and different industrial electrical loads. Single phase and three phase power system, Industrial machine maintenance, Preventive Maintenance, Corrective maintenance and Breakdown maintenance.

UNIT VI

Electrical Maintenance

Types of electrical cables: specifications, selection procedure, uses, and advantages. Fault finding methods: Root cause analysis & Troubleshoot of breakdown machines.

UNIT VII

Maintenance of Machine tools-1

General safety instructions for operation of different types of machine tools. Parts & accessories of different machine tools like: Lathe machine & Milling Machine (Conventional & CNC).

UNIT VIII

Maintenance of Machine tools-II

General safety instructions for operation of different types of machine tools. Parts & accessories of different machine tools like Grinding machines and drilling machine (Conventional & CNC).

UNIT IX

Maintenance of Utilities-I

Contactors, Starters, Solenoid coils & Valves, Silencers, Relays, Pressure meters & Pressure gauges, Preventive & Breakdown maintenance of machine tools like: Lathe machine (Conventional), Milling machine (Conventional), Grinding machines, Drilling machine , maintenance of Pumps, FRL unit, Hydraulic power pack, Pneumatic compressor.

UNIT X

Maintenance of Utilities-II

Preventive & Breakdown maintenance of machine tools like: CNC Lathe machine, CNC Milling machine, CNC Grinding machines, CNC Drilling machine.

PRACTICAL EXERCISES

1. Prepare a maintenance plan for different Tool room Machines (Conventional & CNC)
2. Demonstrate & use electrical protective devices as MCB, MCCB, RCCB, ELCB, OLR, MPCB etc.
3. Use measuring instruments for electrical parameters such as Voltmeter, Ammeter, Multi meter, Power factor meter, Watt meter and Tachometer.
4. Perform tests for Insulation & body short circuit.
5. Perform tests for Troubleshoot in different machine tools.
6. Perform maintenance activities on CNC machine tools following daily, weekly, monthly checklists respectively.
7. Perform maintenance activities on conventional machine tools following daily, weekly, monthly checklists respectively.
8. Carry out General maintenance of Hydraulic power pack.
9. Carry out General maintenance of Centrifugal pump.
10. Carry out General maintenance of Air compressor.

RECOMMENDED BOOKS

1. A. Kelly, “Maintenance Planning and Control”, East West Press.
2. R.A. Collacott, “Mechanical Fault Diagnosis”, Chapman and Hall.
3. Philip Kiameh. “Electrical Equipment Handbook: Troubleshooting and Maintenance”, The McGraw-Hill Companies, Inc.
4. R. K. Rajput, “Electrical Measurements and Measuring Instruments” S. Chand & Co.
5. Abdullah Yousaf, “CNC Machine Maintenance : CNC Machine Maintenance tutorials”, Kindle Edition
6. Operation and Maintenance Manual for respective Conventional & CNC machines

RECOMMENDED WEBSITES

1. Maintenance planning and control : Kelly, Anthony, M. Sc : Free Download, Borrow, and Streaming :Internet Archive
2. https://www.youtube.com/watch?v=7nAIvvI59wo
3. MECH 1200 Mechanical Components and Electric Motors Lecture One (utc.edu)
4. maintanance-management-pdf.pdf (cutm.ac.in)
5. Machinery Maintenance: Guide, Types & Examples | FieldInsight
6. What Is Machine Maintenance? | ToolSense
7. Electrical Equipment Handbook : Troubleshooting and Maintenance pdf - Mon premier blog (free.fr)
8. Chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://mrcet.com/downloads/digital_notes/EEE/09022024/3.MEASUREMENTS%20&%20INSTRUMENTATION%20DIGITAL%20NOTES.pdf

INSTRUCTIONAL STRATEGY

This subject contains ten units of equal weightage. This is theory cum hands-on practice based subject and topics taught in the class should be practiced in the workshop regularly for development of required skills in the students. Teaches should take the students to industry and explain the details of various systems and their components. While imparting instructions, focus should be on conceptual understanding. Training slides and videos should be used to supplement the classroom teaching. During practice work, it should be ensured that students get opportunity to individually perform practical tasks. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Some industrial and field visit may also be arranged.

4.4 ADVANCED MANUFACTURING TECHNEQUES

L	P
1	-

RATIONALE

Advancement of technology has been done by several approaches and utilizing other forms of energy to combine different manufacturing processes with similar objectives of increasing material removal rate, improving surface integrity, reducing tool wear, reducing production time and extending application areas. Moreover the manufacturing processes like Rapid prototyping, Reverse Engineering and Additive manufacturing due to the process of layered building, make it possible to significantly reduce the production time of the most geometrically demanding parts of tools and moulds.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1	Explain various Modern machining process
CO2	List types of Non-Conventional Machining Process
CO3	Explain the concept and significance of Additive Manufacturing Technology.
CO4	Describe the concept, basic principle, need and application of Rapid Prototyping
CO5	Explain significance and applications of CAD for Additive Manufacturing.
CO6	Demonstrate Liquid based, Solid based and Powder based Additive Manufacturing processes.
CO7	Identify the best suitable material as per the process and application.
CO8	Set the best parameters as per the process requirement.
CO9	Explain Various applications of Additive Manufacturing, Functional prototyping and their need, depending upon the application.
CO10	Explain concept, basic principle, need and application of Rapid Prototyping and Reverse Engineering in Tool & Die manufacturing processes.

DETAILED CONTENTS

UNIT I

Non-Conventional Manufacturing Processes -1 : Limitations of conventional manufacturing processes need of unconventional manufacturing processes. Non-conventional Machining Processes:

Principle, Working, Process, Parameters and applications of Non-conventional machining processes such as Electro-Discharge machining, WEDM, Chemical machining, Electro-chemical machining.

UNIT II

Non-Conventional Manufacturing Processes -2: Ultrasonic machining, Abrasive jet machining, Abrasive flow machining, Water jet machining, Laser beam machining, Electron beam machining, IBM and other advanced manufacturing processes.

UNIT III

Introduction to Additive Manufacturing:

Definition, Scope, History & Need of Additive Manufacturing, Classification of Manufacturing Technology i.e. (Formative Mfg. v/s Subtractive Mfg. v/s Additive Mfg.), Steps in Additive Manufacturing, Advantages & Limitation of Additive Manufacturing, Classifications & Applications of Additive Manufacturing Technology, CAD for Additive Manufacturing.

UNIT IV

Liquid based Additive Manufacturing Techniques: VAT Polymerization - Stereo lithography (SLA), Direct Light Processing (DLP).

UNIT V

Solid based Additive Manufacturing Techniques: Material Extrusion – Fused Deposition Modeling (FDM), Continuous Filament Fabrication (CFF), LOM (Laminated Object Manufacturing)

UNIT VI

Powder based Additive Manufacturing Techniques: Direct Metal Laser Sintering (DMLS), Selective Laser Melting (SLM), Selective Laser Sintering (SLS), Electron Beam Melting (EBM)

UNIT VII

Application of Additive Manufacturing: Application in the area of Additive Manufacturing Application Domains: Tooling Industries, Automotive Industries, Aerospace Industries, Electronics Industries, Health Care, Defense, Construction, Food Processing, Machine Tools, Dental Application, Arts & Jewellery, Heritage etc

.

UNIT VIII

Materials in Additive Manufacturing:

Types of various materials used in various forms - Liquid, Solid, Wire, Powder; likes, Polymers

(Thermoplastic & Thermosetting) & their Properties, Metals & their Properties, Non-Metals, Ceramics, Sands etc.

UNIT IX

Rapid Prototyping

Basic principles of Rapid Prototyping, Rapid Prototyping technologies, Limitations of Rapid Prototyping, Practical applications of Rapid Prototyping,

Unit X

Reverse Engineering: Basic principles of Reverse Steps involved in Reverse Engineering, Limitations & Applications of Reverse Engineering

RECOMMENDED BOOKS

1. P Pandey and H Shan, "Modern Machining Processes", MC Graw Hills Publications ltd.
2. P.K. Mishra, "Nonconventional Machining", Narosa Publishing House
3. S.K. Hajra Choudhury, "Workshop Technology II", Media Promoters & Publishers pvt. ltd.
4. PN Rao, "Manufacturing Technology, Vol. II", MC Graw Hills Publications ltd.
5. B.S. Raghuwanshi, "Workshop Technology, Vol. II", Dhanpat Rai & co. ltd.
6. C. P. Paul, A. N. Jinoop, "Additive Manufacturing-Principle of technology and application" , MC Graw Hills

RECOMMENDED WEBSITES

1. http://www.nitttrc.edu.in/nptel/courses/video/112105212/L10.html
2. Chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://home.iitk.ac.in/~nsinha/Non-traditional-machining.pdf
3. https://testbook.com/mechanical-engineering/non-traditional-machining-processes-definition#:~:text=Non%2Dtraditional%20machining%20processes%20encompass,advantages%20for%20precision%20machining%20tasks.
4. https://www.carbon3d.com/resources/blog/the-7-types-of-additive-manufacturing#:~:text=Additive%20manufacturing%20is%20the%20process,in%20a%203D%2Dprinted%20object.
5. chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.fcusd.org/cms/lib/CA01001934/Centricity/Domain/4529/Fundamentals%20of%20Modern%20Manufacturing%20Materials%20%20Processes%20and%20Systems%20%204th%20Edition.pdf

INSTRUCTIONAL STRATEGY

This subject contains ten units of equal weightage. While imparting instructions, focus should be on conceptual understanding. Utilize a combination of instructional methods to accommodate different learning styles, including lectures, demonstrations, discussions, group projects and exposure to industrial work. Integrate multimedia resources such as videos, simulations and interactive tutorials to enhance understanding and engagement. Encourage active learning through problem-solving exercises, quizzes, and practical demonstrations. Develop a variety of assessment tools to evaluate students' comprehension and mastery of the subject matter, including regular quizzes and assessment and end term examinations.

4.5 ON THE JOB TRAINING (OJT)

L	P
-	20

RATIONALE

On the Job Training is aimed at the application of knowledge and competencies gained in the previous semesters in an integrated manner in the industry/field, as per the interest and choice of both the industry and student. It also provide opportunities to the students to work relatively independently over extended and comprehensive periods of time. It is expected from the students to get acquainted with desired attributes for industrial/field environment. For this purpose, students are required to work in different establishments different functional areas of the world of work and develop relevant competencies.

COURSE OUTCOMES

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

CO1: Define the problem statement of the Industrial training as per industry need.
CO2: Develop the problem-solving skills in finding solutions to the problems in the world of work.
CO3: Acquire interpersonal skills and work as a team member.
CO4: Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the industry
CO5: Apply the communication skills in writing and presenting the technical report.

GUIDELINES

The purpose of this on the job training is to expose the students to the world of work and provide professional experience in real life situation. It is suggested that during the training, the student should remain attached with the various sections and functional areas of industry/field such as Consultancy and Marketing, Design, Production Planning and Control, Production and Quality Control, Maintenance and Safety etc. The student will have to maintain a daily/weekly/monthly diary/work book and submit detailed reports of their activities periodically to their supervisor/teacher. These reports will be certified by the concerned/ authorized officer of the organization/indutry where the

student is undergoing professional on the job training and doing his/her project.

Each student is required to undergo one on the job training, according to his/her area of interest and the detailed and comprehensive report is to be submitted at the end of the training. The concerned teacher will guide and supervise the students on work stations (as far as possible) at regular intervals. A systematic plan of action is required to be prepared, well in advance, by the institute in consultation with the organizations where professional on the job training is going to be executed. The teacher should clearly specify the expected learning outcomes and schedule on periodic basis, preferably weekly or fortnightly basis, for the whole of the on the job training period of students. Performa may be developed by the polytechnic Training and Placement Officer, in consultation with the teachers and personnel from industry to monitor the progress of the students. The performa should be filled by the students on daily, weekly and monthly basis, and should be duly countersigned by the personnel from industry and concerned teacher/supervisor attached to the particular student. Each teacher is supposed to guide and supervise about 5 – 8 students, depending upon the strength of the students and teachers in the department.

A criteria for assessing student performance by the internal examiner (personnel from industry and supervisor) and external examiner (teachers and experts) are given in table below:

S. No.	**Performance criteria for Internal Assessment**	**Weightage of marks (in %age)**
1.	Punctuality and regularity	10%
2.	Initiatives taken by the student in learning at training workplace	10%
3.	Defining problem statement, approach and schedule (Planning)	20%
4.	Level /proficiency of new practical skills acquired	20%
5.	Preliminary Action Plan and Report	40%
TOTAL		**100**

S. No.	Performance criteria for External Assessment	Weightage of marks (in %age)
1.	On the Job Training Report/prototype prepared by the student	60%
2.	Presentation and Viva voce	40%
Total marks		**100**

Important Notes:

1. This criteria must be followed by the faculty and they may see the daily, weekly and monthly progress/reports, while awarding awards as per the above criteria.
2. Students may visit websites as their learning tool during industrial training, Search videos, animations, text material on internet for preparation of training report during the training period.
3. The external examiner, preferably, may be the person from different industry/organization/institution, who is well versed with the discipline/branch of professional on the job training of the students, so that she/he can properly evaluate the students on the above criteria.
4. OJT is mandatory for all the students and it can be done in any reputed tool room industry or MSME Technology Centre, which is based on the actual working situation in various departments of Technology center/ Industry such as:
    - Consultancy & Marketing
    - Design & Development
    - PPC
    - Tool Design & CAD/CAM
    - Heat Treatment
    - Maintenance & Safety
    - Inspection & QC
    - Conventional Machining
    - CNC machining
    - Tool & Die assembly.

4.6 PROJECT WORK

L	P
-	10

RATIONALE

Project work will help in developing the relevant skills among the students as per National Skill Qualification Framework. It aims at exposing the students to the present and future needs of various relevant industries. It is expected from the students to get acquainted with desired attributes for industrial environment. For this purpose, students are required to be involved in Project Work.

COURSE OUTCOMES

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

CO1: Define the problem statement of the Project Work according to the need of industry.
CO2: Work as a team member for successful completion of project work.
CO3: Write the project report effectively.
CO4: Present project work report using PPT.

GUIDELINES

Depending upon the interest of the students, they can go for project work as per present and future demand of the industry. The supervisors may guide the students to identify their project work and chalk out their plan of action well in advance. As a project work activity each student is supposed to study the operations at site and prepare a detailed project report of the observations/processes/activities. The supervisor may create a group of 4-5 students or individual, as per their interest, to work as a team for successful completion of the Project Work or it can also be an individual project.

The supervisor shall evaluate the students along with one external industry / academic expert by considering the following parameters:

	Parameter	**Weightage**
I	Defining problem statement, focus and approach	20%
ii	Innovation/creativity	20%
iii	Report Writing	20%
iv	Power Point Presentation	20%
v	Viva - voce	20%

30. ASSESMENT TOOLS & CRITERION

The assessment is carried out by conducting:

1. Formative assessments
2. Summative assessments

1. FORMATIVE ASSESSEMENT

The **formative assessment** will be evaluated on the basis of the internal assessments for theory subjects and practical by the concerned teachers for evaluating the knowledge and skill acquired by students and the behavioral transformation of the students. This **internal assessment** is primarily carried out by collecting evidence of competence gained by the students by evaluating them at work based on assessment criteria, asking questions and initiating formative discussions to assess understanding and by evaluating records and reports, and sessional marks are awarded to them.

2. SUMMATIVE ASSESSMENT

The **summative assessment** will include end semester examination for theory part for each candidate and practical examination with viva voice. Each Performance Criteria will be assigned marks proportional to its importance and proportion of marks for Theory and Skills Practical for each subject should be laid down.

The following assessment tools are used for effective student evaluation:

1. Theory Examinations
2. Practical Work
3. Internships
4. Professional Industrial Training
5. Project Work (Minor & Major)
6. Massive Open Online Courses (MOOCs)
7. Viva Voce
8. Case Studies

1. Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems.

The **formative evaluation** for theory subjects may be caused through

i. Sessional /class-tests,
ii. Quizzes,
iii. Assignments,
iv. Seminars/ Presentations
v. Attendance
vi. Case Studies

For **Summative evaluation** of theory, the question paper may comprise of three sections.

i. It should contain objective type question and multiple choice questions. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.
ii. It should contain short answer questions.
iii. Descriptive type questions , with some internal choice of the questions set may be given in this section

2. Practical Assessment

Evaluation of students performance in practical work (Laboratory experiments, Workshop practical /field exercises) aims at assessing students ability to apply or practice the concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. This will comprise of a creation of mock environment, wherever applicable in the skill lab which is equipped with all required equipment for development of desired skills. Candidate's soft skills, communication, aptitude, safety consciousness, quality consciousness etc. will be ascertained by observation and will be marked in observation checklist along with the assessment of Job carried out in labs and maintenance of Lab Record files.

Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject. The end product will be measured against the specified dimensions and standards to gauge the level of his skill achievements

3. Internship

The two mandatory internships after I Year and II Year of the programme are to be assessed in 3rd and 5th semester subsequently. The internships should be preferably done in the field/ in the industry, can be in house depending upon the stream and availability of resources in and around the institute.

Every faculty should be assigned the students and made responsible for the evaluation and assessment of the internship. Formative assessment should be taken from the industry/institute/ department on the basis of performance, behavior and learning capabilities. Summative evaluation may comprise of weightages on the basis of report submission/ presentation followed by viva-voce of the relevant subject.

4. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject.

The formative assessment should include the evaluation from the employer where the student is doing his training or Project work in the ratio of 40:60. The final assessment will be the combination of the employer assessment and evaluation by the faculty of the institute which shall include report submission/ presentation/ seminar followed by viva-voce of the relevant subject.

5. Project Work Assessment

The purpose of evaluation of project work is to assess student's ability to apply, in an integrated manner, knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The project work assigned should be of

relevance to the core skill, state of the art topics and the project areas that are pertaining to enhance job skill and enhance occupational opportunities. For both, minor and major project, Formative and summative evaluation may comprise of weightages to performance on task, quality of product, nature and relevance of project and general behavior.
The formative assessment should include the continuous assessment based on the work allocated and mid semester viva voice or presentation. The final assessment will be the combination of the project undertaken, report submission and should be followed by viva-voce of the relevant subject.

In case of the assessment of this component, the team of examiners should be constituted on 50 – 50 % basis. i.e. half of the examiners in the team should be invited from outside the institute conducting examination.

6. MOOC COURSES (Open Elective and Multi-Disciplinary Elective)

Massive Open Online Courses (MOOCs) platforms promise open, online courses to massive numbers of students as they are free to join, they provide a wide range of courses, they allow for space and time flexibility and their participants can benefit from various online communication tools and access to quality content.

The coordinating Department/Centre/Office shall monitor every student to adopt the courses online of their choice and preference on Swayam portal. The duration of courses will vary depending on the level and credit points. Courses offered in the duration of 4-10 weeks for 2 to 3 credits at diploma level are to be opted. Students, after they have registered, can get a certificate after attending the classes and submitting the assignments/quizzes and qualifying nationwide exam conducted written exam at the institute close to the one where the student is enrolled.

On successful completion of each course, the institution offering the MOOCs course would issue the certificate, along with the number of credits and grades, through which the student can get credits transferred into his marks certificate issued by his parent institution. Guidelines for credit sharing will be issued by concerned Regulators such as UGC, AICTE, etc. for consideration by various Institutes. There may be standard norms for the host Institution to conduct the course that may include continuous evaluation through assignments, online quizzes, case studies, online writing exercises, term examinations, student feedback, online forum management, etc.

The coordinating Department/Centre/Office of the respective department shall monitor every student and submit to the Office of Examinations, a score sheet (marks card) during the last 10 days prior to the close of the even semester.

7. Viva Voce

This tool will be used to assess the conceptual understanding and the behavioral aspects as regards the job role and the specific task at hand. It will also include questions on safety, quality, environment and equipment's etc. Ask questions on non-prescribed tasks to ensure that the learners have complete knowledge on the assessment

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the marks scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA\ (Si) = \sum(Ci \times Gi) / \sum Ci$$

where Ci is the number of credits of the ith course and Gi is the marks scored by the student in the ith course.
In case, a program is of annual pattern, the calculations will be done by considering all the courses taken by a student in a year.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \sum(Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

31. TEACHING LEARNING TOOLS FOR EFFECTIVE IMPLEMENTATION

For effective implementation of curriculum, the faculty and staff of institutions have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that only a proper mix of different teaching methods in all these places of instruction can bring the changes in students behavior as stipulated in the curriculum document. It is important to understand curriculum document holistically and further be aware of intricacies of Teaching-Learning Tools for achieving curriculum objectives. Given below are certain recommendations which may help in carrying out teaching-learning effectively:

PROGRAMME LEVEL RECOMMENDATIONS

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.

2. An academic plan needs to be prepared at institute level. The Head of the institute have a great role to play in its dissemination and percolation up to grass-root level.

3. Head of Department are required to prepare academic plan at department level referring to institutional academic plan.

COURSE LEVEL RECOMMENDATIONS

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives. Teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period which is made available to them in the academic plan at Board level. With the amount of time to their credit, it is essential for them to use it judiciously by planning all above activities properly and ensure execution of

the plan effectively. Following is the gist of suggestions for subject teachers for effective utilization of Teaching Learning Tools to achieve the course objectives:

1. Teachers need to ensure attainment of course outcomes so as to help the students achieve program outcomes and also meet the desired learning outcomes in five domains of NSQF i.e. Process, Professional knowledge, Professional skills, Core skills and Responsibility.

2. Teachers are required to prepare a course plan, taking into account number of weeks available and courses to be taught.

3. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of contents to be covered, learning material for execution of a lesson plan.

4. Teachers are required to plan for expert lectures from field/industry. For this, necessary steps need to be taken such as planning in advance, identifying field experts, making correspondence to invite them, taking necessary budgetary approval etc.

5. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The assignments and seminars can be thought of as terminal outcome of library experiences.

6. Concept based industrial/field visits may be planned and executed for such contents of course which are abstract in nature and no other requisite resources are readily available in institute to impart them effectively.

7. Lot of focus needs to be laid on skill development. There is need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning and experiential learning effectively. The development and use of lab manuals will enable the institutes to provide lab experiences effectively.

8. Emphasis should to lay on developing soft skills like communication skills, personality Development, self-learning, inter personal skills, problem solving, and creativity etc.

9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use of audio visual aids such as video films, power point presentations and IT tools.

10. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

11. Students be made aware about issues related to ecology and environment, safety, concern f for wastage of energy and other resources etc.

12. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be o offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

13. For effective implementation of Massive Open Online Courses (MOOCs), a faculty member in the department may be identified and given the responsibility to coordinate various activities related to MOOCs. The concerned faculty member will facilitate in registration of students for MOOCs. The faculty member will also be responsible for compiling the result of students on the completion of MOOCs and pass on the information to the concerned authority.

14. Flexibility has been provided in the curriculum for the students to choose a course related to the discipline as per their interest. For effective implementation of discipline-specific electives, the institute should identify some courses from the list of courses prescribed in the curriculum. The courses should be selected and offered keeping in mind the interest of students, infrastructure and expertise available in and around the institute related to the courses. Option for discipline-specific elective may be taken from students through a form and a course, with more than 10 students opting for it, may be run.

15. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use of audio visual aids such as video films, power point presentations and IT tools.

16. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

17. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.

18. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

32. LIST OF EXPERTS

1. Controller of Examination, Haryana State Board of Technical Education, Panchkula.
2. Controller of Administration & Finance, Haryana State Board of Technical Education, Panchkula.
3. Joint Secretary, Haryana State Board of Technical Education, Panchkula.
4. Deputy Secretary, Training & Placement, Haryana State Board of Technical Education, Panchkula.
5. Deputy Secretary, Examination, Haryana State Board of Technical Education, Panchkula.
6. Deputy Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
7. Assistant Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
8. Sh. Ashwani Kant, Deputy General Manager, MSME Technology Centre, Rohtak, Haryana.
9. Sh. Naresh Kumar Jain, Senior Manager, MSME Technology Centre, Rohtak, Haryana.
10. Sh. Ranjay P. Singh, Manager (Mechanical), MSME Technology Centre, Rohtak,Haryana.
11. Sh. Bharat Kumar, MSME Technology Centre, Rohtak, Haryana.
12. Sh. Narinder Singh Jassal, Principal, Indo Swiss Training Centre, Chandigarh.
13. Sh. Jagdeep Singh Khurmi, Assistant Manager Training, Central Tool Room, Ludhiana.
14. Sh. Veer Daman Singh, New Delhi (Industry Expert).
15. Sh. Rajat Sarowa, SDO, HVPML, Haryana
16. Sh. Mrinankush, Engineer Training, Central Tool Room, Ludhiana.
17. Sh. Sandeep Suri, Delhi Institute of Education and Training, Delhi.
18. Dr. Sultan Singh, COAF, Haryana State Board of Technical Education, Panchkula.
19. Sh. Hitesh Kumar, Deputy Secretary (T&P), Haryana State Board of Technical Education, Panchkula.

20. Sh. Harsewak Singh, Senior Engineer, MSME Technology Centre, Rohtak, Haryana.
21. Sh. Jagjit Singh Narang, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Ambala, Haryana.
22. Sh. Hanish Saini, Government Polytechnic, Ambala, Haryana.
23. Sh. Jashanpreet Kaur, Government Polytechnic, Ambala, Haryana.
24. Sh. Subhash Chandra Bhoria, Senior Lecturer, Mechanical Engineering Department,Government Polytechnic, Hisar, Haryana.
25. Sh. Harvinder Singh Saini, Senior Lecturer, Mechanical Engineering Department, Senior Lecturer, Government Polytechnic, Ambala, Haryana.
26. Subhash Bhardwaj, Senior Lecturer, Mechanical Engineering Department, GovernmentPolytechnic, Ambala, Haryana.
27. Sh. Pardeep Kumar, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri, Haryana.
28. Sh. Vikas Sharma, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri, Haryana.
29. Sh. Rajiv Verma, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Adampur, Haryana.
30. Sh. Parveen Saini, Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri, Haryana.
31. Sh. Baljeet Siwach, Lecturer, Mechanical Engineering Department, Government Polytechnic, Sonepat, Haryana.
32. Sh. Kapil Sharma, Lecturer, Mechanical Engineering Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
33. Sh, Baltar Singh, Workshop Superintendent, Mechanical Engineering Department, Government Polytechnic, Ambala, Haryana.
34. Sh. Dinesh Mor, Workshop Superintendent, Workshop Department, Government Polytechnic, Sonipat, Haryana.
35. Sh. Manmohan Singh, Workshop Superintendent, Mechanical Engineering Department, Government Polytechnic, Damla, Haryana.
36. Sh. Balwan Singh, Workshop In-charge, Mechanical Engineering Department, Aryabhatt Institute of Technology, Delhi.

37. Sh. Ashwani Kumar, Workshop Instructor, Electrical Engineering Department, Government Polytechnic, Damla, Haryana.
38. Sh. Gulab Singh, Workshop Instructor, Mechanical Engineering Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
39. Sh. Rajneesh Rana, Workshop Instructor, Electronics Engineering Department, Government Polytechnic, Damla, Haryana.
40. Sh. Ankush Aggarwal, Lecturer, Mechanical Engineering Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
41. Ms. Amita, Deputy Director (Acd), Directorate of Technical Education.
42. Dr. Bhajan Lal, Lecturer, Applied Science Department, Government Polytechnic forWomen, Sirsa, Haryana.
43. Sh. Anil Nain, Lecturer, Applied Science Department, Government Polytechnic, Hisar, Haryana.
44. Dr. Sarita Mann, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.
45. Smt. Bindu Verma, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
46. Dr. Pankaj Sharma, Professor, Applied Science Department, NITTTR, Chandigarh.
47. Dr. Ashok Kumar, Associate Professor, Applied Science Department, NITTTR, Chandigarh.
48. Smt. Pushpa Rani, Senior Lecturer, Applied Science Department, Government Polytechnic, Sonipat, Haryana.
49. Smt. Krishna Bhoria, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.
50. Smt. Preetpal Kaur, Guest Faculty, Applied Science Department, Government Polytechnic, Ambala, Haryana.
51. Ms. Monika, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
52. Dr Neena Sharma, English Department, MCM College, Chandigarh.
53. Sh. Satyawan Dhaka, Senior Lecturer, Applied Science Department, Government Polytechnic, Nilokheri.

54. Mrs. Sapna Sang, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla.

55. Sh. Ravi Bansal, Lecturer, Applied Science Department, Government Polytechnic, Manesar.

56. Mrs. Kiran, Lecturer, Applied Science Department, Government Polytechnic, Sonepat.

57. Dr. Naveen Jha, Assistant Professor, Department of Mathematics, Government Engineering College, Bharatpur.

58. Dr. KC Lachhwani, Assistant Professor, Applied Science, NITTTR, Chandigarh

59. Sh. KG Srinivasa, Professor CSE, IIIT-Naya Raipur.

60. Dr. Vidhi Grover, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla.

61. Sh. Tavinder Singh, Lecturer, Applied Science Department, Government Polytechnic, Sirsa.

62. Ms. Sunita Rani, Lecturer, Applied Science Department, Government Polytechnic, Ambala.

63. Dr. Rajesh Mehra, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh.

64. Dr. AB Gupta, Professor and Head, Education & Educational Management Department, NITTTR, Chandigarh.

65. Sh. PK Singla, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

66. Dr. SK Gupta, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

67. Dr. Meenakshi Sood, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

33. APPENDIX

Sr. No.	LIST OF EQUIPMENT
1.	Work benches with vices (2 vices on each bench)
2.	Marking tables with scribers
3.	Surface plates
4.	Sheet Bending Machine
5.	Tool kits – Taps, Dies, Drills
6.	Tool kits – chisels, hammers, files, hacksaw
7.	Accessories like calipers, V blocks, height, gauges steel rules and scribers
8.	Adjustable wrench
9.	Open end Spanner set
10.	Ring spanner set
11.	Screw Driver Set
12.	Allen Key set
13.	Adjustable Spanner set
14.	Plier Set
15.	Plastic hammers
16.	Measuring Scale
17.	Torque Wrench set
18.	Cordless Drilling Machine
19.	Punch Tool set
20.	Measuring Tapes
21.	Clamping Vice
22.	C-Clamp
23.	Angle Plates
24.	Number & Letter Punch
25.	Tap wrench
26.	Tap Extractor
27.	Grinding Vices
28.	Parallel Block sets
29.	Oil Stones
30.	Safety Goggles, Gloves and Shoes
31.	Apron
32.	Drill Chucks

33.	Reduction sleeves
34.	Drifts
35.	Tapping Attachments
36.	Drills, Reamer, Taps and Dies
37.	T bolts and clamps
38.	Sine vice and sine table
39.	steady rest and follow rest
40.	Thread Chaser
41.	Radius Gauge
42.	Feeler Gauge
43.	Screw Pitch Gauge (Metric)
44.	Screw Pitch Gauge (British)
45.	Precision Bore gauges
46.	Bore Gauges for Extra Small Holes
47.	Digital Vernier Caliper
48.	Analog Vernier Height Gauge
49.	Digital Vernier Height Gauge
50.	Depth Vernier Caliper
51.	Dial Vernier Caliper
52.	Analog Vernier Calipers
53.	Analog Outside Micrometer
54.	Analog Outside Micrometer Interchangeable
55.	Digital Outside Micrometer
56.	Depth Micrometer
57.	Inside Micrometer
58.	3- Point Inside Micrometer (Digital)
59.	Adjustable Snap Gauge
60.	Dial Snap Gauge
61.	Plunger Dial
62.	Lever Dial
63.	Mechanical Comparator Stand
64.	Screw Thread Micrometer
65.	Gear Tooth Micrometer
66.	Combination Set
67.	Inside Calipers

68.	Outside Calipers
69.	Tube Micrometer
70.	Telescope Gauge
71.	Universal Bevel Protractor
72.	Cast Iron Surface plates
73.	Granite Surface plate with stand
74.	Steel Slip Gauge
75.	Setting Ring Gauge
76.	Precision Level (200 x 0.02 mm/mts
77.	Carbide Slip Gauge
78.	Sine Bar
79.	Sine Centre
80.	Magnetic Dial Stand
81.	Optical Flat
82.	Plain Plug Gauge
83.	Master Ring Gauge
84.	Thread Plug Gauge
85.	Thread Ring Gauge
86.	Taper Plug Gauge
87.	Taper Ring Gauge
88.	Magnetic Vee Block
89.	Non-Magnetic Vee Block
90.	Angle Gauge Kit
91.	Parallel Test Mandrel (solid)
92.	Cast Iron surface plate with stand
93.	2-D Height Gauge
94.	Profile Projector
95.	Spherometer
96.	Barometer
97.	Thermometer
98.	Resistor, Rheostat, Key, Ammeter, Voltmeter, Telescope, Microscope etc.)
99.	Pendulum
100.	Cantilever
101.	Galvanometer
102.	Concave & Convex Lenses

103.	Universal Testing Machine
104.	Rockwell Hardness Tester
105.	Brinell Hardness Tester
106.	Izod and Charpy impact Tester
107.	Magnetic Particle and Ultrasonic Tester
108.	Wattmeter
109.	Ammeter
110.	Voltmeter
111.	DC shunt motor
112.	Servo Motors
113.	Single phase variac
114.	Single phase transformer
115.	Resistive load
116.	Multimeter
117.	CRO
118.	Regulated supply
119.	Signal generator
120.	3-phase inductor motor
121.	3-phase variac
122.	DC shunt generator coupled with motor and starter
123.	Rheostat
124.	Tachometer
125.	Electrical lab with all experiments
126.	Basic Automation Lab
127.	Electronics Lab
128.	Maintenance Kit for Air Conditioners
129.	Centre lathes
130.	Tool room lathe
131.	Lathe with copy turning attachment and other attachments
132.	Universal Milling machine
133.	Vertical Milling machine
134.	Horizontal Milling machine
135.	Upright Drilling machine
136.	Universal Cylindrical grinder
137.	Hydraulic Surface Grinder

138.	Tool and Cutter grinder
139.	Power Hacksaw
140.	Pedestal Grinder
141.	Pillar Drilling Machine
142.	Bench Drilling Machine
143.	Bench Grinders
144.	Portable Welding Machine
145.	Vacuum Heat Treatment Equipment
146.	Electro discharge machine
147.	Coordinate Measuring Machine
148.	Cast Iron Surface plates
149.	CNC Turning centres
150.	CNC Milling machines
151.	Vertical Machining centres
152.	CNC Grinding Machine
153.	CNC Milling machine accessories and holding devices
154.	E.D.M wire cut machine
155.	Heavy Duty bench vice & Work bench
156.	Surface Grinding Machine
157.	Pedestal Grinder Wheel 200mm*20mm, 300mm*32mm
158.	Portable Welding Machine
159.	Face Mill Cutters
160.	Indexable End Mill Cutters
161.	Indexable Drills
162.	Side Mill Cutter
163.	Shell Mill Cutters
164.	HSS & Solid Carbide Twist Drills
165.	HSS & Solid Carbide End Mill Cutters
166.	External Turning Holder for Rhombic 80° inserts
167.	External Turning Holder for Diamond 55° inserts
168.	External Turning Holder for Diamond 35° inserts
169.	External Grooving Holder
170.	Boring bars for Internal diameter turning
171.	Collet Chucks
172.	Magnetic Chucks

173.	3 Jaw Chuck
174.	4 - Jaw Chuck
175.	Dead Center
176.	Face plate
177.	Dog carrier
178.	Center Drills
179.	Knurling Tools
180.	Grooving Tools
181.	Capstan lathe
182.	Turret lathe
183.	Parting tools
184.	Boring Head
185.	Injection Moulding Machine
186.	Press (Hydraulic & Mechanical)
187.	Hand Mould Machine
188.	Hydraulics & Pneumatics workstation including various accessorieS
189.	Air Compressor
190.	AutoCAD
191.	Solidworks
192.	Catia V5 -Academic
193.	Creo Parametric
194.	NX Total Machining Bundle
195.	Master CAM Educational Pack
196.	Master CAM Multi axis add on
197.	Autodesk-Powermill, Powershape & Featurecam
198.	Ansys Academic Spacelaim Tool (Multipurpose)
199.	Ansys: Mechanical & CFD Bundle
200.	CNC Simulators
201.	PC /Desktop Computers
202.	Printers
203.	Engineering Drawing Tables
204.	Tool Trollies
205.	Refractometer
206.	Hand Pallet Trucks
207.	Shelving racks for holding material

208.	Hand Lift Table Scissor Type (High Height)
209.	Scrap Trollies
210.	Head Phone
211.	Multimedia Projectors


HOMI BHABHA ACADEMIC BLOCK
NATIONAL INSTITUTE
OF
TECHNICAL
TEACHERS TRAINING
AND RESEARCH
In the Service of the Nation Since 1967...