

UNIVERSITY OF MUMBAI



Bachelor of Engineering

Printing & Packaging Technology

(Third Year – Sem.V & VI), Revised course

(REV- 2012) from Academic Year 2014 -15,

under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

Dean's Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, credit based semester and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

Dr. S. K. Ukarande

Dean, Faculty of Technology,

Member - Management Council, Senate, Academic Council

University of Mumbai, Mumbai

Coordinator's Preamble:

As the application of technology spreads its wings, the scope of engineering education spreads beyond the core disciplines bringing hitherto unheard areas within its ambit. The Printing & Packaging Technology (PPT) is one such discipline uniquely introduced by the University of Mumbai in the year 2006 that is now a full-fledged course with immense potential. Accreditation norms & the industry orientation of the course have been taken into account while framing the revised structure of the PPT syllabus. Accreditation not only emphasizes ensuring quality but demands that the courses result in measurable outcomes. The program educational objectives have been framed taking an all pervasive view and involving all stake holders.

It is a pleasure, as the Coordinator for PPT, to mention here that there was equal participation of industry and academia in the process of syllabus restructuring and defining the PEO's. CEO's / MD's / Manager- Sales & Technical Services from major printing and packaging industries like SMI Coated Product Pvt. Ltd, Gallus India Pvt. Ltd, E.I DuPont India Pvt. Ltd, Ajanta Print Arts, BASF, UPM Raflatac, Avery Dennison, etc. and experienced Professor's from GIPT, UDCT, PVG'S COET also participated in the framing of the PEO's and revision of syllabus. The Program Educational Objectives are defined as follows-

1. The graduates / learners of this program should be industry ready workforce with a strong base in mathematical, scientific and engineering fundamentals.
2. The graduates / learners must acquire high level of technical & research proficiency, analytical and real-life problem solving skills to generate innovative solutions in packaging and printing technology or related areas of the program using modern tools effectively.
3. Learners needs to exhibit sustained learning and adapting to a continually changing field through graduate work, professional development and absolute self study skills so that they can pursue victorious career in Indian as well as multinational organizations and shine in their postgraduate studies.
4. Graduates capable to communicate effectively to various stakeholders and practice their profession with high regard to societal needs, diversity, constraints in the professional workplace and ethical responsibilities enhancing their leadership and managerial qualities.

In addition to Program Educational Objectives, for each course objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education.

Further, with a view to bridge the gap between academics and application it was decided at the behest of the industry to assign the final year project work as a full time one semester apprenticeship in the packaging and printing industry. The students would be taking up a live project and working on it in the industry during the eighth semester of the four year course. This would have a two pronged benefit of the students gaining actual work experience and the industry gaining trained engineers. The structure and content of the course has been made more relevant to the current needs of the industry. I am sure this small but significant step would go a long way in furthering the cause of introducing this discipline.

I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

Dr. AlkaMahajan
Coordinator, Printing & Packaging Technology
University of Mumbai, Mumbai

University of Mumbai
Third Year of Engineering - Printing & Packaging Technology
Curriculum for Semester - V

Code	Course	Teaching Scheme Hrs/wk			Credits Assigned			
		L	T	P	L	T	P	C
PPC501	Plastics Processing & Conversion Technologies	4	-	3	4	-	1.5	5.5
PPC502	Gravure Printing	3	2		3	2	-	5
PPC503	Ancillary Packaging Materials	3	-	3	3	-	1.5	4.5
PPC504	Theory of Machines & Design	4	-	2	4	-	1	5
PPC505	Instrumentation & Process Control	4	-	2	4	-	1	5
PPS501	Communication & Corporate Skills	-	-	4*	-	-	2	2
		18	2	14	18	2	7	27

Scheme for Semester – V

Code	Course	Examination Scheme							Total	
		Theory Marks					Term Work	Prac		Oral
		Internal Assessment			End Sem. Exam					
		Test-1	Test-2	Av. of Test 1&2						
PPC501	Plastics Processing & Conversion Technologies	20	20	20	80	25	25	25	175	
PPC502	Gravure Printing	20	20	20	80	25	-	25	150	
PPC503	Ancillary Packaging Materials	20	20	20	80	25	25	-	150	
PPC504	Theory of Machines & Design	20	20	20	80	25	-	25	150	
PPC505	Instrumentation & Process Control	20	20	20	80	25	-	25	150	
PPS501	Communication & Corporate Skills	-	-	-	-	50	-	-	50	
j		-	-	100	400	125	50	100	825	

University of Mumbai
Third Year of Engineering - Printing & Packaging Technology
Curriculum for Semester - VI

Code	Course	Teaching Scheme Hrs/wk			Credits Assigned			
		L	T	P	L	T	P	C
PPC601	Packaging Machineries & Systems	3	2	-	3	2	-	5
PPC602	Food & Pharmaceutical Packaging	4	-	-	4	-	-	4
PPC603	Industrial Products Packaging	3	-	-	3	-	-	3
PPC604	Flexographic Printing	4	-	3	4	-	1.5	5.5
PPE601*	Elective - I	4	1	-	4	1	-	5
PPL601	Package Design & Graphics	-	-	4	-	-	2	2
PPS601	Industrial Visits	-	-	3	-	-	1.5	1.5
		18	3	10	18	3	5	26

Scheme for Semester – VI

Code	Course	Examination Scheme							Total	
		Theory Marks					Term Work	Prac		Oral
		Internal Assessment			End Sem. Exam					
		Test-1	Test-2	Av. of Test 1&2						
PPC601	Packaging Machineries & Systems	20	20	20	80	25	-	25	150	
PPC602	Food & Pharmaceutical Packaging	20	20	20	80	25	-	-	125	
PPC603	Industrial Products Packaging	20	20	20	80	25	-	-	125	
PPC604	Flexographic Printing	20	20	20	80	25	-	25	150	
PPE601*	Elective - I	20	20	20	80	25	-	25	150	
PPL601	Package Design & Graphics	-	-	-	-	25	50	-	75	
PPS601	Industrial Visits	-	-	-	-	25	-	25	50	
		-	-	100	400	175	50	100	825	

Elective - I: 1. Packaging Distribution Dynamics
3. Digital & Security Printing

2. Inks & Coatings
4. Print Finishing & Converting

Course Code	Course Name	Credits
PPC501	Plastic Processing and Conversion Technologies	4+1.5

Objectives:

1. To study different plastic processing and conversion techniques
2. To know suitable processing technique as per the end product
3. To study Polymer & Plastic properties influencing conversion techniques
4. To get acquainted with various plastics used in day-to-day life
5. To study and analyze different tests for plastic product

Outcomes: At the end of the course, learners should be able to;

1. Describe the fundamental concepts in plastic processing and conversion technology.
2. Analyse the various plastic materials and its application
3. Understand and use suitable conversion technique as per the end product
4. Produce plastic products by using various conversion techniques
5. Perform different testing methods for plastic product

Sr. No.	Details	Hrs
1.	Module 1 - Introduction Basic concept of polymer processing Polymer additives, Polymer properties influencing conversion technologies Thermal properties – melting temperature, the glassy state and glass transition, molecular wt distribution, MFI, HDT	04
2.	Module 2 – Plastic Extrusion Basic Principle of extrusion, extruder parts, types of extruder, process, process variables, Extrusion single screw - machine and equipment Extrusion twins screw - machine and equipment, types- intermeshing, non intermeshing, co-rotating, counter rotating, comparison single screw and twin screw, Extrusion Process – detail of screw geometry and die, melt filters, breaker plate, selection of process and product, extrusion of film and sheet, common defects and remedies, Die end of extruder, melt flow in extruder, die configuration and extruded products	12
3.	Module 3 – Plastic Injection Moulding Principle, Machine, Processing, Process variables, mould cycle, Types of injection mould – cold runner mould, two plate mould, three plate mould, insert mould, hot runner mould, Injection moulding product design tips and guidelines, injection molding defects and troubleshooting, weld line, shrinkage-warpage, burn marks venting, application of injection molding in packaging – caps, closures, containers,	12

	drums etc.	
4.	Module 4 - Rotational Moulding Technology Rotational moulding principle, machine type, process, process parameters, Importance of resin charge, troubleshooting causes and remedies, Advantages and Disadvantages	05
5.	Module 5 – Thermoforming Technology Vacuum thermoforming, pressure thermoforming, matched mould thermoforming, twin sheet thermoforming, thermoforming moulds	05
6.	Module 6 - Blow Moulding Technology Extrusion blow moulding, Injection blow moulding, Injection stretch blow moulding, Blow moulding machine features and operation, parison programming, accumulator head blow moulding, multilayer blow moulding, common troubleshooting causes and remedies, limitations of blow moulding	06
7.	Module 7 - Calendaring and Metallization Principle and process description, Types of calendaring unit (L type, I type, Inverted L type etc., Metallization process, equipment - vacuum metallization with aluminium and silica	04
8.	Module 8 - Compression and Transfer Moulding Compression moulding -process, materials, advantages and disadvantages, Transfer moulding -process, materials, advantages and disadvantages, Applications of compression and transfer moulding	04

Texts / References:

1. A Brent Strong, "Plastic Material & Processing", Pearson Prentice Hall
2. Rosato D. V., "Extruding Plastic-A Practical Processing Handbook", Chapman Hall
3. Rosato D. V., "Blow Molding Handbook", Hanser Publication
4. Harold F. Giles, Jr., John R. Wagner, Jr., Eldridge M. Mount, "Extrusion-The Definitive Processing Guide and Handbook.
5. Crawford R.J., Throne J. L., "Rotational Moulding Technology", William Andrew Publishing
6. James L. Throne, "Technology of Thermoforming", Hanser Gardner Publication

Term Work:

Assignments covering the entire syllabus will be given to learners.

During practical sessions learners should understand and perform the practical as per the standard procedure given by ASTM/IS or other. Minimum eight practicals should be conducted.

List of experiments:

1. To study injection and blow moulding machine setup
2. To manufacture injection moulded article
3. To manufacture blow moulded article
4. To study extrusion and blown film machine setup
5. To make extrusion profile
6. To manufacture blown film
7. To determine compression strength of plastic article
8. To determine flexural strength of plastic article
9. To Study of Melt Flow Index tester
10. To Study of environmental stress crack resistance of plastic items.

The distribution of term work marks is as follows:

Assignments:	10 Marks
Practical Journal & Continuous Assessment:	10 Marks
Attendance (Theory + Practicals):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Practical & Oral Examination:

To gauge the understanding of the subject, Practical and Oral examination will be conducted at the end of the term, each for 25 marks.

Course Code	Course Name	Credits
PPC502	Gravure Printing	3+2

Objectives:

1. Understand the basic principle of Gravure printing process and its characteristics
2. Study the gravure image carrier preparation methods
3. Learn the various operations involved gravure printing process

Outcomes: At the end of the course, learners should be able to;

1. Describe the various components of gravure printing machine and its functions.
2. Explain various design aspects gravure cylinder and the process of engraving it.
3. Summarise the various operations performed while printing on Gravure machine
4. Discuss various inks and substrates used for gravure process with quality control measures.

Sr. No.	Details	Hrs
1.	Module - 1: Introduction, History and Gravure Products Characteristics of Gravure printing-comparison with other processes, History of Gravure product and Market-Publication gravure, Gravure packaging and converting, Product gravure Gravure development stages- Use of Engravings, Roulette tool, Rotary press invention, Aquatint process, Diffusion etch (carbon tissue) process, Direct transfer process, Well formation, Cylinder proofing and correction, Advances in Engraving and Cylinder Imaging.	06
2.	Module - 2: Gravure Cylinder engraving Cylinder Construction- Cylinder design, Sleeve cylinders, Integral shaft cylinder, Base material, Surface material, Deflection, Balancing, Function of Copper, Chrome, Zinc, Principle of Electroplating, Basic design of plating tank, Important variables in plating Electronic Engraving Systems- Electromechanical engraving machine, Cutting action of diamond tool, Variable cell size, Cell alignment, Cell walls, Screen and Screen angles, Ink and Substrate considerations, of cell size to dot size, UCR, Fine line production Chrome plating, Chrome finishing, Cylinder corrections- correction in chrome , correction in copper, Measurement and Testing	10
3.	Module - 3: Gravure Press and its components	10

	<p>A general printing unit, Typical press configurations, Gravure ink fountain-ink fountain and ink transfer, Ink temperature, Ink viscosity</p> <p>Gravure Ink dryers- Need, Solvent removal, Drying of water based inks , dryer functioning, Environmental considerations</p> <p>The gravure doctor blade-Setup, Pressure, cylinder considerations, doctor blade Material, Variations in doctor blade usage</p> <p>Gravure Impression roller- Functions, Roller design and configuration, Deflection, Roller covering, Coating and Hardness, Impression roller and print quality, Effect on web, Electrostatic Assist</p>	
4.	<p>Module - 4: Web Handling</p> <p>Configuration, Reel stands, and Register control-Unwind Reel stand, Control of web tension from the reel, Web tension control-Zone concept, The effect of the printing unit on Tension, Cylinder progression, Register, Reasons for misregister,Tension measurement, Automatic register control, Lateral movement of the web and side register control, Trends in register control, Web viewing,</p>	08
5.	<p>Module - 5: Gravure Ink and Substrates</p> <p>Ink Composition, Classification of Gravure Inks, Special inks and coating, water based inks, Physical properties of Gravure inks, Ink test and Measurement, Problems and trouble shooting</p> <p>Gravure packaging paper substrates- Packaging substrate requirements, Label stock, Paper board, Run ability Tests, Print quality Tests, Waste and Spoilage Gravure non-paper substrates- Types, Properties- Physical properties, Appearance primer and overprint coatings, Surface Versus reverse Printing, Problems and trouble shooting</p>	05

Texts / References:

1. Gravure Education Foundation And Gravure Association of America, “Gravure Process and Technology”Edition 2003
2. J. Michael Adams, Penny Ann Dolin, “Printing Technology 5E”, Delmar Publishing 5th Edition
3. Basic Gravure Technology, PIRA
4. H. Kipphan, Handbook of print Media, ISBN: 3-540-67326-1 Sringer-Verlag Berlin Heidelberg
5. Ronald E. Todd, (1994), Printing Inks: Formulation Principles, Manufacture and Quality Control, Pira International

Term Work:

Assignments covering the entire syllabus will be given to learners.

During tutorial sessions learners should study the standard testing procedures given by ASTM/IS or others and study the gravure printing machine parts, various gravure printed substrates, etc.

Assignments:	10 Marks
Tutorials & Continuous Assessment:	10 Marks
Attendance (Theory + Tutorials):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Oral Examination:

To gauge the understanding of the subject, an oral examination will be conducted at the end of the term for 25 marks.

Course Code	Course Name	Credits
PPC503	Ancillary Packaging Materials	3+1.5

Objectives:

1. Learn and identify various kinds of ancillary materials and its properties
2. Understand the application of ancillary materials in packaging

Outcomes:

1. Perform the main testing procedures and understand the requirements for testing ancillary packaging materials.
2. Choose and design packaging solutions with respect to the right ancillary material for the target product/package.
3. Elaborate the properties and functions of various ancillary materials.

Sr. No.	Details	Hrs
1.	Module - 1: Cushioning materials Packaging hazards –Drop, Vibration, Shock- Functions of cushioning materials– Type- flexible, semi rigids and fillers. Materials – paper, plastic and wood based, foams and rubber, 2 component systems. Properties of Cushioning materials – Creep, moisture and fungus resistance Cushion Design Process- Fragility factor, Cushion factor, Drop test, Cushion design.	10
2.	Module - 2: Adhesion Principles of Adhesion- Mechanical Interlocking, Molecular diffusion, Electrostatic theory, Chemical Bonding. Surface Properties –wetting, contact angle, surface energy. Surface preparation- cleaning, etching, Corona and plasma treatment, Flame treatment. Types of adhesives – Natural/Synthetic adhesives – Water based/Solvent based/Hot melt – Adhesive applicators. Adhesives and adhesive strength evaluation- Bond, peel, Tensile ,Shear. Adhesive and cohesive strength - Rheological Properties- Viscosity / Tack / wetting / yield Climatic / environmental influences.	10
3.	Module - 3: Closures Functions of caps and closures, Types of closures – Once only- Membranes, crowns, Re-usable- Roll on- ROPP &RSNP, Lug caps, Plug type, Snap on/slip lid, lever and	10

	<p>ring- single/double.</p> <p>Design features of threaded closures- Wads – Wadding Materials, properties, selection Criteria</p> <p>Special closures- Child resistant, New generation dispensing closures. Materials- plastics-thermoplastics and thermosets, Metals- Manufacturing process.</p>	
4.	<p>Module - 4 : Labels</p> <p>Applications- purpose & objective, Contents - Classification – self adhesive, wet glue, in mould, inserts, tags, shrink and stretch sleeve, heat sealable, thermal transfer , properties and applications.</p> <p>Label stocks – paper, films, Al foil – specifications and applications - Manufacturing Process- Pressure sensitive, Shrink sleeve - Labelling process, equipments and mechanism - Smart and intelligent Labels / Security labels.</p>	10
5.	<p>Module – 5 : Reinforcements</p> <p>Strapping- purpose and functions. Materials- Metal-steel, Plastics- HDPE / PP / PET / Nylon - Properties and selection of strapping, types of loads –rigid, compressible, stretching, shrinkable - Strap properties- elongation, tensile strength - Tensioning, Crimping and Sealing of straps.</p> <p>Taping- purpose and functions - Kraft paper tapes- properties and types- white and coloured - BOPP/PVC self adhesive tapes- properties and manufacturing.</p> <p>Tape dispensing – Manual, hand held and automatic.</p>	06
6.	<p>Module – 6: Coatings and coding</p> <p>Lacquers for Metal plate / cans, flexible substrates / Laminates- types and functions</p> <p>Over print varnishes and coatings – spot varnish and overprint - purpose , Decorative coatings. Functional coatings – heat seal, barrier and protective – coating equipment.</p> <p>Bar Coding- Significance, structure, parts of the code - Bar code standards, their generation - printing and sensing - 2D and 3D codes .</p>	06

Texts / References:

1. K. L. Yam, The Wiley Encyclopedia of Packaging Technology, 3rd ed., Wiley, 2009
2. W. Soroka, Fundamentals of Packaging Technology, 4th ed., IoPP, 2009
3. J. F. Hanlon, Handbook of Package Engineering, 3rd ed., CRC Press, 1998
4. F. A. Paine, The Packaging User's Handbook, Springer, 1990

Term Work:

Assignments covering the entire syllabus will be given to learners.

During practical sessions learners should understand and perform the practical as per the standard procedure given by ASTM/IS or other. Minimum eight practicals should be conducted.

List of experiments:

1. To find shear resistance of an adhesive.
2. To find peel strength, bond strength of an adhesive.
3. To find dimensional stability of the adhesive.
4. To study the cushion design process.
5. To understand the process of generating bar code and scanning.
6. To find the tack of self adhesive tape by rolling ball tack test.
7. To find opening and closing torque for closures.
8. To study the process of closure design.
9. To find the scuff resistance of printed label.
10. To do the strapping and taping for CFB box.

The distribution of term work marks is as follows:

Assignments:	10 Marks
Practical Journal & Continuous Assessment:	10 Marks
Attendance (Theory + Practicals):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Practical Examination:

To gauge the understanding of the subject, practical examination will be conducted at the end of the term for 25 marks.

Course Code	Course Name	Credits
PPC504	Theory of Machines and Design	4+1

Objectives:

1. Develop an ability to understand the working of mechanisms in machine.
2. Develop an ability to design a system, component, or process to meet desired needs within realistic constraints for various mechanical components.
3. Develop an ability to identify and solve mechanisms in machine.

Outcomes: At the end of the course, learners should be able to;

1. Analyse the stresses and strains in mechanical components, and understand, identify and quantify failure modes for mechanical parts.
2. Describe the basic machine elements used in machine design.
3. Design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.
4. Develop the approach to design the component under realistic conditions.

Sr. No.	Details	Hrs
1.	Module - 1: Basic concept and straight line mechanism Introduction to machines, Mechanisms, Joints, links. Types of kinematic pairs and motions. Degree of freedom, Constrained kinematic chain mechanism. Single slider crank chain, pantograph mechanism, Double slider crank chain mechanism, Straight line mechanism (Exact and approximate).	06
2.	Module - 2: Motion characteristics of mechanisms Velocity and acceleration analysis of mechanisms with single degree of freedom using graphical method. Kennedy's theorem Analysis of velocities of mechanism using instantaneous centre method.	08
3.	Module - 3: Introduction to CAM and followers Introduction and Classification of follower & CAMS. Displacement, velocity and acceleration diagrams when: Follower moves with uniform velocity, SHM, acceleration and retardation, cycloidal motion and Construction of CAM profiles.	12
4.	Module - 4: Basic concepts and principles of machine design Classification of engineering materials, Basic procedure of machine design. Mechanical properties of metals, Basic requirements of machine elements. Selection of materials and its types. Stress strain diagram. Factor of Safety	06

	(FOS), Selection of FOS.Principal stresses and Theories of Failures.	
5.	Module - 5: Design against static loading Cotter joint, Knuckle Joint, Welded joint	12
6.	Module - 6: Design of Keys, Shaft and coupling Taper Keys, Gib headed keys, Parallel Keys, woodruff key.Design of Flange Coupling. Shaft and its types, Shaft design on strength basis, Shaft design on torsional rigidity basis.	08

Texts / References:

1. “ Design of machine elements“ by V.B. Bhandari
2. “Design data book” by K. Mahadevan and K. Balareddy
3. “Textbook of Machine design” by R.S.Khurmi and J.K.Gupta

Term Work:

Assignments covering the entire syllabus will be given to learners.

During practical sessions learners should understand and perform the practical as per the standard procedure given by ASTM/IS or other. Minimum eight practicals should be conducted.

List of experiments:

1. Study of stress strain diagram and modes of failure.
2. Study of motion characteristics and mechanisms
3. Construction of velocity and acceleration diagram using instantaneous centre method.
4. Construction of CAM profiles.
5. Design and drawing sheets of Cotter joint.
6. Design and drawing sheets of Knuckle joint.
7. Design and drawing sheets of Flange coupling.
8. Study of welded joints.

The distribution of term work marks is as follows:

Assignments:	10 Marks
Practical Journal & Continuous Assessment:	10 Marks
Attendance (Theory + Practicals):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Oral Examination:

To gauge the understanding of the subject, oral examination will be conducted at the end of the term for 25 marks.

Course Code	Course Name	Credits
PPC505	Instrumentation and Process Control	4+1

Objectives:

1. To generate clear understanding of fundamentals of basic measuring devices.
2. To provide details of data gathering, processing and computing.
3. To make students familiar with the various methods of process control

Outcomes: At the end of the course, learners should be able to;

1. Knowledge of measuring devices and signal conditioning will help students to select the correct transducer as per the requirement.
2. Students will be able to confidently design a PID controller using opamps or through MATLAB program.
3. The understanding of applications of PLC's in latest printing machines and also packaging machines will be developed.

Sr. No.	Details	Hrs
1.	Module - 1: Measurement and Transducers Measurement: Introduction to the concept of measurement, basic characteristics of a measuring device, block diagram of measuring system, error and its types Transducers: Need of transducer, definition, classification, selection criteria Quantities to be measured: displacement (LVDT, Potentiometer), flow (Rotameter, electromagnetic flowmeter), light (LDR), level (radiation method, ultrasonic method) temperature (RTD, thermocouple), humidity (condensation hygrometer), pressure (bourdon tube, liquid column), strain gauges and their classification, derivation of gauge factor, pH measurement using hydrogen electrode method, sensors and their comparison with transducers.	11
2.	Module - 2: Signal Conditioning Definition of signal conditioning, its need, introduction to op-amp IC-741, inverting and non-inverting amplifier in closed loop, differential amplifier, instrumentation amplifier, filters (active, passive, low-pass, high-pass), adder, subtractor, V to I converter, I to V converter, introduction to IC-555, astable mode and its application as square wave oscillator, monostable mode and its applications as frequency divider and missing pulse detector, bi-stable multivibrator.	09
3.	Module - 3: Control System Dynamics Introduction to control engineering, open loop and closed loop system, classification	06

	of control systems, LTI system, Concept of stability and causality, Role of a control engineer, Importance of mathematical modelling, Block diagram of basic control system, Transfer function, Test input signals, Time domain response: Transient response specifications and Steady state error for various input signals, frequency-domain specifications, hydraulic system, pneumatic system, control system components: AC and DC servomotor, stepper motor	
4.	Module – 4: Process control Block diagram of Process control, Process characteristics, Control system parameters, role of a controller, Controller modes: Discontinuous: Two position, multiposition, floating, Continuous and Composite: Proportional, Integral, Derivative (description only for all modes), block diagram of final control operation	09
5.	Module – 5: Controller design Concept to electronic controller and use of OP-AMP in controllers. Design of all Discontinuous modes using OP-AMP. Design of all continuous controller modes using OP-AMP and derivations for final outputs. Design of all Composite modes using OP-AMP and derivations for final outputs with examples for each mode.	09
6.	Module – 6: Programmable logic controller Concept of relay logic, introduction to ladder diagram and its elements, illustration of ladder diagram with examples, introduction to PLC, advantages of PLC over relay logic, introduction to DAS, data logger, SCADA Application of PLC in pad printing machine PLC controlled automatic packaging machine	08

Texts / References:

1. C.S. Rangan, G.R. Sarma, "Instrumentation devices and systems" TMH.
2. A.K.Sawhney, "Electronic and Electrical measurements and instrumentation", DhanpatRai and CO.
3. H.S.Kalsi, "Electronic Instrumentation", TMH.
4. Johnson, "Process Control Instrumentation Technology", Pearson Education.
5. Norman.S.Nise, "Control Systems Engineering", Wiley Publications

Term Work:

Assignments covering the entire syllabus will be given to learners.

During practical sessions learners should understand and perform the practical as per the standard procedure given by ASTM/IS or other. Minimum eight practicals should be conducted.

List of experiments:

1. Study of Displacement measurement using LVDT.
2. Study of Flow measurement by using Rotameter.
3. Study of LDR.
4. Design of Passive Low Pass Filter.
5. Design of Passive High Pass Filter.
6. Design of Active Low Pass Filter.
7. Design of Active High Pass Filter.
8. MATLAB program for study of step response characteristics.
9. MATLAB Program for designing PID Controller.

The distribution of term work marks is as follows:

Assignments:	10 Marks
Practical Journal & Continuous Assessment:	10 Marks
Attendance (Theory + Practicals):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Oral Examination:

To gauge the understanding of the subject, Oral examination will be conducted at the end of the term for 25 marks.

Course Code	Course Name	Credits
PPS501	Communication and Corporate Skills	2

Objectives:

1. To inculcate in students professional and ethical attitude, effective communication skills, teamwork, multidisciplinary approach and an ability to understand engineer's social responsibilities.
2. To inculcate professional ethics and codes of professional practice and leadership.
3. To prepare students for successful careers that meets the global Industrial and Corporate requirements.

Outcomes:

After completion of this course students will be able to:

1. Communicate effectively in both verbal and written form and demonstrate knowledge of professional and ethical responsibilities
2. Participate and succeed in Campus placements and competitive examinations like GATE, CET.

Sr. No.	Details	Hrs
1.	Module - 1: Report Writing Objectives of report writing. Language and style in a report. Types of reports. Formats of reports: Memo, letter, project and survey based	08
2.	Module - 2: Technical Proposals Objective of technical proposals. Parts of proposal	02
3.	Module - 3: Introduction to Interpersonal Skills Emotional Intelligence, Leadership, Team Building. Assertiveness, Conflict Resolution, Negotiation Skills, Motivation. Time Management.	08
4.	Module – 4: Meetings and Documentation Strategies for conducting effective meetings. Notice, Agenda & Minutes of the meeting.	02
5.	Module – 5: Introduction to Corporate Ethics and Etiquettes Business meeting etiquettes, interview etiquettes, professional and work etiquettes, social skills - Greetings and art of conversation - Dressing and grooming - Dining	02

	etiquette. Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response, the process of making ethical decisions)	
6.	Module – 6: Employment Skills Cover Letter, Resume. Group Discussion, Presentation Skills. Interview skills	06

Texts / References:

1. Fred Luthans, “Organisational Behavior” , McGraw Hill
2. Lesiker and Petit, “Report Writing for Business” , McGraw Hill
3. Huckin and Olsen, “Technical Writing and Professional Communication”, McGraw Hill
4. Wallace and Masters, “Personal Development for Life and Work” , Thomson Learning, 12th edition
5. Heta Murphy, “Effective Business Communication”, McGraw Hill
6. R.C Sharma and Krishna Mohan, “Business Correspondence and Report Writing”
7. B N Ghosh, “Managing Soft Skills for Personality Development”, Tata McGraw Hill. Lehman, Dufrene, Sinha, “BCOM”, Cengage Learning, 2nd edition
8. Bell . Smith, ”Management Communication” Wiley India edition, 3rd edition.

Termwork:

Term work shall consist of assignments as listed below:

1. Report writing (Synopsis or the first draft of the Report)
2. Technical Proposal (Group activity, document of the proposal)
3. Interpersonal Skills (Group activity and Role play)
4. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
5. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
6. Corporate ethics and etiquettes (case study, Role play)
7. Cover Letter and Resume Printout of the Power Point presentation

Term work assessment must be based on the overall performance of the student with every assignment / project / group discussion graded from time to time. The average of grades converted in to marks should be taken into account for term work assessment.

The distribution of marks for term work shall be as follows.

Assignments: 20 marks

Project Report Presentation: 15 marks

Group Discussion: 15 marks

Internal Assessment:

There will be no internal assessment.

Theory Examination:

There will be no theory or end semester examination.

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University of Mumbai
Third Year of Engineering - Printing & Packaging Technology
Curriculum for Semester - VI

Code	Course	Teaching Scheme Hrs/wk			Credits Assigned			
		L	T	P	L	T	P	C
PPC601	Packaging Machineries & Systems	3	2	-	3	2	-	5
PPC602	Food & Pharmaceutical Packaging	4	-	-	4	-	-	4
PPC603	Industrial Products Packaging	3	-	-	3	-	-	3
PPC604	Flexographic Printing	4	-	3	4	-	1.5	5.5
PPE601*	Elective - I	4	1	-	4	1	-	5
PPL601	Package Design & Graphics	-	-	4	-	-	2	2
PPI601	Industrial Visits	-	-	3	-	-	1.5	1.5
		18	3	10	18	3	5	26

Scheme for Semester - VI

Code	Course	Examination Scheme							Total	
		Theory Marks					Term Work	Prac		Oral
		Internal Assessment			End Sem. Exam					
		Test-1	Test-2	Av. of Test 1&2						
PPC601	Packaging Machineries & Systems	20	20	20	80	25	-	25	150	
PPC602	Food & Pharmaceutical Packaging	20	20	20	80	25	-	-	125	
PPC603	Industrial Products Packaging	20	20	20	80	25	-	-	125	
PPC604	Flexographic Printing	20	20	20	80	25	-	25	150	
PPE601*	Elective - I	20	20	20	80	25	-	25	150	
PPL601	Package Design & Graphics	-	-	-	-	25	50	-	75	
PPI601	Industrial Visits	-	-	-	-	25	-	25	50	
		-	-	100	400	175	50	100	825	

Elective - I: 1. Packaging Distribution Dynamics
 3. Digital & Security Printing

2. Inks & Coatings
 4. Print Finishing & Converting

Course Code	Course Name	Credits
PPC601	Packaging Machineries and Systems	3+2

Objectives:

1. Understand the concept of systems & online Packaging techniques.
2. Understand the various machineries used for conversions of different packaging materials.
3. Study the different packaging machineries used for line operations and systems.
4. Study various ancillary equipments used apart from packaging machineries.
5. Understand the importance of testing, online & offline equipment's used industries

Outcomes: At the end of the course, learners should be able to;

1. Suggest the packaging material use and its conversion as per the product geometry.
2. Suggest the filling machine required for the line operations.
3. Choose the ancillary machineries required in the line operations based on the product to be packed.
4. Analyse the different conveying system used for various line operations.
5. Select different online and offline testing methods that are required during the converting operations or on the packaging lines.

Sr. No.	Details	Hrs
1.	<p>Module - 1: Introduction and Manufacturing Metals Cans & Drums</p> <p>Introduction, Machineries used for conversion, online packaging, system packaging, Ancillaries Machines and equipment, Online and Offline inspection equipment.</p> <p>Metal Cans-Three piece, DRD & DWI can manufacturing machine and its various sections-Coating Equipments.</p> <p>Metal drum-Types-Different machines used in manufacturing.</p> <p>Fibre & Composite drum-Drum types-Machine used in manufacturing.</p>	07
2.	<p>Module -2:Machineries for Manufacturing of Sacks, Cartoning, Flexible Laminates & Corrugated Box</p> <p>Sacks-Types-Machine used in manufacturing of bag-Synthetic sack-Types-Manufacturing machine.</p> <p>Folding Cartons -Cartoning-Types of Cartons-Machine used in cartoning.</p> <p>Flexible Laminates-Types of lamination techniques-Different components of the Lamination Machine.</p> <p>Corrugated Box-Board construction-Machine used in manufacturing.</p>	06

3.	<p>Module - 3: Types of fillers, VFFS, HFFS, Multiwall Sack filling</p> <p>Filling machineries by count-Filling machineries-Liquid-Carbonated, Still-Design consideration and selection of fillers.</p> <p>Types of Solid fillers-Cup, Weight, Auger, Multi-head weigher</p> <p>Vertical Form fill seal (VFFS), Horizontal Form fill seal (HFFS) Machines-Machine overview, Types-Different section on the machine-New technologies available.</p> <p>Multiwall bag-Types of filling technique.</p>	06
4.	<p>Module - 4:Aseptic System, Retort System Packaging of Drugs & Pharmaceuticals</p> <p>Retort System-Overview-Process description, Canning Operation-Type of Retort system& machines/equipments.</p> <p>Aseptic System-Concept- Types of Aseptic Packs-Aseptic Packaging Machineries based on sterilization method.</p>	06
5.	<p>Module - 5: Blister & Strip Packaging, Case packing Machines,</p> <p>Blister Packaging-Blister Design Parameters-Types of Blisters, Sections on Blister packaging machines.</p> <p>Strip Packaging-Strip packaging process-Materials used-Strip Packing Machinery</p> <p>Case packing or Case loading- Case loading Methods-Machine used in case packing.</p>	04
6.	<p>Module - 6: Wrapping Machines, Ancillary Machines &Equipments</p> <p>Wrapping Machine-Style of wrapping-Machines used</p> <p>Shrink Wrapping Machine-Machine types and its parameters</p> <p>Stretch Wrapping Machine-Pre stretching film-Types of Wrapper models.</p> <p>Label Applicator Machines-Capping Machines-Sealing machines-Coding & Marking machines-Stencilling-Taping machine-Strapping machine-Slitting machine.</p>	06
7.	<p>Module – 7: Conveying, Buffering &Accumulatng Systems and Online &Offline Testing machines</p> <p>Introduction-Integration of Conveyor-Design and Installation of Conveyor systems- Conveying systems-Power transmission components-Transfer between conveyors- Interconnecting machinery</p> <p>Online Inspection machine used on packaging lines.</p> <p>Offline Testing machine-Packaging Materials, Shipping Packages</p>	04

Texts / References:

1. Davis, C.G., Introduction to Packaging Machinery, Packaging Machinery Manufacturers Institute.
2. Luciano, R., How to Write Packaging Machinery Specifications, Institute of Packaging Professionals
3. Zepf, P.J., Improving Packaging Line Performance, Institute of Packaging Professionals
4. G. K. Dubey, Fundamentals of Electric Drives, Narosa Publishing house
5. Dr. J. S. Rao and Dukhipeti, Theory of M/cs and Mechanisms, New Age International
6. H. P. Garg, Industrial Maintenance, S.Chand
7. Kit L Yam, The Wiley Encyclopedia of Packaging Technology, John Wiley & Sons Inc. Publication, 2009
8. F A Paine, The Packaging User's Handbook, Blackie Academic & Professional, 4th Reprint, 1996
9. Kaushik, Chaurasia & Dhakar, "Textbook of Pharmaceutical Packaging Technology", CBS Publishers & Distributors Pvt. Ltd, 1st Edition, 2009
10. EIRI Board of Consultant & Engineer, "Handbook of Packaging Technology", Engineers India Research

Term Work:

Assignments covering the entire syllabus will be given to learners.

During tutorial sessions learners should study the different machine components/elements and study the demonstration of various packaging machines.

Assignments:	10 Marks
Tutorials & Continuous Assessment:	10 Marks
Attendance (Theory + Tutorials):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Oral Examination:

To gauge the understanding of the subject, Oral examination will be conducted at the end of the term for 25 marks.

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Course Code	Course Name	Credits
PPC602	Food and Pharmaceutical Packaging	4

Objectives:

1. Learn and understand the types of food, their modes of deterioration and the fundamentals of package barriers.
2. Learn shelf life studies and sensory evaluation based on type of product.
3. Study the various food preservation techniques with real-life packaging examples.
4. Study the fundamental characteristics of pharmaceutical drugs & their dosage forms.
5. Understand the various existing pharma package forms

Outcomes: At the end of the course, learners should be able to;

1. Analyse and choose a barrier material for a specific food product based on barrier properties studied.
2. Analyse and choose a preservation method for a specific food product based product sensitivity and shelf life required.
3. Describe the various characteristics of pharmaceutical drugs and their sensitivities.
4. Select the right type of package form for a pharma product, based on the product nature, form & size.

Sr. No.	Details	Hrs
1.	<p>Module - 1: Introduction to Food Packaging</p> <p>An overview & Introduction to the science, technology, socio economic needs and packaging functions.</p> <p>Types of food – Perishable / Semi-perishable, acidity of food product.</p> <p>Gas and Vapour permeation - Basic concepts and theory of permeation and units.</p> <p>Barrier materials used in Food Packaging - Food-package compatibility and migration issues.</p>	12
2.	<p>Module -2: Shelf Life studies and sensory evaluation</p> <p>The concept and factors influencing or affecting shelf life - Food deterioration (Order of reactions) and intrinsic & extrinsic factors, evaluation studies and methods to assess shelf life (Normal & Accelerated).</p> <p>Sensory evaluation – Concept, Human sensory perception, Errors in sensory evaluation.</p> <p>Sensory Evaluation Tests – Discriminative, Descriptive & Affective/Consumer Tests.</p>	12

3.	Module - 3: Food Preservation Techniques Drying – Cold Preservation (Refrigeration, Deep Freezing) – Pickling – Sterilization (Retort/Canning, Irradiation) Modified & Controlled Atmosphere Packaging – Gases used – Vacuum Packaging Active Food Ingredients.	06
4.	Module - 4: Food products, characteristics and processing needs Cereals and bakery products - Meat and meat products - Dairy and confectionary products, fats, oils, drinks – Fresh fruits & vegetables - frozen foods	04
5.	Module - 5: Characteristics of Drugs & Pharmaceuticals Pharmaceutical vs Food Product – Definition of Drug – Characteristics – Stability – Chemical change/Reactions – Thermal Protection – Light protection – Purity & Sterility. Dosage forms of drugs – Vaccines – Biologically-produced Pharmaceuticals – Medical/Health/Nutritional foods – Packaging materials.	10
6.	Module - 6: Packaging of Drugs & Pharmaceuticals Aseptic Packaging – Types & systems – Injectables and orals/ointments – Ampules, Vials, strip / blister packaging. Packaging of bulk drugs. Reference to IP/BP and significance – packaging regulations – labeling requirements	08

Texts / References:

1. Mathlouthi M., Food packaging & preservation, Blackie Academic & Professional
2. Gordon L Robertson, Food packaging principles & practice, Taylor & Francis Group
3. Food packaging technology Handbook, National Institute of Industrial Research (NIIR) Board
4. Hirsch A., Flexible food packaging, Van Nostrand Reinhold Co.
5. Lee, Yam, Piergiovanni, Food Packaging Science & Technology, CRC Press.
6. Piringer&Baner, Plastic Packaging Materials for Food, Wiley – VCH verlag GmbH.
7. Bauer E., Pharmaceutical Packaging Handbook, 1st Edition, CRC Press
8. Dean D. A., Evans E. R., Hall I. H., Pharmaceutical Packaging Technology, Taylor & Francis
9. Paine F. A., Lockhart H., Packaging of Pharmaceuticals and Healthcare Products, Springer

Term Work:

Assignments covering the entire syllabus will be given to learners.

The distribution of term work marks is as follows:

Assignments: 20 Marks

Attendance (Theory): 05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Course Code	Course Name	Credits
PPC603	Industrial Products Packaging	3

Objectives:

1. Study the classification, characteristics & sensitivities of various industrial products.
2. Understand package design & development approach based on the type of industrial product.
3. Study the classification and properties of wood, including the defects.
4. Study the different wood based packaging forms and other bulk carriers.
5. Understand the product protection principles.

Outcomes: At the end of the course, learners should be able to;

1. Effectively choose packaging materials based on characteristics of industrial products.
2. Describe the various properties & defects of wood packaging material
3. Analyze the various hazards & environmental issues related to Packaging and select a specific protection method for the product.
4. Choose various bulk carriers for industrial packaging based on the type of product.

Sr. No.	Details	Hrs
1.	Module - 1: Introduction & Classification: Introduction to industrial products packaging. Difference between consumer and industrial packaging needs. The packaging Considerations and package design approach, protective requirements and distribution – hazards, their sensitivity influencing packaging design and development criteria Industrial Products Classification – Product Group Wise, Its Nature, Classification & Requirements; Heavy, Medium and Light Engineering Goods; Electronic Products; Auto Components/ Spares, Chemicals and others.	10
2.	Module - 2: Wood as Packaging Material: Classification of wood – Groups, softwood & hardwood, plywood Properties of wood – Density, Moisture Content Defects found in wood – Knots, Cross Grain, Cupping, checking and others. Introduction to Wood seasoning & Preservation	08
3.	Module - 3: Wood Packaging Forms Wooden Boxes & Crates – Difference & Types Introduction to Wooden Pallets, Palletized Boxes & Box Pallets and their various	07

	components; Wooden Dunnages.	
4.	Module - 4: Product Protection: Corrosion – Types and Preventive Methods, Introduction to Desiccants Cushioning – Concept, Fragility & Cushion Factor, Shock & Vibration. Open & Closed cell cushions and various cushioning Materials. Internal Fitments – Functions & Different Materials; Types of Internal Fitments - Corner supports, Pads, Liners/collars, Trays, Slotted Partitions and others. Concept of Reinforcement & Unitization	08
5.	Module - 5: Bulk Carriers: Intermediate Bulk Containers (IBC) – Rigid & Flexible – Types, Materials of Constructions & Various designs. Corrugated Fibreboard Boxes, Paper Sacks, Jerry Cans, Fibre Drums and others.	06

Texts / References:

1. Friedman W.F. and J.J. Kipness, Industrial Products packaging, John Wiley & Sons
2. Klimchuck, Packaging Design & Engineering, Wiley
3. Joseph F.L. Robert S Keley, Handbook of Package Engineering, Technomic Publishing
4. F. A. Paine, Fundamentals of Packaging, Blackie A& P
5. Friedman W.F. and J.J. Kipness, Distribution Packaging, Robert E. Krieger Publishing Co
6. Wooden Containers/crates, Corrugated board/boxes, marking : Specification and Testing as per Indian Standards

Term Work:

Assignments covering the entire syllabus will be given to learners.

The distribution of term work marks is as follows:

Assignments: 20 Marks

Attendance (Theory): 05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

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Course Code	Course Name	Credits
PPC604	Flexographic Printing	4+1.5

Objectives:

1. To help learners acquire basic knowledge for flexographic printing process.
2. To help learners to identify printing challenges on the press.

Outcomes: At the end of the course, learners should be able to;

1. Learners develop ability to operate flexography machine.
2. Learners acquire skills to handle trouble shoot on flexography presses.

Sr. No.	Details	Hrs
1.	Module - 1: Introduction to Flexography Overview of major conventional printing technologies, the flexographic potential, brief history of process. Working principle, features, characteristics and advantages of flexography. Comparison with other major printing process basic elements of flexography.	04
2.	Module - 2: Image Carrier Design considerations and objectives of general flexographic printing image carrier. Introduction of flexographic plates, Molded Plate making, Photopolymer plates: sheet and liquid plate making, Laser Design Rolls and Flexo CTP. Properties, Benefits, Comparisons, Handling and Storage of Flexographic Plates. Different light sensitive chemistries used in plate material manufacturing.	08
3.	Module - 3: Mounting & Proofing Need and significance of plate mounting operation. Introduction to mounting. Types of mounting procedures: Double-sided Tape, Magnetic, Sleeve, pin register system. Plate mounting and proofing machines. Troubles and trouble-shooting with regard to improper plate mounting.	04
4.	Module - 4: Flexographic Press Press types: Working, advantages & Limitations of Stack, Common Impression, Inline. Basics of Tension zones and web tension control systems. Printing Station: Types of Inking systems, Fountain Roller, Anilox Roller, Plate Cylinder, Impression Rollers, Dryers and Cooling Rollers, side and circumferential register control.	17

	<p>Web Tensions: Tension Zones & Tension ranges, Transducer feedback control, Unwind tension control, In-feed Tension Control, Rewind Tension Control.</p> <p>Web Inspection: Stroboscope, Mirror Drum, TV Print Scanner, Static Control, Film Treaters.</p>	
5.	<p>Module - 5: Substrates and Inks</p> <p>Absorbent and Non-absorbent substrates, physical properties, printing characteristics, Special substrate. Substrate's surface and optical properties affecting printing resolution.</p> <p>Inks</p> <p>End-use requirements, introduction to printing inks, ink vehicles, ink classifications, principles of ink selection, ink consumption, ink quality assurance tests and ink storage. Ink's surface and optical properties affecting printing resolution.</p>	03
6.	<p>Module - 6: Process Colour Printing</p> <p>Halftone Printing, Theory of color, color separations, basic requirements for process color printing, flexographic printing characterization, ink density and standardization, dot gain. Effects of plate, anilox roller, fountain and impression roller on printing density. Process controls & standardization. Process colour screen angles, relationship between LPI requirement and line frequency of anilox roll, electronic colour registration systems. Quality range with FM and AM screening techniques.</p>	11
7.	<p>Module - 7: Quality Control and Environment & Safety</p> <p>Introduction, Characteristics of quality, economics of quality improvement, the principles of total quality management, statistical process control, tools of statistical process control, element of process control in flexography. ISO 9000.</p> <p>Environment & Safety</p> <p>Clean Air Act, Toxic substance control act, Resource conservation & recovery act, occupational safety & health act.</p>	05

Texts / References:

1. Foundations of FTA, Flexography Principles & Practices, 5th Edition.
2. Herbert L. Weiss, Flexography Proficiency, Converting Technology Corp.
3. Tony White, High Quality Flexography, Pira International Reviews.
4. J. Michael Adams, Printing Technology, 5th Edition, Delmar.
5. Michael Barnard "The Print & Production Manual" PIRA

Term Work:

Assignments covering the entire syllabus will be given to learners.

During practical sessions learners should understand and perform the practical as per the standard procedure given by ASTM/IS or others. Minimum eight practicals should be conducted.

List of experiments:

1. Introduction to construction and features of flexographic unit.
2. Understanding design and working of tension control elements of Flexographic web threading path.
3. Flexographic Plate Mounting with varying plate dimensions, adhesive strength and repeat length.
4. Setting up of single and multicolour flexographic press for printing.
5. To print single color job on given absorbent stock and analyze print quality.
6. To print single color job on given non-absorbent stock and analyze print quality.
7. To study tension setting on flexographic machine.
8. To analyze effect of anilox & fountain roller pressure on print.
9. To analyze effect of flexographic inks on print.
10. To print two color job on absorbent stock and analyze print quality.
11. To print two color job on non-absorbent stock and analyze print quality.

The distribution of term work marks is as follows:

Assignments:	10 Marks
Practical Journal & Continuous Assessment:	10 Marks
Attendance (Theory + Practicals):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Oral Examination:

To gauge the understanding of the subject, an oral examination will be conducted at the end of the term for 25 marks.

MUQuestionPapers.com

Course Code	Course Name	Credits
PPE601	Packaging Distribution Dynamics (Elective –I)	4+1

Objectives:

1. Learn the fundamentals hazards encountered in distribution
2. Study the various principles of distribution dynamics.
3. Learn the method for estimating the vibration, shock encountered by a product in distribution
4. Study estimation of cushioning requirement for a product in distribution.

3. Understand the different tests that can be done to gauge package performance in distribution.

Outcomes: At the end of the course, learners should be able to;

1. Analyse the hazards encountered in distribution and determine protection requirement
2. On the basis of principles of distribution dynamics estimate the vibration, shock encountered by a product in distribution
3. Calculate cushioning requirement for a product in distribution.
4. Perform tests to gauge package performance in distribution.

Sr. No.	Details	Hrs
1.	Module - 1: Introduction: Overview of Packaging distribution - Modes of distributions – Hazards in Distribution – Vibration, Impact, Drop, Compression, Shock	03
2.	Module - 2: Fundamentals of Motion & Vibration Mass – Velocity – Acceleration Introduction to Vibration – Simple vibratory motion – The yo-yo analogy – Linear Spring – Natural frequency – Vibrating Spring mass system – Combination of springs and cushions – Spring Constant & Modulus of elasticity. Concept of Unforced & Forced Vibration - Vibration Magnification – Sample problems	10
3.	Module - 3: Damped Vibrations, Vibrations in Distribution, Testing & Random Vibration Damped Vibration – Vibration sensitivity – Vibration of packaged product - Random Vibration – Fourier analysis - Power Density Spectrum – Vibration Test Equipments- Sample problems	14
4.	Module - 4: Mechanical Shock, shock in distribution and Cushion design Introduction - Free Falling Package - Mechanical Shock Theory - Shock Duration -	17

	Shock Amplification & Critical element –Horizontal Impacts - Mechanical Shock in DistributionSystem - Damage Boundary Curve (DBC) –Constructing a DBC - Shock Fragility - Shock Response Spectrum Cushion Design & product protection – Cushions & Vibrations - Sample problems	
5.	Module - 5: General Considerations for Package Testing Introduction to Distribution Testing/Transport or Distribution Engineering – Hazards of the Logistical Environment - Measuring Logistical Hazards - Product Design for Distribution - Package Performance Testing - Equipments - National & International TestingProtocols - Reference to ASTM / IS standards – Distribution tests in detail – Drop, Compression, Impact, Vibration, Shock, Rolling, Salt Spray, Rain and other tests.	08

Texts / References:

1. Brandenburg & Lee, Fundamentals of Packaging Dynamics
2. Harris & Crede, Shock & Vibration Handbook. McGraw Hill
3. Goodwin & Young, Protective Packaging for Distribution, Destech Publications

Term Work:

Assignments covering the entire syllabus will be given to learners.

During tutorial sessions learners should understand the various testing methods & equipments used for transport package evaluation as per IS/ASTM or other standards

The distribution of term work marks is as follows:

Assignments:	10 Marks
Tutorials & Continuous Assessment:	10 Marks
Attendance (Theory + Tutorials):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Oral Examination:

To gauge the understanding of the subject, an oral examination will be conducted at the end of the term for 25 marks.

MUQuestionPapers.com

Course Code	Course Name	Credits
PPE602	Inks and Coatings (Elective –I)	4+1

Objectives:

1. To study the ink formulation and its components.
2. To study the requirements of inks for different printing processes and materials.
3. To understand the working of different coatings.

Outcomes: At the end of the course, learners should be able to;

1. Explain the formulation for different types of inks.
2. Explain the ink components for different printing processes and materials.
3. Test and analyze the properties of inks and coatings.

Sr. No.	Details	Hrs
1.	Module - 1: Raw Materials Introduction & History of inks - Applications of ink - Ingredients and their functions- Pigments and dyes in printing Inks - organic and inorganic – pigments for different colors and effects - their sources and processing. Vehicle components - oil, resin, solvent, additives – Oils – drying and non drying – oils for odours – Solvents – diluents/drying/dissolving, distillate and volatile. Resins – their functions- natural and synthetic – Additives – driers, anti oxidants, plasticizers, anti setoff, anti foaming, anti settling, anti pinhole and anti misting agents, surfactants, gelling agent.	16
2.	Module - 2: Types Of Inks Printing Inks for different processes - letterpress, lithography, dry offset, gravure, flexographic, inkjet and screen inks - formulation, components and functions - troubleshooting for ink related problems Inks as per different drying process- coldset, heatset, quickset, UV curable – the formulation and working. Inks for different substrates – absorbent, non absorbent- coated paper, newsprint, tinfoil, flexible packaging, Processing of substrate for ink adhesion.	14
3.	Module - 3: 3.1 Manufacturing Process Making of varnish – Paste ink and liquid ink - Mills for mixing the components- Roll	16

	<p>mill – two, three and four roll - Ball and bead mill - Mixers- Rotor/stator, cavitation . Storage and Handling – liquid & paste inks – Ink Packaging – Health, Safety and Environment- Estimation of ink requirements and ordering .</p> <p>3.2 Properties and Testing</p> <p>Optical properties- color, transparency, tint, gloss. Flow properties- rheology- Newtonian/non-newtonian, viscosity, tack. Resistance properties- light, acid and alkali, heat, abrasion.</p>	
4.	<p>Module - 4: Other coatings in printing and packaging</p> <p>Varnish- functions , formulation and manufacturing – overprint and spot varnish coating methods, Priming coats, lacquers for metals – formulations and coating methods, Other functional coatings- corrosion resistant, water resistant and chemical resistant, silicone release, biocides, self seal adhesives.</p>	06

Texts / References:

1. R.H.Leach & R.J.Pierce, The Printing Ink Manual, 5th ed., Kluwer, 1991
2. Arthur Tracton ,Coatings Materials and surface Coatings, 3rd ed., CRC Press, 2007
3. NIIR, Modern Technology of Printing & Writing Inks, 1st ed., Asia Pacific Business Press
4. NPCS, “Inks, Paints, Lacquers, Varnishes and Enamels”, NPCS

Term Work:

Assignments covering the entire syllabus will be given to learners.

During tutorial sessions learners should understand the various testing methods & equipments used for evaluating inks & coatings as per IS/ASTM or other standards

The distribution of term work marks is as follows:

Assignments:	10 Marks
Tutorials & Continuous Assessment:	10 Marks
Attendance (Theory + Tutorials):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Oral Examination:

To gauge the understanding of the subject, an oral examination will be conducted at the end of the term for 25 marks.

MUQuestionPapers.com

Course Code	Course Name	Credits
PPE603	Digital and security Printing (Elective –I)	4+1

Objectives:

1. To study digital printing & the importance of security printing with respect to bank note papers and boards, passports and government documents.
2. To study image editing
3. To understand limitations, pros & cons of digital printing.
4. To study working principles and applications of different digital printing devices
5. To study first line inspection of different documents

Outcomes: At the end of the course, learners should be able to;

1. Analyse & describe the fundamental concepts in digital printing.
2. Elaborate the importance of security printing with respect to use in everyday documents.
3. Analyse and perform image editing
4. Describe first line inspection of different documents
5. Explain the pros & cons of digital printing.

Sr. No.	Details	Hrs
1.	Module - 1: Introduction to Digital Printing Understanding the digital printing, when to go for digital? Creating and processing the image: anatomy of digital image, pixel and bit depth, resolution, halftones, contours and dither. Digital image input, image editing using software. File format and image compression. Printer drivers and printing software. Comparing digital printing technologies with conventional. Storage devices. Limitations, Pros & cons of digital printing.	08
2.	Module - 2: Digital Print Technologies Introduction to digital presses. Digital Workflow: Introduction to workflow, comparison between conventional & digital workflow. Elements of workflow, job ticket, pre-flight checking, trapping, proofing, imposition, archiving, corrections, conversion, image replacement, APR, OPI servers, networking. Operation, construction, working principles and applications of different digital printing devices - Inkjet, Electrophotography, Ionography, Magnetography, Thermography, Electrography. High volume – Xeikon and Indigo E-print. Direct imaged conventional press. Latest development in digital printing.	12
3.	Module - 3: Digital Print Application	12

	(Digital proof & Inkjet proof, requirements of a proofing system, and latest trend in proofing technologies. Customize printing, print on demand, variable data printing, distribute & print, remote publishing, wide format printing, 3D, printing on microscopic items.	
4.	Module - 4: Introduction to Security Printing Introduction to security Printing, Optical document security, importance of security printing of bank note papers and boards, passports and government documents. UV-visible Printing, rainbow printing, micro lines, guilloches, numbering, Line-printing, stamp embossing, hot-foil-embossing, embossing / punching, fibers, hologram, solvent color, multi color UV-fluorescence stitching thread, holographic foil or lamination of a page, Digital Watermark.	06
5.	Module - 5: Inks and Brand Security Inks: Invisible inks, Specialist security printers inks; such as thermo chromic, UV fluorescing, water fugitive, solvent sensitive inks, combifuge, photo chromic, Fluorescent Inks, Watermarks, Testing, Deterrent measures Brand Security: First line inspection of documents using optical elements such as Holograms, optical variable graphics, diffraction structures, liquid crystal materials, optical security in laminates etc., invisible document security and Brand protection.	06
6.	Module - 6: Security Products Credit Cards, Smart cards, club cards, credit / debit cards, Plastic ID cards, Water mark cards, RFID technology, Bar codes, Printers used for bar codes, Cheques and their value documents, MICR/OCR/Cheque printing technology Counterfeit, fraud prevention, Cheque fraud prevention, method and arrangement for processing negotiable instruments. First line inspection of documents using optical elements such as Holograms, optical variable graphics, diffraction structures, liquid crystal materials, optical security in laminates etc. invisible document security and Brand protection.	08

Texts / References:

1. "Computer Stationery and MICR Cheque Production" Association for research and development in printing, Madras
2. "Hand Book of Printing Technology" EIRI Board of Consultants and Engineers, Engineers India Research Institute, New Delhi

3. “Bank Credit Card Business” Indian Institute of Bankers (1999), Macmillan, Delhi
4. “Introduction to security printing” Richard D. Warner and Richard M.Adams II, PIA GATF Press
5. “Handbook of Print Media”, H Kipphan, Springer – VetagBzlin Heidelberg, 2001
6. “The Hand Book of Digital Publishing (Volume I) PH” Michel L. Kleper, PTR Publishing
7. “Art and Print Production”, N.N Sarkar, Oxford Publication Harald Johnson, Mastering Digital Printing
8. “Inkjet printing tips and techniques” Andrew Darlow

Term Work:

Assignments covering the entire syllabus will be given to learners.

During tutorial sessions learners should study & understand different digital images, file compression techniques & their effects on image quality, digital proofing, security printing features in real-life examples and also various testing methods used in digital/security printing as per IS/ASTM or other standards

The distribution of term work marks is as follows:

Assignments:	10 Marks
Tutorial & Continuous Assessment:	10 Marks
Attendance (Theory + Tutorials):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Oral Examination:

To gauge the understanding of the subject, an oral examination will be conducted at the end of the term for 25 marks.

Course Code	Course Name	Credits
PPE604	Print Finishing and Converting (Elective –I)	4+1

Objectives:

1. Introducing the basic concepts of print finishing and binding.
2. Study Raw materials and consumable for finishing and binding operations
3. Study Machineries and equipments required in different finishing and binding operations

Outcomes: At the end of the course, learners should be able to;

1. Analyze the print finished product.
2. Examine the Product for the entire process involved in manufacturing and finishing.
3. Discuss the print finishing requirements for verity of different segment jobs.

Sr. No.	Details	Hrs
1.	Module - 1: Introduction to Binding & Finishing Overview of Binding & finishing and its scope, Physical Parts of Book, Binding classifications. Major operation performed in binding and finishing. Pre-forwarding, forwarding operations. Tools and equipments used for binding, Binder's marks. Organization and bindery layout. Latest developments in print finishing.	06
2.	Module - 2: Materials Paper- British standard and ISO paper sizes. Advantages of ISO paper sizes. Advantages and Limitations of different measurement, standards Units for number of paper ream, quire, gross. Types of boards. Multiples and subdivisions of a given size. Study of different types applications of board used in binding and finishing work Securing materials- Thread, wire, tape, cord - Selection based on application, gauge of wire, thread strength, and cost Covering materials- Binding cloth, Mull cloth, Rexene, leather, laminates, jackets. Adhesives –Adhesion theory for binding, types of adhesives and their properties and applications, various selection criteria for adhesives.	14
3.	Module - 3: Pre-forwarding and forwarding operation Pre-forwarding Operation -Jogging & knocking, removing Mis-registered sheets, counting, folding, bundling, gathering, collating, and sewing. Forwarding operations - Removing the swell, fixing end papers, fraying out the slips,	14

	gluing the back, trimming, rounding and backing, fixing head & tail bands, lining the back, edge decoration, cutting the boards, capping up, squaring the board, lacing in, covering, setting the joints, pasting down, pressing, jacketing	
4.	<p>Module - 4: Folding and Cutting Machines</p> <p>Knife folding, buckle folding, combination folding principle, construction and working</p> <p>Hand folding- method of various folding scheme, advantages and limitation</p> <p>Gathering machines-construction and working</p> <p>Machines: Single knife guillotine machine-major parts and their function, maintenance, safety devices, trim disposal system, application. Straw board cutter-construction and working. Three knife trimmer-major parts, function and its application.</p>	06
5.	<p>Module - 5:Securing methods and Binding Machines</p> <p>Study of construction and working principle of wire stitching machine, Thread securing method. Study of construction and working principle of book sewing machine. Case binding, case making machine- part and functions. Covering- Quarter, half, full, limp & library style binding. Boarding methods- Pasting down, split, draw in work, cut flush, extra square. Stationary Binding.</p> <p>Binding Machines</p> <p>Perfect Binding Machines-Major parts and their functions, maintenance, safety devices, application. Types- Burst binding, Notch binding, two shot wet on wet binding.</p>	08
6.	<p>Module - 6: Finishing and converting Operation</p> <p>Blocking, Numbering, Perforation, Creasing, Die cutting, round cornering, Edge decoration-gilding, Index cutting, Foil stamping, graining, varnishing, Embossing, eyeleting, ruling and numbering. Spot UV.</p>	04

Texts / References:

1. Lyman Ralph, "Binding and Finishing", GATF, USA
2. Tedesco T.J. (1999) "Binding Finishing Mailing" GATF , USA
3. Mendiratta, "Binding and Finishing",Printek Publication, New Delhi.
4. Geoff & Potter, "Binding and Finishing", Blue Print
5. Hugh Speirs, "Introduction to Printing and Finishing" PIRA, UK (1998)

6. A.G. Martin, "Finishing process in Print Industry", Hastings House, 1972.
7. Aurther W. Johnsori, "The Manual for Book Binding", Thames and Hudson ,1984.
8. U.S. Govt. Printing- Theory and Practice of Book Binding

Term Work:

Assignments covering the entire syllabus will be given to learners.

During tutorial sessions learners should study the various operations involved and material requirement in different procedures of print finishing and binding.

The distribution of term work marks is as follows:

Assignments:	10 Marks
Tutorials & Continuous Assessment:	10 Marks
Attendance (Theory + Tutorials):	05 Marks

Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining question will be randomly selected from all the modules.

Internal Assessment:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 70% of curriculum) or assignment on live problems or course project.

Oral Examination:

To gauge the understanding of the subject, an oral examination will be conducted at the end of the term for 25 marks.

Course Code	Course Name	Credits
PPL601	Package Design and Graphics (Laboratory)	2

Objectives:

1. Study the various product design principles and practically apply them.
2. Learn and understand the tools of graphic designing with the help of CAD softwares.
3. Study the method of designing various shapes and 3D objects as per specifications.

Outcomes: At the end of the course, learners should be able to;

1. Define basic design terminology,
2. Identify and apply the available design tools using various CAD softwares
3. Design and construct various package forms and their drawings.

Texts / References:

1. Marianne Rosner Klimchuk and Sandra A. Krasovec, "Packaging Design", John Wiley and Sons, Inc, 2006.
2. Geoff A. Giles, "Design and Technology of Packaging Decoration for the consumer market, SmithKline, Beecham, 2000
3. Alastair Campbell, The Graphics Designer Handbook, MacDonald & Co, 1983
4. David A. Lauer, Stephen Pentak, Design Basics, 6th Edition, Wadsworth, 2005
5. Poppy Evans and Mark A. Thomas, Exploring the Elements of Design, Delmar Publishers, 2004
6. Albert C. Book, C. Dennis Schick, "Fundamentals of Copy and Layout", Crain Books, 1984
7. Roger Walton, Keith Gillies, Lindsey Heppell, "Graphic Design", Ebury Press, 1987

Term Work:

Assignments covering the entire syllabus will be given to learners.

During practical sessions learners should understand and perform the practical as per the standard procedures. Minimum eight practicals should be conducted.

List of experiments:

1. Create 2D drawings in CAD software using Different basic shapes
2. Create Isometric views of different objects / packages
3. Create Graphics Design for Folding cartons
4. Create Graphics Design for Glass containers
5. Create Graphics Design for Plastic containers
6. Create Graphics Design for Bags & Pouches
7. Create Dieline layouts for folding cartons and their multiple upsDevelop a 3D package design and draw out the different views in 2D.
8. By manipulating 2D vector graphics & Fonts, create a graphic design
9. Design an artwork/graphics for a label.
10. Design an artwork/graphics for a carton
11. Design an artwork/graphics for a corrugated fibre board box

The distribution of term work marks is as follows:

Practical Journal & Continuous Assessment: 20 Marks

Attendance: 05 Marks

Practical Examination:

To gauge the understanding of the subject, a practical examination will be conducted at the end of the term for 50 marks.

Course Code	Course Name	Credits
PPI601	Industrial Visits	1.5

Objectives:

1. To give the practical exposure with better Industrial orientation
2. Experience the raw material processing and conversion in print and packaging
3. Study Machineries and processes evolved in different print and packaging industries

Outcomes:At the end of the course, learners should be able to

1. Analyze the print, packaged, converted & finished product.
2. Examine the Product for the entire process involved in manufacturing, converting and finishing.

Sr. No.	Type of Industries that can be visited
1.	Paper & paperboard manufacturing/ Paper & paperboard recycling plants
2.	Label stock manufacturing, and Printing
3.	Offset , Flexography, Gravure printing presses
4.	Screen Printing & Pad Printing Presses
5.	Digital Printing, Proofing and Large Format Presses
6.	Newspaper presses
7.	Commercial/ magazine printing presses
8.	Binging and finishing operation houses
9.	Plastics tube manufacturing & printing
10.	Plastics drum / Can manufacturing & printing
11.	Metal can/ tube manufacturing, printing and decoration
12.	Metal drum/tin box manufacturing, printing
13.	Carton box and Corrugated fiberboard box manufacturing
14.	Fiber board drum/ composite box package manufacturing
15.	Thermoform manufacturing and packages manufacturing
16.	Glass factory and Glass bottles manufacturing
17.	Blow molding, Injection molding and Rotational molding factories
18.	Cushion material manufacturing
19.	Multiwall / woven sack manufacturing
20.	VFFS / HFFS filling machine line for Solid and liquid filling operations

21.	Frozen food packaging facilities/ factory
22.	Pharmaceutical packaging
23.	Bakery product and Confectionary packaging
24.	Milk & milk product packaging unit
25.	Edible oil, Lubricant packaging
26.	Aluminum Collapsible Tube Manufacturing unit
27.	Blown film plant
28.	Mumbai Port Trust, Marine cargo Handling
29.	Aseptic filling, Vacuum and Gas flush Packaging machines
30.	Package Sterilization facilities

Atleast 8 Industrial Visits to be conducted. Care should be taken, not to visit similar industries more than once, since the concept is to help students practically see & learn as many manufacturing & converting facilities as possible.

Termwork:

During industrial visits, students are expected to study the process, machines, consumables & facilities utilized in the Industry. They have to then write a report for every Industrial visit based on their understanding.

Industrial Visit Reports: 20 Marks

Attendance: 05 Marks

Oral Examination:

1. Question will be compulsory asked, based on visited Industries only.
 2. Questions can be randomly asked, based on the industrial visit reports generated by the students.
- Oral examination will be conducted for 25 Marks.