AC- 29/06/2021
Item No.: 6.11

UNIVERSITY OF MUMBAI

Bachelor of Engineering

in

Printing and Packaging Technology

Third Year with Effect from AY 2021-22

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**Third Year B.E. in Printing and Packaging Technology**
2	Eligibility for Admission	**After Passing Second Year Engineering as per the Ordinance 0.6243**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6243**
5	No. of Years / Semesters	**8 semesters**
6	Level	~~P.G.~~ **/ U.G./** ~~Diploma / Certificate~~ (Strike out which is not applicable)
7	Pattern	~~Yearly~~ **/ Semester** (Strike out which is not applicable)
8	Status	~~**New**~~ **/ Revised** (Strike out which is not applicable)
9	To be implemented from Academic Year	**2021-2022**

Date

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

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 Science and Technology (in particular Engineering) of University of Mumbai has taken a lead in incorporating philosophy of outcome-based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are 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. Choice 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. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self-learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self-learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

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Incorporation and implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self-learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of 'C' scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self-learning to learner. Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals / HoD's / Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

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Program Structure for Third Year Engineering
Semester V & VI
UNIVERSITY OF MUMBAI
(With Effect from 2021-2022)

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract. / Tut.	Theory	Pract. / Tut.	Total
PPC501	Plastics Processing & Conversion Technologies	3	--	3	--	3
PPC502	Theory of Machines & Design	3	--	3	--	3
PPC503	Instrumentation & Process Control	4	--	4	--	4
PPC504	Ancillary Packaging Materials & Industrial Packaging	3	--	3	--	3
PPDO501X	Department Level Optional Course – 1	3	--	3	--	3
PPL501	Plastics Processing & Conversion Technologies Laboratory	--	3	--	1.5	1.5
PPL502	Theory of Machines & Design Laboratory	--	2	--	1	1
PPL503	Instrumentation & Process Control Laboratory	--	2	--	1	1
PPL504	Professional communication and ethics –II	--	2*+2	--	2	2
PPSBL501	Package Design & Graphics - I	--	3	--	1.5	1.5
PPPBL501	Mini Project – 2 A	--	4$	--	2	2
Total		**16**	**18**	**16**	**09**	**25**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac/ oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
PPC501	Plastics Processing & Conversion Technologies	20	20	20	80	3	--	--	100
PPC502	Theory of Machines & Design	20	20	20	80	3	--	--	100
PPC503	Instrumentation & Process Control	20	20	20	80	3	--	--	100
PPC504	Ancillary Packaging Materials & Industrial Packaging	20	20	20	80	3	--	--	100
PPDO501X	Department Level Optional Course – 1	20	20	20	80	3	--	--	100
PPL501	Plastics Processing & Conversion Technologies Laboratory	--	--	--	--	--	25	25	50
PPL502	Theory of Machines & Design Laboratory	--	--	--	--	--	25	25	50
PPL503	Instrumentation & Process Control Laboratory	--	--	--	--	--	25	--	25
PPL504	Professional communication and ethics –II	--	--	--	--	--	25	--	25
PPSBL501	Package Design & Graphics - I	--	--	--	--	--	25	25	50
PPPBL501	Mini Project – 2 A	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	--	**150**	**100**	**750**

$ indicates work-load of Learner (Not Faculty), for Mini Project
PBL – Project Based Learning
SBL – Skill Based Laboratory

Department Level Optional Course - 1:

1. Packaging Distribution & Dynamics
2. Inks & Coatings
3. Print Finishing & Converting
4. Additive Manufacturing (3D Printing)

Course Code	Course Name	Credits
PPC501	**Plastic Processing and Conversion Technologies**	**03**

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 analyse different tests for plastic product

Outcomes: Learner will be 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
6. Study different processing parameters required in industry

Module	Details	Hrs.
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 weight distribution, MFI, HDT	03
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	08
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 moulding defects and troubleshooting, weld line, shrinkage-warpage, burn marks venting, application of injection moulding in packaging – caps, closures, containers, drums etc.	08
4	**Blow Moulding & Rotational MouldingTechnology** 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 Rotational moulding principle, machine type, process, process parameters, Importance of resin charge, troubleshooting causes and remedies, Advantages and Disadvantages	08

5	**Thermoforming, Calendaring and Metallization** Vacuum thermoforming, pressure thermoforming, matched mould thermoforming, twin sheet thermoforming, thermoforming moulds. 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	06
6	**Compression and Transfer Moulding** Compression moulding -process, materials, advantages and disadvantages, Transfer moulding -process, materials, advantages and disadvantages, Applications of compression and transfer moulding in packaging.	03

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

Text/Reference Books:

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 Moulding 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

Links for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/112/107/112107221/

Course Code	Course Name	Credits
PPC502	**Theory of Machines and Design**	**03**

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: Learner will 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.
5. Design Machine element against static loading
6. Develop the ability to design the component under realistic conditions

Module	Details	Hrs.
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).	04
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.	06
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.	08
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 (FOS), Selection of FOS. Principal stresses and Theories of Failures.	06
5	**Design against static loading** Cotter joint, Knuckle Joint, Welded joint	06
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.	06

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

Text/Reference Books:

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

Links for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/112/105/112105125/
2. https://nptel.ac.in/courses/112/105/112105124/

Course Code	Course Name	Credits
PPC503	**Instrumentation and Process Control**	**04**

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: Learner will be able to…

1. Have a knowledge of measuring devices and signal conditioning; helping to select the correct transducer as per the requirement.
2. 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.
4. Understand applications of PLC's in industries and printing and packaging machines.
5. Explain PLC and SCADA systems and their use in process control.
6. Understand and formulate various applications like DAS and data logger

Module	Details	Hrs.
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	10
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, mono stable mode and its applications as frequency divider and missing pulse detector, bi-stable multi-vibrator.	08
3	**Control System Dynamics** Introduction to control engineering, open loop and closed loop system, classification of control systems, LTI system, Concept of stability and causality, Block diagram of basic control system, Role of a control engineer, Hydraulic system, pneumatic system, Transfer function, Test input signals Mathematical preliminaries, concept of Poles and Zeroes	06
	Process control Block diagram of Process control, Process characteristics, Control	

4	system parameters, role of a controller, Controller modes: Discontinuous: Two position, multi-position, floating, Continuous and Composite: Proportional, Integral, Derivative (description only for all modes), block diagram of final control operation	08
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.	08
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

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

Text/Reference Books:

1. C. S. Rangan, G. R. Sarma, “Instrumentation devices and systems” TMH.
2. A. K. Sawhney, “Electronic and Electrical measurements and instrumentation”, Dhanpat Rai 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

Links for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/107/106/107106081/
2. https://nptel.ac.in/courses/108/105/108105064/
3. https://onlinecourses.nptel.ac.in/noc21_ch26/preview

Course Code	Course Name	Credits
PPC504	**Ancillary Packaging Materials & Industrial Packaging**	**03**

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: Learner will 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. Analyse 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.
5. Analyse various types of internal fitments for product protection and retainment.
6. Explain the characteristics and applications of various wooden package forms.

Module	Details	Hrs.
1	**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, Shear; Adhesive and cohesive strength – Rheological Properties – Viscosity / Tack / wetting / yield Climatic / environmental influences.	06
2	**Labels & Closures:** Labels - objective, Contents of a Label – Classification – self-adhesive, wet glue, in-mould, inserts, tags, shrink and stretch sleeve, heat sealable, thermal transfer, properties and applications. 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 Functions of caps and closures, Types – Once only – Membranes, Crowns, Re-usable- Roll on – ROPP&RSNP, Lug caps, Plug type, Snap on/slip lid, lever and ring – single/double. Design features. Wads– Materials, properties, selection. Criteria for Special closures – Child resistant, New generation dispensing closures; Materials- plastics – thermoplastics and thermosets, Metals – Manufacturing process for closures.	06

3	**Coatings and coding:** Lacquers for Metal plate / Cans, Flexible substrates / Laminates- types and functions; Over print varnishes and coatings – spot varnish and overprint – purpose; Decorative coatings; Functional coatings – heat seal, barrier and protective – coating equipment. Bar Coding- Significance, structure, parts of the code.	04
4	**Industrial Products - 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.	04
5	**Wood - Packaging Material & Pack Forms** 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. Wooden Boxes & Crates – Difference & Types, Introduction to Wooden Pallets & Box Pallets and their various components; Wooden Dunnages	06
6	**Corrosion Protection, Cushioning & Reinforcement** **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. **Strapping**- functions; Materials- Metal-steel, Plastics- HDPE / PP / PET / Nylon; Types of loads –rigid, compressible, stretching, shrinkable; Properties and Criteria for Selection of strapping Materials; Tensioning; Crimping and Sealing of straps; **Taping** – functions- Kraft paper tapes- properties and types- white and coloured - BOPP/PVC self-adhesive tapes - properties and manufacturing; Tape dispensing – Manual, hand-held and automatic. **Other Bulk Packages** for Industrial Products: Intermediate Bulk Containers (IBC) – Rigid & Flexible, Paper Sacks, Jerry Cans, Fibre Drums and others.	10

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:
Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

Text/Reference Books:

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
5. Friedman W.F. and J.J. Kipness, Industrial Products packaging, John Wiley & Sons
6. Klimchuck, Packaging Design & Engineering, Wiley
7. F. A. Paine, Fundamentals of Packaging, Blackie A& P
8. Friedman W.F. and J.J. Kipness, Distribution Packaging, Robert E. Krieger Publishing Co.
9. Wooden Containers/crates, Corrugated board/boxes, marking: Specification and Testing as per Indian Standards

Course Code	Course Name	Credits
PPDO5011	**Packaging Distribution Dynamics (Department Level Optional Course – 1)**	**03**

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: Learner will be 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.
5.Analyse ways to reduce the effect of vibration, shock and handling of product during distribution.
6.Explain the method for developing the cushion curve and damage boundary curve.

Module	Details	Hrs.
1.	**Module - 1: Introduction:** Overview of Packaging distribution - Modes of distributions – Hazards in Distribution – Vibration, Impact, Drop, Compression, Shock	02
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	09
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	09
4.	**Module - 4: Mechanical Shock, shock in distribution and Cushion design** Introduction - Free Falling Package - Mechanical Shock Theory - Shock Duration - Shock Amplification & Critical element –Horizontal Impacts - Mechanical Shock in Distribution System - Damage Boundary Curve (DBC) –	12

	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 Testing Protocols - Reference to ASTM / IS standards – Distribution tests in detail – Drop, Compression, Impact, Vibration, Shock, Rolling, Salt Spray, Rain and other tests.	04

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

Text /Reference Books:

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

Course Code	Course Name	Credits
PPDO5012	**Inks and Coatings (Department Level Optional Course – I)**	**03**

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: Learner will be 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 analyse the properties of inks and coatings.
4. Suggest ink for a given process
5. Toubleshoot problems related to ink synthesis
6. Suggest suitable varnish for a given application.

Module	Details	Hrs
1.	**Introduction** Introduction & History of inks - Applications of ink - Ingredients and their functions- Pigments and dyes in printing Inks - organic and inorganic – pigments for different colours and effects - their sources and processing.	03
2.	**Raw Materials:** 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.	08
3.	**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 Ink s as per different drying process- cold-set, heat-set, quickset, UV curable – the formulation and working. Inks for different substrates – absorbent, non-absorbent- coated paper, newsprint, tinplate, flexible packaging, Processing of substrate for ink adhesion.	10
4.	**Ink Manufacturing Process** Making of varnish – Paste ink and liquid ink - Mills for mixing the components- Roll 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.	06

5.	**Inks - Properties and Testing** Optical properties- colour, transparency, tint, gloss. Flow properties- rheology- Newtonian/non-newtonian, viscosity, tack. Resistance properties- light, acid and alkali, heat, abrasion.	04
6.	**Module - 4: Other coatings in printing and packaging** 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.	05

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

Text/Reference Books:

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

Links for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/112/105/112105053/
2. https://nptel.ac.in/courses/116/102/116102052/

Course Code	Course Name	Credits
PPDO5013	**Print Finishing and Converting (Department Level Optional Course – I)**	**03**

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 equipment required in different finishing and binding operations.

Outcomes: Learner will be be able to…

1. Analyse 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.
4. Analyse the layout and imposition of the job
5. Identify and rectify post finishing process problems
6. Discuss the various post finishing terminology

Module	Details	Hrs.
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.	04
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.	09
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, 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.	08

4.	**Folding and Cutting Machines** Knife folding, buckle folding, combination folding principle, construction and working Hand folding- method of various folding scheme, advantages and limitation Gathering machines-construction and working 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.	05
5.	**Securing methods and Binding Machines** 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. **Binding Machines** Perfect Binding Machines-Major parts and their functions, maintenance, safety devices, application. Types- Burst binding, Notch binding, two shot wet on wet binding.	06
6.	**Finishing and converting Operation** Blocking, Numbering, Perforation, Creasing, Die-cutting, round cornering, Edge decoration-gilding, Index cutting, Foil stamping, graining, varnishing, Embossing, eyeleting, ruling and numbering. Spot UV.	04

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

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

Course Code	Course Name	Credits
PPDO5014	**Additive Manufacturing (3D Printing) (Department Level Optional Course – I)**	**03**

Objectives:

1. Gain knowledge and skills related to 3D printing technologies.
2. Understand the fundamentals of various Additive Manufacturing Technologies for application to various industrial needs.
3. Learn the selection of material, equipment and development of a product for Industry 4.0 environment.
4. Understand the method of manufacturing of liquid based, powder based and solid based techniques.
5. Understand the manufacturing procedure of a prototype using fused deposition modeling (FDM) technique.

Outcomes: Learner will be be able to…

1. Develop a CAD models for 3D printing
2. Import and Export CAD data and generate .stl file
3. Select a specific material for the given application
4. Understand the fundamentals of Additive Manufacturing Technologies for engineering applications.
5. Understand the methodology to manufacture the products using additive and subtractive theory
6. Produce a product using 3D Printing or Additive Manufacturing (AM) with comparative analysis of various designs

Module	Details	Hrs
1	**Introduction** Historical development, Prototyping fundamentals, Advantages AMT, Commonly used terms, Process, Classifications, Additive v/s Conventional Manufacturing processes, Applications to various fields	04
2	**CAD for Additive Manufacturing** Introduction, understanding steps to prepare CAD file, CAD Data formats, Data translation, Data loss, STL format, G-code generation **Additive Manufacturing Techniques** Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology, Process, Process parameter, Process Selection for various applications	08
3	**Materials** Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties, estimating cost and amount of raw material required for various applications	08
4	**Additive Manufacturing Equipment and its components** Components – Motor, drive assembly, heating system, nozzle types and additional components Types of Equipment - Design and process parameters, Factors affecting bonding mechanism, Common defects and troubleshooting, recent developments	08

5	**Additive Manufacturing Applications**: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools – Motor type, Case studies and comparative analysis of articles produced	04
6	**Post Processing: Requirement and Techniques** Support Removal, Sanding, Acetone treatment, polishing, Product Quality - Inspection and testing, Defects and their causes	04

Theory Examinations:

a) End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

b) Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

Text/Reference Books:

1. Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies:Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, RapidTooling, Rapid Manufacturing", Hanser Publisher, 2011.
3. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.
4. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.
5. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series inMaterial Science, 2013.
6. L. Lu, J. Fuh and Y.S. Wong, "Laser-Induced Materials and Processes for Rapid Prototyping", Kulwer Academic Press, 2001.
7. Zhiqiang Fan and Frank Liou, "Numerical Modelling of the Additive Manufacturing (AM)Processes of Titanium Alloy", InTech, 2012

Links for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/110/106/110106146/

Course Code	Course Name	Credits
PPL501	**Plastic Processing and Conversion Technologies Laboratory**	**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 analyse different tests for plastic product

Outcomes: Learner will be 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.
6. Study different processing parameters required in industry.

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Eight)

Module	Details	Laboratory Sessions
1	To study injection moulding machine setup	3 Hrs
2	To study blow moulding machine setup	3 Hrs
3	To manufacture injection moulded article	3 Hrs
4	To manufacture blow moulded article	3 Hrs
5	To study extrusion and blown film machine setup	3 Hrs
6	To make extrusion profile	3 Hrs
7	To manufacture blown film	3 Hrs
8	To Study of Melt Flow Index tester	3 Hrs
9	To Study of environmental stress crack resistance of plastic items	3 Hrs

b) Mini-Project: A group of 4-6 students should be given a design assignment. This should be considered as mini project in PPCTL. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Laboratory Work	10 marks
3.	Mini project	10 marks

End Semester Oral Examination (for 25 marks): Oral assessment to be conducted by internal and external examiners.

Course Code	Course Name	Credits
PPL502	**Theory of Machines and Design Laboratory**	**01**

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: Learner will be 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.
5. Design Machine element against static loading
6. Develop the ability to design the component under realistic conditions

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Eight)

Module	Details	Laboratory Sessions
1.	Study of stress strain diagram and modes of failure	2 Hrs
2	Study of motion characteristics and mechanisms	2 Hrs
3	Construction of velocity and acceleration diagram using instantaneous centre method	2 Hrs
4	Construction of CAM profiles	2 Hrs
5	Design and drawing sheets of Cotter joint	2 Hrs
6	Design and drawing sheets of Knuckle joint	2 Hrs
7	Design and drawing sheets of Flange coupling	2 Hrs
8	Study of welded joints	2 Hrs
9	Study of Torsional Vibrations	2 Hrs
10	Study of Gyroscope	2 Hrs

b) Mini-Project: A group of 4-6 students should be given a design assignment. This should be considered as mini project in TOMDL. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (theory & Practical)	05 marks
2.	Laboratory Work	10 marks
3.	Mini project	10 marks

End Semester Oral Examination (for 25 marks): Oral assessment to be conducted by internal and external examiners.

Course Code	Course Name	Credits
PPL503	**Instrumentation and Process Control Laboratory**	**01**

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: Learner will be 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.
4. Understand applications of PLC's in industries and printing and packaging machines.
5. Explain PLC and SCADA systems and their use in process control.
6. To Understand and formulate various applications like DAS and data logger

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Eight)

Module	Details	Laboratory Sessions
1	Study of Displacement measurement using LVDT	2 Hrs
2	Study of Flow measurement by using Rotameter	2 Hrs
3	Study of LDR	2 Hrs
4	Design of Passive Low Pass Filter and High Pass Filter	2 Hrs
5	Design of Active Low Pass Filter and Active High Pass Filter	2 Hrs
6	Design of PI circuit using OPAMP	2 Hrs
7	Design of PD circuit using OPAMP	2 Hrs
8	Introduction to PLC and Ladder Logic Programming on simulator	2 Hrs
9	Implementation of Basic gates using PLC ladder logic	2 Hrs

b) Mini-Project: A group of 4-6 students should be given a design assignment. This should be considered as mini project in IPCL. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory & Practical)	05 marks
2.	Laboratory Work	10 marks
3.	Mini project	10 marks

Link for online NPTEL/SWAYAM courses:

1. https://nptel.ac.in/courses/107/106/107106081/
2. https://nptel.ac.in/courses/108/105/108105064/
3. https://onlinecourses.nptel.ac.in/noc21_ch26/preview

Course Code	Course Name	Credits
PPL504	**Professional Communication and Ethics –II**	**02**

Objectives:

Learners should be able to:

1. Discern and develop an effective style of writing important technical/business documents.
2. Investigate possible resources and plan a successful job campaign.
3. Understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4. Develop creative and impactful presentation skills.
5. Analyse personal traits, interests, values, aptitudes and skills.
6. Understand the importance of integrity and develop a personal code of ethics.

Outcomes: Learner will be able to…

1. Plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles.
2. Strategize their personal and professional skills to build a professional image and meet the demands of the industry.
3. Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.
4. Deliver persuasive and professional presentations.
5. Develop creative thinking and interpersonal skills required for effective professional communication.
6. Apply codes of ethical conduct, personal integrity and norms of organizational behaviour.

MODULE	DETAILS	HRS
MODULE 1 - ADVANCED TECHNICAL WRITING :PROJECT/PROBLEM BASED LEARNING (PBL)		
1.1. Purpose and Classification of Reports	**Classification on the basis of:** ● Subject Matter (Technology, Accounting, Finance, Marketing, etc.) ● Time Interval (Periodic, One-time, Special) ● Function (Informational, Analytical, etc.) ● Physical Factors (Memorandum, Letter, Short & Long)	**06**
1.2. Parts of a Long Formal Report	● Prefatory Parts (Front Matter) ● Report Proper (Main Body) ● Appended Parts (Back Matter)	
1.3. Language and Style of Reports	● Tense, Person & Voice of Reports ● Numbering Style of Chapters, Sections, Figures, Tables and Equations ● Referencing Styles in APA & MLA Format ● Proofreading through Plagiarism Checkers	

1.4. Definition, Purpose & Types of Proposals	• Solicited (in conformance with RFP) & Unsolicited Proposals • Types (Short and Long proposals)	
1.5. Parts of a Proposal	• Elements • Scope and Limitations • Conclusion	
1.6. Technical Paper Writing	• Parts of a Technical Paper (Abstract, Introduction, Research Methods, Findings and Analysis, Discussion, Limitations, Future Scope and References) • Language and Formatting • Referencing in IEEE Format	
MODULE 2 - EMPLOYMENT SKILLS		
2.1. Cover Letter & Resume	• Parts and Content of a Cover Letter • Difference between Bio-data, Resume & CV • Essential Parts of a Resume • Types of Resume (Chronological, Functional & Combination)	**06**
2.2 Statement of Purpose	• Importance of SOP • Tips for Writing an Effective SOP	
2.3 Verbal Aptitude Test	• Modelled on CAT, GRE, GMAT exams	
2.4. Group Discussions	• Purpose of a GD • Parameters of Evaluating a GD • Types of GDs (Normal, Case-based & Role Plays) • GD Etiquettes	
2.5. Personal Interviews	• Planning and Preparation • Types of Questions • Types of Interviews (Structured, Stress, Behavioural, Problem Solving & Case-based) • Modes of Interviews: Face-to-face (One-to one and Panel) Telephonic, Virtual	
MODULE 3 - BUSINESS MEETINGS		
3.1. Conducting Business Meetings	• Types of Meetings • Roles and Responsibilities of Chairperson, Secretary and Members • Meeting Etiquette	**02**
3.2. Documentation	• Notice • Agenda • Minutes	

MODULE 4 -TECHNICAL/ BUSINESS PRESENTATIONS		
4.1. Effective Presentation Strategies	• Defining Purpose • Analysing Audience, Location and Event • Gathering, Selecting &Arranging Material • Structuring a Presentation • Making Effective Slides • Types of Presentations Aids • Closing a Presentation • Platform Skills	**02**
4.2 Group Presentations	• Sharing Responsibility in a Team • Building the contents and visuals together • Transition Phases	
MODULE 5 - INTERPERSONAL SKILLS		
5.1. Interpersonal Skills	• Emotional Intelligence • Leadership & Motivation • Conflict Management & Negotiation • Time Management • Assertiveness • Decision Making	**08**
5.2 Start-up Skills	• Financial Literacy • Risk Assessment • Data Analysis (e.g. Consumer Behaviour, Market Trends, etc.)	
MODULE 6 - CORPORATE ETHICS		
6.1. Intellectual Property Rights	• Copyrights • Trademarks • Patents • Industrial Designs • Geographical Indications • Integrated Circuits • Trade Secrets (Undisclosed Information)	**02**
6.2. Case Studies	• Cases related to Business/ Corporate Ethics	

LIST OF ASSIGNMENTS FOR TERMWORK
(In the form of Short Notes, Questionnaire/ MCQ Test, Role Play, Case Study, Quiz, etc.)

1. Cover Letter and Resume
2. Short Proposal
3. Meeting Documentation
4. Writing a Technical Paper/ Analysing a Published Technical Paper
5. Writing a SOP
7. IPR
8. Interpersonal Skills

9. Aptitude test (Verbal Ability)

Note:

1. The Main Body of the project/book report should contain minimum 25 pages (excluding Front and Back matter).
2. The group size for the final report presentation should not be less than 5 students or exceed 7 students.
3. There will be an end–semester presentation based on the book report.

GUIDELINES FOR INTERNAL ASSESSMENT

Term Work	25 Marks
Assignments	10 Marks
Attendance	05 Marks
Presentation slides	05 Marks
Book Report (hard copy)	05 Marks
Internal Oral -	25 Marks

Oral Examination will be based on a GD & the Project/Book Report presentation.

Group Discussion	10 Marks
Project presentation (Individual Presentation)	10 Marks
Group Dynamics	05 Marks

SUGGESTED READING

1. Arms, V. M. (2005). Humanities for the engineering curriculum: With selected chapters from Olsen/Huckin: Technical writing and professional communication, second edition. Boston, MA: McGraw-Hill.
2. Bovée, C. L., &Thill, J. V. (2021). Business communication today. Upper Saddle River, NJ: Pearson.
3. Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning.
4. Masters, L. A., Wallace, H. R., & Harwood, L. (2011).Personal development for life and work. Mason: South-Western Cengage Learning.
5. Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). Organizational Behaviour. Harlow, England: Pearson.
6. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and Practice. Oxford University Press
7. Archana Ram (2018) Place Mentor, Tests of Aptitude For Placement Readiness. Oxford University Press
8. Sanjay Kumar &PushpLata (2018). Communication Skills a workbook, New Delhi: Oxford University Press.

Virtual Labs

https://ve-iitg.vlabs.ac.in/- Virtual English and Communication Virtual Lab, IIT Guwahati

http://vlabs.iitb.ac.in/vlabs-dev/labs/communication/- Professional Communication Virtual Lab, IIT Bombay

Course Code	Course Name	Credits
PPSBL501	**Skill Based Lab: Package Design and Graphics – I**	**1.5**

Objectives:

1. Study the various product design principles and practically apply them.
2. Learn and understand the tools of SolidWorks Software.
3. Study the method of designing various shapes and 3D objects as per specifications

Outcomes: Learner will be be able to…

1. Define basic design terminology,
2. Visualize and prepare detail drawing of a given object
3. Create a design based on specific requirement.
4. Design Plastic/Glass/Metal Containers.
5. Analyse various package designs.
6. Design & draw detail and assembly of different packages

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Eight) (Software to be used: SolidWorks)

Module	Details	Laboratory Sessions
1	Create 2D drawings using different basic entities	3 Hrs.
2	Create basic 3D Models in SolidWorks	3 Hrs.
3	Create 3D Models from 2D Drawings	3 Hrs.
4	Create different parts and learn assembly mating options	3 Hrs.
5	Create an assembly from a given product 2D Drawing	3 Hrs.
6	Create a detailed 2D drawing of an assembly	3 Hrs.
7	Create a package from 2D drawing given	3 Hrs.
8	Create a 3D Package Model and draw detailed 2D drawing.	3 Hrs.
9	Create primary package and orient inside a secondary package	3 Hrs.

b) Mini-Project: A group of 4-6 students should be given a design assignment. This should be considered as mini project in IPCL. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

1.	Attendance	05 marks
2.	Laboratory Work	10 marks
3.	Mini project	10 marks

End Semester Practical Examination (for 25 marks): Under single head of examination, including Practical (15 marks assessment) followed by oral (10 marks assessment) to be conducted by internal and external examiners

Course Code	Course Name	Credits
PPPBL501	**Mini Project 2A**	**02**

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcome: Learner will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work

on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below:
    - Marks awarded by guide/supervisor based on logbook : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
    - Identification of need/problem
    - Proposed final solution
    - Procurement of components/systems
    - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
    - First shall be for finalisation of problem and proposed solution
    - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria:

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact

9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points:

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication