



No. AAMS(UG)/ 83 of 2021-22

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular No. UG/95 of 2018-19, dated 2nd August, 2018 relating to the revised syllabus as per (CBCS) for the T.E. (Printing & Packaging Technology Engineering) (Sem. V & VI).

They are hereby informed that the recommendations made by the Board of Studies in Mechanical Engineering at its meeting held on 15th May, 2021 and subsequently passed by the Board of Deans at its meeting held on 11th June, 2021 vide item No. 6.11 (R) have been accepted by the Academic Council at its meeting held on 29th June, 2021 vide item No. 6.11 (R) and that in accordance therewith, the revised syllabus (Rev - 2019 'C' Scheme) for the B.E. in (Printing & Packaging Technology) (T.E. - Sem. V and VI.) has been brought into force with effect from the academic year 2021-22 accordingly. (The same is available on the University's website www.mu.ac.in).

MUMBAI - 400 032
30th September, 2021


(Dr. B.N. Gaikwad)
I/c REGISTRAR

To

The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.11 (R) 29/06/2021

No. AAMS(UG)/ 83-A of 2021-22

MUMBAI-400 032

30th September, 2021

Copy forwarded with Compliments for information to:-

- 1) The Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies in Mechanical Engineering,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Co-ordinator, University Computerization Centre,


(Dr. B.N. Gaikwad)
I/c REGISTRAR

Copy to :-

- 1. The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
- 2. The Deputy Registrar, College Affiliations & Development Department (CAD),**
- 3. The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
- 4. The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
- 5. The Deputy Registrar, Executive Authorities Section (EA),**
- 6. The Deputy Registrar, PRO, Fort, (Publication Section),**
- 7. The Deputy Registrar, (Special Cell),**
- 8. The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
- 9. The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

- 1. P.A to Hon'ble Vice-Chancellor,**
- 2. P.A Pro-Vice-Chancellor,**
- 3. P.A to Registrar,**
- 4. All Deans of all Faculties,**
- 5. P.A to Finance & Account Officers, (F.& A.O),**
- 6. P.A to Director, Board of Examinations and Evaluation,**
- 7. P.A to Director, Innovation, Incubation and Linkages,**
- 8. P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
- 9. The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
- 10. The Director of Board of Student Development,**
- 11. The Director, Department of Students Welfare (DSD),**
- 12. All Deputy Registrar, Examination House,**
- 13. The Deputy Registrars, Finance & Accounts Section,**
- 14. The Assistant Registrar, Administrative sub-Campus Thane,**
- 15. The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
- 16. The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
- 17. The Assistant Registrar, Constituent Colleges Unit,**
- 18. BUCTU,**
- 19. The Receptionist,**
- 20. The Telephone Operator,**
- 21. The Secretary MUASA**

for information.

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.

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

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.

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

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

Semester V

Semester V									
Course Code	Course Name	Teaching Scheme (Contact Hours)				Credits Assigned			
		Theory		Pract. / Tut.		Theory	Pract. / Tut.		Total
PPC501	Plastics Processing & ConversionTechnologies	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 ^s		--	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 & ConversionTechnologies	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	50
PPSBL501	Package Design & Graphics - I	--	--	--	--	--	25	25	50
PPPBL501	Mini Project – 2 A	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	125	775

\$ 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)

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract. / Tut.		Theory	Pract. / Tut.	Total		
PPC601	Packaging Machineries & Systems	3	--		3	--	3		
PPC602	Food & Pharmaceutical Packaging	3	--		3	--	3		
PPC603	Gravure Printing	3	--		3	--	3		
PPC604	Colour Management	3	--		3	--	3		
PPDO601X	Department Level Optional Course – 2	3	--		3	--	3		
PPL601	Food Packaging Laboratory	--	2		--	1	1		
PPL602	Colour Management Laboratory	--	2		--	1	1		
PPT601	Industrial Visits	--	3			1.5	1.5		
PPSBL601	Package Design & Graphics - II	--	3		--	1.5	1.5		
PPPBL601	Mini Project – 2 B	--	4 ^s		--	2	2		
Total		15	14		15	07	22		
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
PPC601	Packaging Machineries & Systems	20	20	20	80	3	--	--	100
PPC602	Food & Pharmaceutical Packaging	20	20	20	80	3	--	--	100
PPC603	Gravure Printing	20	20	20	80	3	--	--	100
PPC604	Colour Management	20	20	20	80	3	--	--	100
PPDO601X	Department Level Optional Course – 2	20	20	20	80	3	--	--	100
PPL601	Food Packaging Laboratory	--	--	--	--	--	25	25	50
PPL602	Colour Management Laboratory	--	--	--	--	--	25	25	50
PPT601	Industrial Visits	--	--	--	--	--	25	25	50
PPSBL601	Package Design & Graphics - II	--	--	--	--	--	25	25	50
PPPBL601	Mini Project – 2 B	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	125	125	750

\$ indicates workload of Learner (Not Faculty), for Mini Project

SBL – Skill Based Laboratory

PBL – Project Based Learning

Department Level Optional Course – 2:

1. Laws, Regulations& Sustainability
2. Digital & Security Printing
3. Finance & Marketing Management
4. Project Management & Entrepreneurship

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 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 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 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, BlackieA& 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 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 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. Troubleshoot 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 Inks 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 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.
	Introduction to Binding & Finishing	
1.	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
	Materials	
2.	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
	Pre-forwarding and forwarding operation	
3.	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, eyeletting, 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. Aurthier W. Johnstori, "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 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	PostProcessing: 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. LanGibson,David
W.RosenandBrentStucker,“AdditiveManufacturingTechnologies:Rapid PrototypingtoDirectDigitalManufacturing”,Springer,2010.
2. AndreasGebhardt,“UnderstandingAdditiveManufacturing:RapidPrototyping,RapidTooling,RapidManufacturing”,HanserPublisher,2011.
3. KhannaEditorial,“3DPrintingandDesign”,KhannaPublishingHouse,Delhi.
4. CKChua,KahFaiLeong,“3DPrintingandRapidPrototyping-PrinciplesandApplications”,WorldScientific,2017.
5. J.D.MajumdarandI.Manna,“Laser-AssistedFabricationofMaterials”,SpringerSeriesinMaterialScience,2013.
6. L.Lu,J.FuandY.S.Wong,“Laser-InducedMaterialsandProcessesforRapidPrototyping”,KulwerAcademicPress,2001.
7. Zhiqiang
FanandFrankLiou,“NumericalModellingoftheAdditiveManufacturing(AM)Processes ofTitaniumAlloy”,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 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 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 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 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

Course Code	Course / Subject Name	Credits
PPC601	Packaging Machineries and Systems	03

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 equipment used apart from packaging machineries.
5. Understand the importance of testing, online & offline equipment's used industries

Outcomes:Learner will 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.
6. Suggest Methods and Machine used for case packing.

Module	Details	Hrs
1.	Introduction and Manufacturing Metals Cans & Drums Introduction, Machineries used for conversion, online packaging, system packaging, Ancillaries Machines and equipment, Online and Offline inspection equipment. Metal Cans-Three piece, DRD & DWI can manufacturing machine and its various sections-Coating Equipments. Metal drum-Types-Different machines used in manufacturing. Fibre& Composite drum-Drum types-Machine used in manufacturing.	06
2.	Machineries for Manufacturing of Sacks, Cartoning, Flexible Laminates & Corrugated Box Sacks-Types-Machine used in manufacturing of bag-Synthetic sack-Types-Manufacturing machine. Folding Cartons -Cartoning-Types of Cartons-Machine used in cartoning. FlexibleLaminates-Types of lamination techniques-Different components of the Lamination Machine. Corrugated Box-Board construction-Machine used in manufacturing.	05
3.	Types of fillers, VFFS, HFFS, Multiwall Sack filling Filling machineries by count-Filling machineries-Liquid-Carbonated, Still-Design consideration and selection of fillers. Types of Solid fillers-Cup, Weight, Auger, Multi-head weigher Vertical Form fill seal (VFFS), Horizontal Form fill seal (HFFS) Machines-Machine overview, Types-Different section on the machine-New technologies available. Multiwall bag-Types of filling technique.	05
4.	Aseptic System, Retort System Packaging of Drugs & Pharmaceuticals Retort System-Overview-Process description, Canning Operation-Type of Retort system& machines/equipments.	06

	Aseptic System-Concept- Types of Aseptic Packs-Aseptic Packaging Machineries based on sterilization method.	
5.	Blister & Strip, Case packing Machines, Conveying, Buffering & Accumulating Systems and Blister Packaging-Blister Design Parameters-Types of Blisters, Sections on Blister packaging machines. Strip Packaging-Strip packaging process-Materials used-Strip Packing Machinery. Case packing or Case loading-Case loading Methods-Machine used in case packing. Introduction-Integration of Conveyor-Design and Installation of Conveyor systems-Conveying systems-Power transmission components-Transfer between conveyors-Interconnecting machinery Online Inspection machine used on packaging lines. Offline Testing machine -Packaging Materials, Shipping Packages	08
6.	Wrapping Machines, Ancillary Machines & Equipments Wrapping Machine-Style of wrapping-Machines used Shrink Wrapping Machine-Machine types and its parameters Stretch Wrapping Machine-Pre-stretching film-Types of Wrapper models. Label Applicator Machines-Capping Machines-Sealing machines-Coding & Marking machines-Stencilling-Taping machine-Strapping machine-Slitting machine.	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.

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

Course Code	Course Name	Credits
PPC602	Food and Pharmaceutical Packaging	03

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: Learner will 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.
5. Determine the shelf life of given food and develop the technique to improve the same.
6. Develop a pharmaceutical package to increase the stability of the medicine during its storage.

Module	Details	Hrs
1.	Introduction to Food Packaging An overview & Introduction to the science, technology, socio economic needs and packaging functions. Types of food – Perishable / Semi-perishable, acidity of food product. Gas and Vapour permeation - Basic concepts and theory of permeation and units. Barrier materials used in Food Packaging - Food-package compatibility and migration issues.	07
2.	Shelf Life studies and sensory evaluation 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). Sensory evaluation – Concept, Human sensory perception, Errors in sensory evaluation. Sensory Evaluation Tests – Discriminative, Descriptive & Affective/Consumer Tests.	09
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.	04

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.	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.	06
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 – labelling requirements	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.

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

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/126/105/126105015/>

Course Code	Course Name	Credits
PPC603	Gravure Printing	03

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: Learner will 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. Summarize the various operations performed while printing on Gravure machine
4. Discuss various inks and substrates used for gravure process with quality control measures
5. Describe various web handling and registration control for gravure printing
6. Calculate the different anatomy of gravure cylinder

Module	Details	Hrs.
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	Gravure Cylinder 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	04
3	Gravure Cylinder engraving 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	05
4	Gravure Press and its components A general printing unit, Typical press configurations, Gravure ink fountain-ink fountain and ink transfer, Ink temperature, Ink viscosity Gravure Ink dryers- Need, Solvent removal, drying of water based inks, dryer functioning, Environmental considerations The gravure doctor blade-Setup, Pressure, cylinder considerations, doctor blade Material, Variations in doctor blade usage	09

	Gravure Impression roller- Functions, Roller design and configuration, Deflection, Roller covering, Coating and Hardness, Impression roller and print quality, Effect on web, Electrostatic Assist	
5	Web Handling 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	7
6	Gravure Ink and Substrates 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 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	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 / 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 Springer-Verlag Berlin Heidelberg
5. Ronald E. Todd, (1994), Printing Inks: Formulation Principles, Manufacture and Quality Control, Pira International

Course Code	Course Name	Credits
PPC604	Colour Management	03

Objectives:

1. Introducing concept of Colour management and it's importance in printing industry.
2. Understand profile and its role in Colour management
3. Study the importance of media or substrate in colour perception
4. Study Standardization of colour and its reproduction
5. Apply Colour corrections and Image adjustments

Outcomes: Upon successful completion of this course, the learner will be able to

1. Summarize importance of Colour management.
2. Select test charts for various devices to create profile based on the need.
3. Apply various rendering intents on images using image editing software.
4. Measure the quality of profile generated by software.
5. Summarize various colour management workflows.
6. Understand the current trends in Colour management industry.

Module	Details	Hrs
1.	Need for Colour Management Need for colour management, device characteristics, closed and open loop colour control, Steps in CMS - calibration, characterization, conversion; International colour consortium –standards, profiles, profile types, profile structure, Colour measurement, viewing conditions.	06
2.	Profiles Test targets, Devices, Calibration and characterization of scanner-Different test charts available for scanner, digital camera-DC Profile maker-Profile settings, monitor- 4Cs, Monitor viewing settings, Press and Proofer- IT test charts, Issues, Profiling software- Settings	07
3.	Conversion CMM-Colour Management Module in various display devices, Gamut boundaries, Different types of Rendering Intent- Absolute, Relative, Colorimetric, Saturation- Gamut mapping – influencing factors, algorithms- Parametric Gamut mapping algorithm, Successive mapping algorithm.	07
4.	Colour Management Workflow Colour Management workflows – RGB workflow, CMYK workflow, embedded workflow, assumed workflow, Internet workflow, Soft proofing, Hardcopy proofing, Colour management in software applications (Adobe Photoshop), Operating System (Microsoft, Apple)	07
5.	Current Trends in Colour Management Dynamic Device link profiles, Profile editing, profile quality, ECI, Colour appearance modelling, Case studies. Quality Control in Profiles.	04

6.	Introduction to Digital Printing: Digital Technology types: Primarily electrophotography, inkjet (wide-format versus sheetfed inkjet), HP Indigo, Webfed digital for labels and packaging applications, Costing for digital printing, Digital Finishing/Post-press, IT expertise for data handling for VDP, Substrates suitable for digital printing	05
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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) Abhay Sharma, Understanding Colour Management
- 2) Richard M. Adams, Joshua B. Weisberg GATF press, The GATF practical guide To Colour Management
- 3) R.W.G Hunt, The Reproduction of Colour, Fountain Press, England
- 4) E.P. Danger, The Colour Handbook, Gower Publication

Course Code	Course Name	Credits
PPDO6011	Packaging Laws, Regulations & Sustainability (Department Level optional Course – 2)	03

Objectives:

1. To learn various rules and regulations with respect to packaging in India and their impact in the domestic market
2. To understand the International laws with relation to Packaging including export market
3. To understand concepts of sustainable development
4. To study metrics for sustainable packaging & LCA
5. To study various waste management systems
6. To study biopolymers & biobased polymers

Outcomes: Learner will be able to...

1. Summarize the rules and regulations with respect to packaging in India and their impact in the domestic market.
2. Identify and compare the international laws with relation to packaging
3. Describe the need & scope of sustainability in a process, product/package or equipment.
4. Describe & analyze the metrics & LCA for packaging sustainability.
5. State and explains the various waste management systems.
6. Describe the need of biopolymers & biobased polymers in sustainable economy.

Module	Details	Hrs
1.	Indian Regulatory System Introduction, Laws and regulations- Need/Importance - Bureau of Indian Standards The Standards of weights and Measures Act (SWMA), Standard Units, Laws, Regulations and Ministries involved, Essential Commodities Act, Agricultural Produce (Grading and Marketing) Act, Prevention of Food Adulteration Act, Codex Standard Act, Export (Quality Control and Inspection) Act, Declarations on Packaged Commodities -Declarations for Interstate Trade and Commerce, Standard Packages, Maximum Permissible Error, Label Declarations, Standard Quantity specifications for various products, Symbols and Units used.	06
2.	International Laws CE Marking, EU-REACH Regulations in packaging, RoHS (Restriction on Hazardous Substances), Uniform Weights and Measures Law, Details of Violations, offences, Penalties under various sections, ISO 14000 Environment Management System, IMDG (International Maritime for Dangerous Goods), EU Directives, Various storage requirements of Products, Specifications of Raw Materials used, IS Specifications with respect to packaging and Packaging Materials	07
3.	Food Packaging Requirements & Others FSSAI, Packaging requirements under PFA, Declaration and Labelling, PFA Enforcement methods, Fruit Products Order (FPO), Meat Food Products Order (MFPO), Agricultural Grading and Marking Rules (AGMARK), Edible Oil Packaging (Regulatory) Order.	05
4.	Introduction to Sustainability Sustainable Development & Processes, Need Today, Three Pillars of Sustainability & their effects on sustainable growth - Relation with environment waste management Relevance of Sustainable Development in	05

	Packaging Sector - Traditional Packaging vs. Sustainable Packaging	
5.	LCA and Waste Management Introduction to LCA Methodology, how to conduct LCA studies and its importance, Waste Management – various techniques and description, mechanical recycling, feedstock recovery, incineration, landfills etc. , alternative material to reduce waste	07
6.	Sustainable Economics & CSR Activities for Sustainable Development Environmental Compliance: National & International Legislations - Cost Factors & their implications - Sustainable Development Policies - Corporate Social Responsibility & Key Performance Indicators (KPIs)	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. G C P Ranga Rao, "Modern Food Packaging, Packaging Laws and Regulations", CFTRI Mysore , IIP Publications, 2005
2. The Standards of Weights and Measures act, (1976 & Standards of Weights and Measures (Packaged Commodities) Rules (1977),
3. Rule Book, Govt. Of India.
4. Scott Boylston , Designing Sustainable Packaging, , Laurence King Publishing, 2009.
5. Wendy Jedlicka, Packaging Sustainability: Tools, Systems and Strategies for Innovative Package Design, 1st Edition, Wiley, 2009
6. Wendy Jedlicka, Sustainable Graphic Design: Tools, Systems and Strategies for Innovative Print Design, 1st Edition, Wiley, 2009
7. Sustainable Materials, Processes and Production, 1st Edition, Thames and Hudson, 2013
8. M. Braungart, W. McDonough, Cradle to Cradle: Remaking the Way We Make Things, 1st edition, North Point Press, 2002
9. W. Klöpffer, B. Grah, Life Cycle Assessment (LCA), Wiley VCH, 2014

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/105/105/105105157/>

Course Code	Course Name	Credits
PPDO6012	Digital and Security Printing (Department Level optional Course – 2)	03

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: Learner will be able to...

1. Analyse & describe the Digital image anatomy for Pre-press environment.
2. Analyse & describe the concepts in digital printing with its Merits & De-merits.
3. Summarise the process involved in Digital work-flow & data handling.
5. Elaborate the importance of security printing with respect to use in everyday life.
6. Describe first line inspection of different documents & Creation of various security devices.
7. Discuss the significance of Brand protections and tools available.

Module	Details	Hrs
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, contones 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.	06
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.	08
3.	Digital Print Application (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.	05

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 colour, multi-colour UV-fluorescence stitching thread, holographic foil or lamination of a page, Digital Watermark.	05
5.	Inks and Brand Security Inks: Invisible inks, Specialist security printers inks; such as thermos-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.	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.	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.

Texts/Reference Books:

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 – VerlagBzlin 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

Course Code	Course Name	Credits
PPDO6013	Financial & Marketing Management (Department Level optional Course – 2)	03

Objectives:

1. To get an overview of Indian financial system, instruments and market.
2. To learn basic concepts of value of money, returns and risks, corporate finance, working capital and its Management.
3. To acquire knowledge about sources of finance, capital structure, dividend policy.
4. To get introduced to the basic elements of marketing management.
5. To understand various marketing concepts and get acquainted with contemporary marketing practices.

Outcomes: Learner will be able to...

1. Explain the Indian finance system and their components,
2. Describe the sources of finance and estimate the Present & Future Value.
3. Estimate the financial ratios & perform investment appraisals.
4. Explain the marketing concept and marketing environment.
5. Describe the concepts of Marketing Mix, Product & pricing decisions
6. Elaborate on Distribution & Promotion decisions and describe the various marketing strategies.

Module	Details	Hrs
1.	Overview of Indian Financial System: Characteristics, Components and Functions. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments - Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets - Capital Market, Money Market and Foreign Currency Market Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions -Commercial Banks, Investment-Merchant Banks and Stock Exchanges	04
2.	Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting. Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance - Investment Decision, Financing Decision, and Dividend Decision. Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Sources of Short-Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance.	07

3.	Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; etc. Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, IRR Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	07
4.	Introduction to Marketing Concept, Evolution of Marketing from Production to Sustainability & Customer Orientation. Understanding the Basics: Concept of Need, Want and Demand, Concept of Product and Brand Business Environment in India, Marketing environment and Evaluation of Market Opportunities available in various like Services, Rural & International.	05
5.	Market Research & Marketing, Information Systems and Demand Forecasting and Market Potential, Analysis, Consumer Buying Process & Organizational Buying Behaviour Pillars of Marketing - Market Segmentation, Target Marketing, Positioning & Differentiation. Marketing Mix and Product Decisions – Product Life Cycle & Brand New Product Development Process and Pricing Decisions	07
6.	Distribution Decisions – Logistics & Channel Decisions (Retail, E-commerce, etc.) Promotion Decisions – Integrated Marketing Communications Concept: Advertising, Sales Promotions, Public Relations, Direct Marketing; Communication Tools Personal Selling & Sales Management. Overview of Marketing Strategies: BCG, Ansoff, GE, Shell Model, Porter Generic Model, 5 Forces Model, PLC, 7s Model of Marketing, Value Chain Model Case studies / Presentations	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. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGrawHill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.
5. Marketing Management (A South Asian Perspective) by Philip Kotler, Kevin Lane Keller, Abraham Koshy & Mithileshwar Jha, Pearson Education
6. Marketing Management by R. Varshney, S. Chand
7. Marketing Management by Rajan Saxena, Tata McGraw Hill
8. Basic Marketing by Jr., William Perreault, Joseph Cannon and E. Jerome McCarthy
9. Marketing Management – Planning, Implementation and Control by V.S. Ramswamy and S. Namakumari, McMillan
10. Business Marketing Management by M. Hutt, Cengage Learning

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/110/107/110107144/>
2. <https://nptel.ac.in/courses/110/104/110104068/>
3. <https://nptel.ac.in/courses/110/104/110104070/>
4. <https://nptel.ac.in/courses/110/105/110105067/>

Course Code	Course Name	Credits
PPDO7014	Project Management and Entrepreneurship (Department Level optional Course – 2)	03

Objectives:

1. To get acquainted with various aspects of project management
2. To study different scheduling and planning techniques used in the industry
3. To study various applications of inventory and project management with respect to the Printing and Packaging Industry.
4. To study Life-cycle of the project
5. To develop and strengthen entrepreneurial quality in students.
6. To impart basic entrepreneurial skills and understandings to run a business efficiently and effectively.

Outcomes: Learner will be able to...

1. Describe the fundamental concepts in Project management
2. Analyze the various scheduling and planning techniques
3. Understand and apply suitable strategy for any specific project
4. Apply project management principles in business situations to optimize resource utilization and time.
5. Demonstrate skills needed to run a successful business.

Module	Details	Hrs
1.	Introduction to Project Management Project Management – Definition –Goal - Lifecycles. Project Selection Methods. Project Portfolio Process – Project Formulation. Project Manager – Roles- Responsibilities and Selection – Project Teams.	04
2.	Planning and Budgeting The Planning Process – Work Break down Structure – Role of Multidisciplinary teams. Budget the Project – Methods. Cost Estimating and Improvement. Budget uncertainty and risk management.	06
3.	Scheduling and Resource allocation GANTT Chart, PERT & CPM Networks, GERT, Crashing – Project Uncertainty and Risk Management – Simulation –Gantt Charts – Algorithms for solving sequencing problems – Processing of N jobs through K machines, Assignments and transportation algorithms - Expediting a project – Resource loading and leveling. Allocating scarce resources – Goldratt's Critical Chain.	08
4.	Project control and conclusion The Plan-Monitor-Control cycle – Data Collecting and reporting – Project Control – Designing the control system. Project Evaluation, Auditing and Termination.	06
5.	Entrepreneurial competence & Business plan Preparation Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality -Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur.	07

	Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product -Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.	
6.	Launching and Management of Small business Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection -Growth Strategies –Break even analysis- Product Launching – Incubation, Venture capital.Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.	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. John M.Nicholas, “Project management for business/Technology”, Pearson
2. Uddesh Kohli, K.K Chitkara, “Project Management Handbook”, Tata McGraw Hill
3. Samuel J.Mantel et al, “Project management”, Wiley India
4. S.Choudhury, “Project Management”, Tata McGraw Hill
5. P K Joy, “Total Project Management –The Indian context”, Macmillan
6. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001
7. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/110/104/110104073/>
2. <https://nptel.ac.in/courses/110/107/110107081/>
3. <https://nptel.ac.in/courses/110/107/110107094/>
4. <https://nptel.ac.in/courses/110/105/110105067/>
5. <https://nptel.ac.in/courses/110/106/110106141/>

Course Code	Course Name	Credits
PPL 601	Food Packaging Laboratory	01

Objectives:

1. To understand the food characteristics
2. To study the food package compatibility
3. To study the package material characteristics
4. To study the latest technologies in Food Packaging

Outcomes: Learner will be able to...

1. Analyze the Food product and its dependency on Moisture content
2. Use the sensory analysis technique to characterize the product
3. Estimate the permeability of the packaging materials
4. Evaluate the shelf life of packaged food product
5. Apply the latest packaging technologies to various food product
6. Design the suitable package for the food product

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Eight)

Module	Details	Laboratory Sessions
1	Moisture Content and Total Soluble Solids Analysis of Food	2 Hrs
2	Sensory Analysis of Food – Descriptive Test	2 Hrs
3	Sensory Analysis of Food – Ranking Test	2 Hrs
4	Estimation WVTR of a flexible packaging material by Dish Method	2 Hrs
5	Estimation of OTR of a packaging material	2 Hrs
6	Estimation of overall migration of packaging material	2 Hrs
7	Head space analysis of a Package	2 Hrs
8	Shelf-Life evaluation with quality index as CIE values.	2 Hrs
9	Study of MAP for Different Products	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 FPL. 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 Oral Examination (for 25 marks): Oral assessment to be conducted by internal and external examiners.

Link for online NPTEL/SWAYAM courses:

1. https://onlinecourses.swayam2.ac.in/cec20_ag06
2. <https://nptel.ac.in/courses/126/105/126105015/>

Course Code	Course / Subject Name	Credits
PPL602	Colour Management Laboratory	01

Objectives:

1. Introducing concept of Colour management and its importance in printing industry.
2. Understand profile and its role in Colour management
3. Study the importance of media or substrate in colour perception
4. Study Standardization of colour and its reproduction
5. Apply Colour corrections and Image adjustments

Outcomes: Learner will be able to...

1. Summarize importance of Colour management.
2. Select test charts for various devices to create profile based on the need.
3. Apply various rendering intents on images using image editing software.
4. Measure the quality of profile generated by software.
5. Summarize various colour management workflows.
6. Understand the current trends in Colour management industry.

Term Work: (Comprises both a & b)

a) List of Practicals / Experiments (Minimum 8)

Module	Details	Laboratory Sessions
1	Editing rendering intent settings of an image in Photoshop and record the difference.	2 Hrs
2	Calibrate the monitor and create a monitor profile.	2 Hrs
3	Generate and Measure a Printer test chart and develop an ICC printer profile.	2 Hrs
4	Measure a scanner test chart and create a scanner profile.	2 Hrs
5	Perform Proofer calibration for a given media.	2 Hrs
6	Develop a Soft proof and Hard proof.	2 Hrs
7	Applications of Mat-Lab software for colour processing.	2 Hrs
8	Generating two different profiles by varying settings and comparing the gamut in software	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 FPL. 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 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
PPT601	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: Learner will be able to...

1. Analyse the print, packaged, converted & finished product
2. Examine the Product for the entire process involved in manufacturing, converting and finishing.
3. Understand operational workflows for various Industries.
4. Analyse Plant Layout, Inventory & Logistics provisions.
5. Understand the Organisational structure and Manpower requirements.
6. Discuss the Safety-Health-Environmental practices, Laws, Regulations & Certifications found in the Industry.

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.	Binding 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.	Fiberboard drum/ composite box package manufacturing
15.	Thermoform manufacturing and packages manufacturing
16.	Glass factory and Glass bottles manufacturing
17.	Blow moulding, Injection moulding and Rotational moulding 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.	Aluminium 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

At least 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

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

Course Code	Course / Subject Name	Credits
PPSBL601	Skill Based Lab: Package Design & Graphics-II	1.5

Objectives:

1. Learn to Create Structural Design for Packaging, understand the basic requirements and folding sequences in 3D.
2. Create and evaluate best layout for a packaging design, understand various factors for choosing a layout.
3. Using the created ARD file, create and make a print ready packaging graphic
4. Evaluate different print & substrates in Visualizer

Outcomes: Learner will be able to...

1. Understand the need and importance of CAD file in Packaging Design
2. Impact CAD of and Layout on costing and production
3. Using 3D as a QA tool to evaluate packaging design
4. Make a print ready graphic file (trapping, white/ varnish layers/barcodes / preflighting etc.,)
5. Understand the concepts of Digital sample making.
6. Understand various print and finishing processes and their effects on graphics.

Term Work: (Comprises both a & b)

a) List of Practicals / Experiments (Minimum Eight)

Module	Details	Laboratory Sessions
1	Use existing Library Designs for both corrugated and Carton designs, change values of different flaps and understand the basic concepts.	3 Hrs
2	Take an existing packaging box and understand the 2d structure, recreate the same in ESKO ArtiosCAD software	3 Hrs
3	Prepare a layout of the cad file and consider different types of layout and validate the area used & wastage percentages	3 Hrs
4	Create and fold the design in 3d, understand all tools. Do an animation of the folding sequence and export a video file	3 Hrs
5	Place created CAD file in Illustrator and create graphics + Text as per packaging requirements	3 Hrs
6	Prepare White / Varnish layers, add printer marks	3 Hrs
7	Trap the file for surface print and reverse print	3 Hrs
8	Place a CAD file on an artwork in illustrator and open studio to observe the 3D of the design, Use Studio as a QA tool to see various graphic position on all sides of a package, export to 3d pdf and open in acrobat and analyse results	3 Hrs
9	Apply Various print and finishes in Visualizer	3 Hrs
10	Export various 3D formats from Visualizer (image sequence, studio viewer) and understand the importance of 3d for digital proofing.	3 Hrs

b) Mini Project: On any of the following topics:

1. Create a packaging design (CAD+ Artwork) for a Fmcg product
2. Use an existing product in the market and create new graphics and text and prepare for a digital approval
3. Use an existing product (design) and add foiling and embossing to improve the overall packaging effect
4. Create a costing chart for various cad files and layouts for a predefined number of boxes. (Optional)

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
PPPBL601	Mini Project 2 B	2

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 components/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