

**UNIVERSITY OF MUMBAI**



**Bachelor of Engineering**

in

**Printing and Packaging Technology**

**Final Year with Effect from AY 2022-23**

**(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	<b>Final Year B.E. in Printing and Packaging Technology</b>
2	Eligibility for Admission	<b>After Passing Third Year Engineering as per the Ordinance 0.6243</b>
3	Passing Marks	<b>40%</b>
4	Ordinances / Regulations ( if any)	<b>Ordinance 0.6243</b>
5	No. of Years / Semesters	<b>8 semesters</b>
6	Level	<del>P.G. / U.G./Diploma / Certificate</del> (Strike out which is not applicable)
7	Pattern	<del>Yearly / Semester</del> (Strike out which is not applicable )
8	Status	<del>New / Revised</del> (Strike out which is not applicable )
9	To be implemented from Academic Year	<b>2022-2023</b>

Date

Dr S K Ukarande  
Associate Dean  
Faculty of Science and Technology  
Member, Academic Council, RRC in Engineering  
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  
Member, Academic Council, RRC in Engineering  
University of Mumbai  
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  
Member, Academic Council, RRC in Engineering  
University of Mumbai

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

**Program Structure for Second Year Engineering**  
**Semester VII & VIII**  
**UNIVERSITY OF MUMBAI**  
**(With Effect from 2022-2023)**  
**Semester VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract. / Tut.	Theory	Pract. / Tut.	Total			
PPC701	Flexographic Printing	3	--	3	--	3			
PPC702	Packaging Distribution & Logistics	3	--	3	--	3			
PPDLO703X	Department Optional Course – 3	3	--	3	--	3			
ILO701X	Institute Optional Course - I	3	--	3	--	3			
PPL701	Flexographic Printing Laboratory	--	2	--	1	1			
PPL702	Industrial Skills*	--	2	--	1	1			
PPT701	Total Quality Management Tutorial	--	2	--	2	2			
PPT702	Printing & Packaging Costing Tutorial	--	2	--	2	2			
PPSBL701	Packaging Distribution & Logistics Laboratory	--	2	--	1	1			
<b>Total</b>		<b>12</b>	<b>10</b>	<b>12</b>	<b>7</b>	<b>19</b>			
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac/oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
PPC701	Flexographic Printing	20	20	20	80	3	--	--	100
PPC702	Packaging Distribution & Logistics	20	20	20	80	3	--	--	100
PPDLO703X	Department Optional Course – 3	20	20	20	80	3	--	--	100
ILO701X	Institute Optional Course - I	20	20	20	80	3	--	--	100
PPL701	Flexographic Printing Laboratory	--	--	--	--	--	25	25	50
PPL702	Industrial Skills*	--	--	--	--	--	25	25	50
PPT701	Total Quality Management Tutorial	--	--	--	--	--	25	--	25
PPT702	Printing & Packaging Costing Tutorial	--	--	--	--	--	25	--	25
PPSBL701	Packaging Distribution & Logistics Laboratory	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>80</b>	<b>320</b>	<b>--</b>	<b>125</b>	<b>75</b>	<b>600</b>

SBL – Skill Based Laboratory

\* Common with Mechanical Engineering

## Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned		
		Theory	Pract.	Pract.	Total		
PPP801	Industrial Training & Project*	--	5x8=40	20	20		
<b>Total</b>		<b>--</b>	<b>40</b>	<b>20</b>	<b>20</b>		
Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Prac/oral	Total
		Internal Assessment	End Sem Exam	Exam. Duration (in Hrs)			
		Midterm					
PPP801	Industrial Training & Project*	50	--	--	100	50	200
<b>Total</b>		<b>50</b>	<b>--</b>	<b>--</b>	<b>100</b>	<b>50</b>	<b>200</b>

\* Industrial Training and Project work shall be of 24 weeks duration.  
(Learners load: 8 hours a day and 5 days a week translates into 40 contact hours per week)

### Industrial Training & Project:

Students can form groups with not more than 4 (Four)

Faculty Load: In Semester VIII – 1 hour per week per two project groups.

### Department Optional Courses

Course Code	Sem. VII: Department Optional Course- 3
PPDLO7031	Advanced Food Packaging
PPDLO7032	Advanced Industrial Products Packaging
PPDLO7033	Labelling Technology
PPDLO7033	Product Design & Development

### Institute Optional Courses

Course Code	Institute Optional Course-I <sup>#</sup>
ILO7011	Product Lifecycle Management
ILO7012	Reliability Engineering
ILO7013	Management Information System
ILO7014	Design of Experiments
ILO7015	Operation Research
ILO7016	Cyber Security and Laws
ILO7017	Disaster Management and Mitigation Measures
ILO7018	Energy Audit and Management
ILO7019	Development Engineering

# Common with all branches

Course Code	Course Name	Credits
PPC701	Flexographic Printing	03

**Objectives:**

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

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

1. Develop ability to operate flexography machine.
2. Acquire skills to handle trouble shoot on flexography presses.
3. Identify press type & configuration.
4. Discuss the merits & demerits of press types & structural variants.
5. Analyse the ink & Substrate for any print job.
6. Describe the Quality control, Environmental & safety tools & regulations available.

Module	Details	Hrs
1.	<b>Introduction to Flexography</b> Overview of major conventional printing technologies, the flexographic potential, brief history of process. Working principle, features, characteristics and advantages of flexography. Comparison with other major printing process basic elements of flexography.	02
	<b>Image Carrier</b> Design considerations and objectives of general flexographic printing image carrier. Introduction of flexographic plates, Moulded Plate making, Photopolymer plates: sheet and liquid plate making, Laser Design Rolls and Flexo CTP. Properties, Benefits, Comparisons, Handling and Storage of Flexographic Plates. Different light sensitive chemistries used in plate material manufacturing. Kodak Flexcel NX (film-based) versus Esko HD Flexo (laser-based).	05
2.	<b>Mounting &amp; Proofing</b> Need and significance of plate mounting operation. Introduction to mounting. Types of mounting procedures: Double-sided Tape, Magnetic, Sleeve, pin register system. Plate mounting and proofing machines. Troubles and trouble-shooting with regard to improper plate mounting.	04
3.	<b>Flexographic Press</b> Press types: Working, advantages & Limitations of Stack, Common Impression, Inline. Basics of Tension zones and web tension control systems. Printing Station: Types of Inking systems, Fountain Roller, Anilox Roller, Plate Cylinder, Impression Rollers, Dryers and Cooling Rollers, side and circumferential register control. Web Tensions: Tension Zones & Tension ranges, Transducer feedback control, Unwind tension control, In-feed Tension Control, Rewind Tension Control. Web Inspection: Stroboscope, Mirror Drum, TV Print Scanner, Static Control, Film Treaters.	08

4.	<p><b>Substrates and Inks</b> Absorbent and Non-absorbent substrates, physical properties, printing characteristics, Special substrate. Substrate's surface and optical properties affecting printing resolution.</p> <p><b>Inks</b> End-use requirements, introduction to printing inks, ink vehicles, ink classifications, principles of ink selection, ink consumption, ink quality assurance tests and ink storage. Ink's surface and optical properties affecting printing resolution.</p>	05
5.	<p><b>Process Colour Printing</b> Halftone Printing, Theory of colour, colour separations, basic requirements for process colour printing, flexographic printing characterization, ink density and standardization, dot gain. Effects of plate, anilox roller (How to select an anilox for a job), fountain and impression roller on printing density. Process controls &amp; standardization. Process colour screen angles, relationship between LPI requirement and line frequency of anilox roll, electronic colour registration systems. Quality range with FM and AM screening techniques. Extended Colour Gamut printing (fixed-pallet, CMYK OGV)</p>	08
6.	<p><b>Finishing, Quality Control and Environment &amp; Safety</b> Finishing in flexo (inline and offline), The debate of flexo versus gravure, Introduction &amp; Characteristics of quality, economics of quality improvement, the principles of total quality management, statistical process control, tools of statistical process control, element of process control in flexography. ISO 9000.</p> <p><b>Environment &amp; Safety</b> Clean Air Act, Food safety concerns (role of flexo inks), Toxic substance control act, Resource conservation &amp; recovery act, occupational safety &amp; health act.</p>	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. Foundations of FTA, Flexography Principles & Practices, 5th Edition.
2. Herbert L. Weiss, Flexography Proficiency, Converting Technology Corp.
3. Tony White, High Quality Flexography, Pira International Reviews.
4. J. Michael Adams, Printing Technology, 5th Edition, Delmar.
5. Michael Barnard "The Print & Production Manual" PIRA.

Course Code	Course Name	Credits
<b>PPC702</b>	<b>Packaging Distribution &amp; Logistics</b>	<b>03</b>

**Objectives:**

1. To understand supply chain management & role of packaging in it.
2. To study retailing concepts & strategies from packaging perspective.
3. To study Unit Load Devices & their applications
4. To learn the various tests to be performed for transport worthiness of a package.

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

1. Apply the supply chain management approach in various processes of a package development.
2. Describe the role of retailing in packaging industry.
3. Evaluate the usage & application of Unit Load Devices.
4. Explain and perform transport worthiness tests for a given package.
5. Describe the material handling & storage techniques used during package distribution.
6. Elaborate on various distribution channels and the transport management.

Module	Details	Hrs
<b>1.</b>	<b>Introduction</b> Basic concept of Unit Load Devices (ULD) - Types of ULD - Examples & Case Studies.	<b>04</b>
<b>2.</b>	<b>Palletization</b> Pallets as ULD - Wood Pallet Terminologies - Pallet Classification, Structures & Applications as per standards. Introduction to plastic & non-plastic pallets - Advantages & Applications.	<b>05</b>
<b>3.</b>	<b>Containerization</b> Containers as ULD - History & Classification of containers - Intermodal & Multimodal Containers - Container Markings & Placarding - Concept of Rating, Taremass & Payload - Air & Marine Containers - Reefer Containers.	<b>09</b>
<b>4.</b>	<b>Introduction to Logistics &amp; Supply Chain Management</b> Introduction to Logistics - Components & Activities of Logistics - Inward & Outward Logistics. Introduction to Supply Chain Management (SCM) - Comparison of Logistics & Supply Chain Management. Product Package Life Cycle & SCM activities.	<b>06</b>
<b>5.</b>	<b>Distribution Channels &amp; Transport Management</b> Introduction to Distribution Channels - Types & levels of Channels - Marketing Systems - Choice of Distribution Channels. Principles of Transportation Functions - Transportation Management - Legal Types & Modes. Introduction to INCO Terms.	<b>06</b>
<b>6.</b>	<b>Material Handling &amp; Storage</b> Introduction to Material Handling - Types of Materials - Principles of Material Handling - Material Handling Devices like Pallet Trucks, Fork lift, Stacker, conveyors, cranes etc. - Loading & Unloading Techniques of Materials/ULDs on Vehicles, Ships etc. Introduction to Inventory Management - Classes of Inventories - Inventory Control. Concept of Warehouse - Functions & Types - Warehouse Designs & Structures	<b>06</b>

### **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.

### **References:**

1. Integrated packaging system for Transportation and Distribution – Charles webbling
2. Design and Technology of package Decoration for the consumer Market – Geoff A. Giles.
3. Problems in Packaging – The Environmental Issues – I Boustead / K Lidgren.
4. Dangerous Goods Regulations – International Air Transport Association (Canada)
5. International Maritime Dangerous Goods code (IMDG Code) – International Maritime organizations (London).
6. Supply Chain Management Strategy, Planning, and operations, Sunil Chopra and Peter Meindl
7. Materials Management & Purchasing, Ammer D.S. Tarapurawala
8. Distribution packaging, Friedman W.F. and J.J. Kipness, Robert E. Krieger Publishing Co

### **Links for online NPTEL/SWAYAM courses:**

1. <https://nptel.ac.in/courses/110/105/110105122>

Course Code	Course Name	Credits
PPDLO7031	Advanced Food Packaging	03

**Objectives:**

1. To get acquainted with various permeation measurement techniques.
2. To study overall & specific migration.
3. To study various shelf-life models.
4. To study filling systems for liquid & solid food products.
5. To study the retort & aseptic processes for microbial destruction in packaged foods.

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

1. Choose a packaging material with suitable permeability value as required.
2. Describe & perform the migration analysis for packaging materials.
3. Evaluate the shelf life of packaged food product.
4. Describe the filling system & suggest a suitable one based on product need.
5. Apply concepts of microbial inactivation for retort & aseptic packaging.
6. Elaborate on the active & intelligent packaging and Innovations in food packaging.

Module	Details	Hrs
1.	<b>Permeation of Gases through Packaging Materials</b> Revision of diffusion, Fick's Law & derivation Permeation Rate Equation - Experimental measurement of gas permeability - Estimation of permeability, diffusion & solubility co-efficient.	06
2.	<b>Migration Studies</b> Revision of Migration Processes - Kinetic & Thermodynamic approach - Migration Models - Estimation of partition & diffusion co-efficient - Estimation of worst case & safe level addition	06
3.	<b>Retort &amp; Aseptic Packaging</b> Concept of Aseptic, Retort & Hot filling - Understanding microbial growth curve - Thermal destruction of micro-organisms & food quality - Thermal Process Designing - In-container pasteurization & sterilization - materials used for retorting - Flow process & Systems for aseptic packaging - Sterilization techniques	06
4.	<b>Shelf Life Studies</b> Revision of Shelf Life Concepts - Temperature dependence in chemical kinetics - Water activity & its effect - Shelf life models based on microbial growth, migration, for constant & variable driving forces for oxygen & moisture	08
5.	<b>Filling Systems &amp; Microwavable Packaging</b> Introduction to various filling systems - Classification of filling systems for liquid & solid products - Types of Fillers - Concept of microwave - Modes of Interaction - Challenges - Microwavable Food Packaging Materials	05
6.	<b>Active &amp; Intelligent Packaging &amp; Innovations in Food Packaging</b> Concept of Active & Intelligent Packaging - Active Absorbing & Releasing Systems, other Systems - Intelligent Packaging Framework & smart packaging devices - Legal aspects of intelligent packaging - Case studies of Innovative food packaging designs & MAP products	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.

### **References:**

1. D. S. Lee, "Food Packaging Science & Technology", CRC Press
2. Han, "Innovations in Food Packaging", Academic Press
3. Piringer & Baner, "Plastic Packaging Materials for Food", Wiley
4. Graves, "Handbook of Aseptic Processing & Packaging", CRC Press
5. Food Packaging & Preservation – Mathlouthi. M. – Blackie A & P – 1994
6. Modified Atmosphere packaging – Malette.C.P – 2nd edition – CRC Press
7. Vacuum Packaging – CRC Press – Brody 1996
8. Shelf Life Evaluation – Man & Jones – Aspen Publishers-2nd Edition

### **Links for online NPTEL/SWAYAM courses:**

1. <https://nptel.ac.in/courses/103/107/103107088/>
2. <https://nptel.ac.in/courses/126/105/126105018/>

Course Code	Course Name	Credits
PPDLO7032	Advanced Industrial Products 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:** At the end of the course, learners should be able to;

1. Effectively choose packaging materials based on characteristics of industrial products.
2. Describe the various properties & defects of wood packaging material
3. Analyze the various hazards & environmental issues related to Packaging and select a specific protection method for the product.
4. Choose various bulk carriers for industrial packaging based on the type of product.
5. Estimate the number of packages in a given bulk package system optimizing cube utilization.
6. Design an internal fitment based on a given product requirement.

Module	Details	Hrs
1.	<b>Industrial Packaging Materials &amp; Corrosion Prevention</b> Industrial Packaging Papers (Speciality), Films and Foils. Various Corrosion Prevention Coatings for metallic surfaces. Estimation of desiccant requirements for a industrial package. Numerical Problems. VCI Papers – Properties and applications.	10
2.	<b>Wood Package Design:</b> Structural design softwares (CAD) for designing of wooden packages - Design examples of a wooden box and crate as per Indian standard – Concepts of blocking and Bracing - Case studies to learn the importance of package dimensions with respect to product fitment inside the package and distribution chain.	04
3.	<b>Corrugated Fibreboard Box Design:</b> Implications of CFB Box design for transport packaging w.r.t internal and external box dimensions. Numerical Problems on CFB Box Dimensions for an industrial Product. Concept of Cube Utilization and associated case studies/numerical problems.	06
4.	<b>Internal Fitment Design &amp; Reinforcement:</b> Case studies / Numerical problem on Internal Fitment design for industrial packages like electronic products w.r.t paper and plastic. Examples of designs of corner supports, Pads, Liners/collars, Trays, Slotted Partitions, etc.	04
5.	<b>Special/Ancillary Packaging Materials:</b> Air Bubble Cushions – Manufacture, properties and applications, Paper Sacks – Manufacture, properties, applications and testing, Dunnage Bags –	07

	properties and applications, E-fluted Cartons, Anti-Counterfeit/security features, Reinforcements, Bundling, Unitizing (Stretch/Shrink wrapping) and Easy opening devices. Criteria for selection of reinforcement materials like straps – Numerical problems.	
<b>6.</b>	<b>Industrial Product Packaging Considerations:</b> Packaging of Chemicals (Cement, Fertilizers, Pesticides/Insecticides, Petroleum products and Others) Packaging of Handicrafts, Textiles, Toys, Jewelry. Bulk packaging systems for pharmaceutical drugs and edible nuts/spices	<b>05</b>

### 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.

### References:

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

Course Code	Course Name	Credits
<b>PPDLO7033</b>	<b>Labelling Technology</b>	<b>03</b>

**Objectives**

1. To study the different types of labels, their features and manufacturing process.
2. To understand the process of printing, finishing and applying labels on the packs.
3. To study the types of labels and materials used on the different packages.
4. To study the designing of the labels of all types along with the compensations.
5. To study the new trends in the labelling industry.

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

1. Explain and compare the different types of labels, their features and manufacturing process.
2. Explain the process of printing, finishing and applying labels on the packs.
3. Select a type of label and material based on the package type.
4. Design the labels of all types along with the compensations.
5. Describe the new trends in the labelling industry.
6. Choose a label based on product-package needs.

Module	Details	Hrs
1.	<b>Introduction</b> Functions of labels – Role of labels- growth, market share, types of labels, labelled products. Primary and secondary labels, labels in logistics, coding. Selection of substrates- runnability, printability requirements for different products. Printing methods, analog – flexography, gravure, offset and screen printing and digital- inkjet, thermal transfer and electrophotography, combipresses - types of combinations. Finishing on labels- foil stamping, varnishing, lamination, embossing, holograms, perforation. Overprinting and coding. Pre –treatment of containers for labelling.	<b>08</b>
2.	<b>Plain Adhesive Labels</b> Glued on labels, materials and properties, pre-gummed labels. Printing and finishing, label applicator - machines and workflow. Direct mail address labels with variable data printing.	<b>04</b>
3	<b>Pre adhesive Labels</b> Types - pressure and heat sensitive. Heat sensitive adhesive label types - instantaneous and delayed action. Printing, cutting and applying, precautions for heat sensitive labels. Self-adhesive labels construction, Types – Permanent, removable and repositionable, applications. Materials – substrate, release liner, release coating, adhesives and manufacturing. Considerations for different types of products. Designing, Printing and finishing - process and machines, die cutting. Label rewinding, applicator types - single and multi label applicator, applicator fitted with over printer, fixing. New developments - recycling compatibility, liner processing, linerless labels.	<b>08</b>
3.	<b>3.1 Shrink Sleeve labels</b> Shrink labels- materials – selection for different types of packs, advantages and disadvantages. Designing, Printing and finishing, process and machines. Surface and reverse printing. Shrink tunnel – construction and working, variables affecting shrinkage. Compensating distortion in design due to shrinkage.	<b>05</b>

	<b>3.2 Stretch sleeve labels</b> Stretch label - advantages and disadvantages, Materials, properties. Designing, Printing and finishing- process and machines. Stretch film tubes – separation by cut off knives and perforation -application station- mandrel.	<b>02</b>
4.	<b>Other types of labels</b> In mould labels-materials, properties, Printing and finishing, label application process. Thermal transfer labels, reversible, tie on and insert labels, tags. Specific products for the label types.	<b>05</b>
5.	<b>Trends</b> Customized labels with variable data printing. Smart and intelligent labels – functions - security, tracing, safety and preservation of the product, convenience, information transfer. Some of the technologies – RFID, thermochromic inks, barcodes. Online shopping and labels.	<b>04</b>

### 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. Technical Hand book of Self-adhesive labels, FINAT
2. Kit L. Yam, Wiley encyclopedia of Packaging Technology, 2010
3. FA Paine, Packaging user handbook, Blackie A & P, 1990
4. Joseph Hanlon, Hand Book of Package engineering, Technomic Publishing, Third edition

Course Code	Course Name	Credits
<b>PPDLO7034</b>	<b>Product Design &amp; Development</b>	<b>03</b>

**Objectives**

1. To acquaint with various approaches in designing and developing new products.
2. To familiarize with various software solutions for designing and developing products.
3. To familiarize with modern approaches like concurrent engineering, product life cycle management, robust design, rapid prototyping / rapid tooling, etc.

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

1. Develop competency in designing and developing products right from the conceptual level incorporating cost effective solutions.
2. Get familiarized with computer aided product design approach.

Module	Details	Hrs
1.	<p><b>1.1 Introduction:</b> Definition of product design, Classification of products, Design by evolution, Design by innovation, Various phases in product development and Design, Morphology of Design, Considerations in product design, Product specifications.</p> <p><b>1.2 Conceptual Design:</b> Market research, Need-based origin of product, Technology driven products, Analysis of ideas from various angles of design methodology and user needs, Function analysis and component process study, 2-D and 3-D representations in the form of concept drawing, Computer generated images, dummy and prototypes.</p> <p><b>1.3 Materials:</b> Overview of materials including new generation materials, Tailor made material concepts, Material selection process.</p>	<b>05</b>
2.	<p><b>2.1 Design for manufacturing (DFM):</b> Producibility requirements, Accuracy and Precision requirements, Manufacturing (Forging and casting) for various metal forms like sheets, wires, etc and manufacturing for various plastics.</p> <p><b>2.2 Design for Assembly (DFA):</b> Analysis of assembly requirements, Standardization, Ease of Assembly and disassembly, Design for bolted, welded and riveted components, Design for hinge and snap fit assemblies, maintenance, consideration of handling and safety, Modular concepts.</p>	<b>05</b>
3.	<p><b>3.1 Strength considerations in Design:</b> Criteria and objectives, designing for uniform strength, designing for stiffness and rigidity, Practical ideas for material saving in design of ribs, corrugations, rim shapes, bosses, laminates, etc.</p> <p><b>3.2 Designing with plastics:</b> Mechanical behavior, special characteristics and considerations, Design concepts for product features to be manufactured by various production process technologies, Special considerations for designing of components for load bearing applications, Designing for safety, Reliability and environmental considerations.</p>	<b>06</b>
4.	<p><b>Value Engineering:</b> Product value and its importance, Value analysis job plan, Steps to problem solving and value analysis, Value analysis tests, Value Engineering idea generation check list, Material and process selection in value engineering, Cost reduction, case studies and exercises.</p>	<b>04</b>
5.	<p><b>5.1 Product Ergonomics:</b> Anthropometry, Environmental conditions, thermal, noise, vibration, displays, illusions, Psycho and psychological</p>	<b>10</b>

	<p>aspects in design, Man-machine information exchange.</p> <p><b>5.2 Product Aesthetics:</b> Visual awareness, Form elements in context of product design, Concepts of size, shape and texture, Introduction to colour and colour as an element in design, Colour classifications and dimensions of colour, Colour combinations and colour dynamics, Interaction / communication of colours, Psychological aspects of colours, generation of products forms with analogies from nature.</p> <p><b>5.3 Product Graphics:</b> Graphics composition and layout, Use of grids in graphics composition, Study of product graphics and textures.</p> <p><b>5.4 Creativity:</b> Role of creativity in problem solving, Vertical and lateral thinking, Brain storming, Synectics, Group working dynamics, Adaptation to changing scenarios in economics, social, cultural and technological fronts, Anticipation of new needs and aspirations.</p>	
6.	<p><b>6.1 Software solutions:</b> Software for drafting, modeling, assembly, detailing, CAM interfacing, Rapid tooling/rapid prototyping, etc.</p> <p><b>6.2 Modern Applications:</b> Concurrent Engineering, QFD, Robust Design, Sustainable Design, Rapid Prototyping, Rapid Tooling, Product Life Cycle Management techniques and application areas.</p>	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. Design Fundamentals, R. G. Scott.
2. Design methods inter science, Jones.
3. Creative Engineering Design, Buhl H. R.
4. The Science of Engineering Design, Holt, Hill Percy H.
5. Ergonomics, Marilyn Joyce, Ulrika Waller Steiner.
6. Human Factors in Engineering & Design, 4th edition
7. Human Engineering Guide & Equipment Design, Morgon C. T. & Others
8. Barron D.ed, Creativity, New York, Art Directors
9. Design for Production, Baldwin E. W. & Niebel B. W. Edwin, Homewood Illinois.

### Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/112/107/112107217/>
2. <https://nptel.ac.in/courses/112/104/112104230/>
3. <https://nptel.ac.in/courses/112/107/112107282/>
4. <https://nptel.ac.in/courses/107/103/107103082/>

Course Code	Course Name	Credits
ILO7011	Product Life Cycle Management	03

**Objectives:**

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

**Outcomes:** Learner will be able to...

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant
- 5.

Sr. No.	Detailed Contents	Hrs
01	<b>Introduction to Product Lifecycle Management (PLM):</b> Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications <b>PLM Strategies:</b> Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	<b>Product Design:</b> Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase/ Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	<b>Product Data Management (PDM):</b> Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	<b>Virtual Product Development Tools:</b> For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	<b>Integration of Environmental Aspects in Product Design:</b> Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05

<b>06</b>	<b>Life Cycle Assessment and Life Cycle Cost Analysis:</b> Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	<b>05</b>
-----------	--	-----------

**Assessment:**

**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)

**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 Q2 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.**

**REFERENCES:**

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment- A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ILO7012	Reliability Engineering	03

**Objectives:**

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

**Outcomes:** Learner will be able to...

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Sr. No.	Detailed Contents	Hrs
1	<b>Probability theory:</b> Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. <b>Probability Distributions:</b> Central tendency and Dispersion, Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. <b>Measures of Dispersion:</b> Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
2	<b>Reliability Concepts:</b> Reliability Definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. <b>Failure Data Analysis:</b> Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. <b>Reliability Hazard Models:</b> Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
3	<b>System Reliability:</b> System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
4	<b>Reliability Improvement:</b> Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
5	<b>Maintainability and Availability:</b> System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
6	<b>Failure Mode, Effects and Criticality Analysis:</b> Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05

## **Assessment:**

### **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)

### **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.**

### **REFERENCES:**

1. L.S. Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillon, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Connor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO7013	Management Information System	03

**Objectives:**

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

**Outcomes:** Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Sr. No.	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

**Assessment:**

**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)

**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.**

**REFERENCES:**

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10<sup>th</sup> Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Draft Syllabus

Course Code	Course Name	Credits
ILO7014	Design of Experiments	03

**Objectives:**

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

**Outcomes:** Learner will be able to...

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Sr. No	Detailed Contents	Hrs
01	<b>Introduction</b> 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	<b>Fitting Regression Models</b> 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	<b>Two-Level Factorial Designs</b> 3.1 The $2^2$ Design 3.2 The $2^3$ Design 3.3 The General $2^k$ Design 3.4 A Single Replicate of the $2^k$ Design 3.5 The Addition of Center Points to the $2^k$ Design, 3.6 Blocking in the $2^k$ Factorial Design 3.7 Split-Plot Designs	07
04	<b>Two-Level Fractional Factorial Designs</b> 4.1 The One-Half Fraction of the $2^k$ Design 4.2 The One-Quarter Fraction of the $2^k$ Design 4.3 The General $2^{k-p}$ Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07
05	<b>Response Surface Methods and Designs</b> 5.1 Introduction to Response Surface Methodology 5.2 The Method of Steepest Ascent 5.3 Analysis of a Second-Order Response Surface 5.4 Experimental Designs for Fitting Response Surfaces	07

<b>06</b>	<b>Taguchi Approach</b> 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04
-----------	---	----

**Assessment:**

**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)

**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.**

**REFERENCES:**

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3<sup>rd</sup> edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2<sup>nd</sup> Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T. Voss

Course Code	Course Name	Credits
ILO7015	Operations Research	03

**Objectives:**

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

**Outcomes:** Learner will be able to...

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Sr. No.	Detailed Contents	Hrs
01	<p><b>Introduction to Operations Research:</b> Introduction, Structure of the Mathematical Model, Limitations of Operations Research</p> <p><b>Linear Programming:</b> Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis</p> <p><b>Transportation Problem:</b> Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.</p> <p><b>Assignment Problem:</b> Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem</p> <p><b>Integer Programming Problem:</b> Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.</p>	14
02	<p><b>Queuing models:</b> queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population</p>	05
03	<p><b>Simulation:</b> Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation</p>	05
04	<p><b>Dynamic programming.</b> Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening,</p>	05

	capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	
05	<b>Game Theory.</b> Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	<b>Inventory Models:</b> Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

**Assessment:**

**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)

**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.**

**REFERENCES:**

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Wiley and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons

Course Code	Course Name	Credits
ILO7016	Cyber Security and Laws	03

**Objectives:**

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

**Outcomes:** Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Sr. No.	Detailed Contents	Hrs
01	<b>Introduction to Cybercrime:</b> Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	<b>Cyber offenses &amp; Cybercrime:</b> How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	<b>Tools and Methods Used in Cyberline</b> Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	<b>The Concept of Cyberspace</b> E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	<b>Indian IT Act.</b> Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	<b>Information Security Standard compliances</b> SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

## Assessment:

### **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)

### **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.**

### **REFERENCES:**

1. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
6. Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
7. William Stallings, *Cryptography and Network Security*, Pearson Publication
8. Websites for more information is available on: The Information Technology ACT, 2008- TIFR: <https://www.tifrh.res.in>
9. Website for more information, A Compliance Primer for IT professional: <https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>

Course Code	Course Name	Credits
ILO7017	Disaster Management and Mitigation Measures	03

**Objectives:**

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

**Outcomes: Learner will be able to...**

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Sr. No.	Detailed Contents	Hrs
01	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion 2.2 Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities,	06

	importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	
05	Financing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09
06	Preventive and Mitigation Measures: 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

### Assessment:

#### **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)

#### **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.**

#### **REFERENCES:**

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
<b>ILO7018</b>	<b>Energy Audit and Management</b>	<b>03</b>

**Objectives:**

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

**Outcomes: Learner will be able to...**

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Sr. No	Detailed Contents	Hrs
01	<b>Energy Scenario:</b> Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	<b>Energy Audit Principles:</b> Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	<b>Energy Management and Energy Conservation in Electrical System:</b> Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. <b>Energy efficiency measures in lighting system, Lighting control:</b> Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	<b>Energy Management and Energy Conservation in Thermal Systems:</b> Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of	10

	performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	
05	<b>Energy Performance Assessment:</b> On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	<b>Energy conservation in Buildings:</b> Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

**Assessment:**

**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)

**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.

**REFERENCES:**

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. [www.energymanagertraining.com](http://www.energymanagertraining.com)
9. [www.bee-india.nic.in](http://www.bee-india.nic.in)

Course Code	Course Name	Credits
<b>ILO7019</b>	<b>Development Engineering</b>	<b>03</b>

**Objectives:**

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development.
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To understand the Nature and Type of Human Values relevant to Planning Institutions

**Outcomes:** Learner will be able to...

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently

Sr. No.	Detailed Contents	Hrs
<b>01</b>	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	<b>08</b>
<b>02</b>	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development	<b>04</b>
<b>03</b>	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	<b>06</b>
<b>04</b>	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	<b>04</b>

05	<p>Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education.</p> <p>Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution;</p> <p>Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values;</p> <p>Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom.</p>	10
06	<p>Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics;</p> <p>Professional ethics; Ethics in planning profession, research and education</p>	04

**Assessment:**

**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)

**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

**References:**

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission, New Delhi
6. Planning Guide to Beginners
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V., Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407

Course Code	Course / Subject Name	Credits
<b>PPL701</b>	<b>Flexographic Printing Laboratory</b>	<b>01</b>

**Objectives:**

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

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

1. Acquire skills to handle trouble-shooting on flexography presses.
2. Print single colour job
3. Mount plate on the machine.
4. Control tension setting.
5. Analyse effect of anilox & fountain roller pressure.
6. Operate flexography machine.

**Term Work:** (Comprises both a & b)

**a) List of Practicals / Experiments (Minimum 8)**

Module	Details	Laboratory Sessions
1	Introduction to construction and features of flexographic unit.	2 Hrs
2	Understanding design and working of tension control elements of Flexographic web threading path.	2 Hrs
3	Flexographic Plate Mounting with varying plate dimensions, adhesive strength and repeat length.	2 Hrs
4	Setting up of single and multicolour flexographic press for printing.	2 Hrs
5	To print single colour job on given absorbent stock and analyse print quality.	2 Hrs
6	To print single colour job on given non-absorbent stock and analyse print quality.	2 Hrs
7	To study tension setting on flexographic machine.	2 Hrs
8	To analyse effect of anilox & fountain roller pressure on print.	2 Hrs
9	To analyse effect of flexographic inks on print.	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 FGPL. 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
<b>PPL702</b>	<b>Industrial Skills</b>	<b>1</b>

**Course Rationale:** This course has been designed to prepare final year mechanical engineering students for placements, as well as to build computer skills and advanced soft skills to make them ready for a career in the industry.

**Objectives:**

1. To familiarise mechanical engineering students with basic computer/IT skills in the industry.
2. To practise soft skills and communication to be industry-ready.
3. To inculcate critical thinking and problem-solving abilities for efficient team and project outcomes.
4. To be prepared for campus placements by practising aptitude, logical reasoning, Group discussion and personal interview rounds.

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

1. Skilfully prepare and edit documents and slides on MS Word and MS PowerPoint etc.
2. Execute functions on MS Excel.
3. Learn how to navigate tasks and execute functions in G-suite.
4. Understand and practice metacognitive skills of creativity and problem solving.
5. Hone team building and leadership skills.

Perform well in campus placement rounds by practising Aptitude, Logical reasoning, Group Discussion and Personal Interviews.

Module	List of Experiments and Activities	No. of Lab sessions (*2hrs)
1	<b>Computer/IT skills</b>	6
1.1	Basics of Computers- Desktop/Laptop operations	
1.2	Microsoft Office	
1.2.1	<ul style="list-style-type: none"> <li>• MS Word- Assignment to Create and use various commands in a Word document (Page setup, text formatting, templates, SmartArt, Title and Ribbon bar, Editing etc.)</li> </ul>	
1.2.2	<ul style="list-style-type: none"> <li>• MS Excel- Assignment to Create and tabulate a spreadsheet (Excel- data analysis, charts, pivot tables, VBA, etc.)</li> </ul>	
1.2.3	<ul style="list-style-type: none"> <li>• MS- Power point- Assignment to design and use a Presentation Software(MSPPT, Prezi, etc. – Presentation design, templates, custom slides, animation, graphs, charts, troubleshooting etc.)</li> </ul>	
1.2.4	<ul style="list-style-type: none"> <li>• MS Outlook (Navigation, archiving, tasks distribution, filters, scheduling etc.)</li> </ul>	
1.3		
1.4	<ul style="list-style-type: none"> <li>• G-Suite (Gmail, G-Meet, Calendar, Sheets, Docs, Slides etc.)</li> <li>• An introduction to the typesetting package LATEX.</li> </ul>	
2	<b>Aptitude and Logical Reasoning</b>	2
2.1	Aptitude – Aptitude training, types of questions, mock tests	
2.2	Logical Reasoning – Verbal and Non-verbal reasoning, Types of questions, Mock tests	

3	<b>Developing Metacognitive skills</b>	2
3.1	Task orientation and Goal setting (can be based on Final year Project):	
3.2	Creativity and Problem-solving	
4	<b>Collaborative Techniques:Team building skills</b>	1
4.1	Activities on Team building	
4.2	Case studies on Leadership, Decision making and Team building	
5	<b>GD – PI</b>	2
5.1	Group Discussion – Factual, Strategic, Abstract, Case study, Picture based	
5.2	Personal Interview–Types of Interview Questions, Strategies, Sample answers, Mock Interviews	

**Assignments:** Assignments and activities should enable a steady progress in developing the aforementioned skills. A record of the conducted activities can be attached in journal as image printouts, and write up of case studies.

1. Application of MS Office skills (Individual)
  - Create and edit Word documents
  - Create and execute MS Excel functions
  - Create and enhance MS PPT
2. Writing a simple document in LATEX editor and running the typesetter program to produce finished document
3. Aptitude and Logical reasoning tests/practice sheets
4. Team building skills: Activities/Tasks to be performed as a team of 3 or 4 students.
5. Group Discussions

Case studies on problem-solving to be done as a team activity.  
Personal Interview questions log book

**Assessment: Total – 50 Marks**

Marks distribution will be as follows:

**FINAL TERM WORK – 25 Marks**

**Assignments (Journal) – 20 Marks**

**Attendance - 05 Marks**

**ORALS/Written – 25 Marks**

1. Aptitude Test (Written) - 15 Marks
2. Mock Interview (Orals) – 10 Marks

**Books recommended/References/ Resources:**

1. Meenakshi Raman, Prakash Singh. *Business Communication*, Oxford University Press, 2012
2. Claudyne Wilder. *The Presentations Kit: 10 steps for Selling Your Ideas*, John Wiley & Sons, 1994.
3. Lesikar, Flatley. *Basic Business Communication: Skills for Empowering the Internet Generation*, Tata McGraw Hill, 2008.
4. Flavell, J. H. *Cognitive development: Past, present, and future*. 1992.
5. Thorpe, Edgar and Showick Thorpe. *Objective English*, Pearson, 2013. (7<sup>th</sup> edition Amazon)
6. Thorpe, Edgar. *Test of Reasoning: for All Competitive Examination*. 7<sup>th</sup> edition., Amazon
7. Sinha, Nishit K., *Reasoning*, Pearson.
8. Aggarwal, R.S., *A Modern Approach to Logical Reasoning*, S. Chand.

9. Weblinks - <https://cambridge-community.org.uk/professional-development/gswmeta/index.html>
10. Various Quantitative aptitude books and websites list  
<https://eduly.in/best-quantitative-aptitude-books/>  
<https://prepinsta.com/learn-aptitude/>  
<https://www.simplilearn.com/learn-ms-excel-free-training-course-skillup>

### **NPTEL**

Creativity <https://nptel.ac.in/courses/109101017>

### **Course Era**

MS Excel <https://www.coursera.org/projects/introduction-microsoft-excel>

G-suite <https://www.coursera.org/projects/collaborating-g-suite-apps>

Problem solving <https://www.coursera.org/learn/problem-solving>

Udemy

G-suite <https://www.udemy.com/course/learn-gsuite/>

Draft Syllabus

Course Code	Course Name	Credits
<b>PPT701</b>	<b>Total Quality Management Tutorial</b>	<b>02</b>

**Objectives:**

1. To acquaint with the significance and features of TQM philosophy.
2. To familiarize with various quality tools and their uses in problem solving.
3. To give an insight into the ongoing global trends in quality approach and practices.

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

1. Appreciate the importance of quality and its dimensions in striving for excellence
2. Understand the conscious compromise between cost and quality
3. Use statistical approach for quality control.
4. List and explain various TQM Tools.
5. Evaluate process capability
6. Implement quality tools for continuous improvement.

**Term Work:** (Comprises both a & b)

**a) List of Tutorials (Minimum Eight)**

Sr. No.	Details	Tutorial Sessions
1	Understand Workflow of different departments in Print/Packaging Industry using flowchart	2 Hrs
2	Case Study - Implementation of TQM in Printing/Packaging Industry	2 Hrs
3	Case study - Implementation of Lean manufacturing, 5S in Printing/Packaging industry	2 Hrs
4	Constructing house of quality diagram for Printing/Packaging scenario	2 Hrs
5	Statistical Process Control: Seven Quality Tools Application	2 Hrs
6	Study on how to evaluate process capability and its various indices Cp, Cpk, Cpm for different machines	2 Hrs
7	Study of Six Sigma with the help of case study	2 Hrs
8	Study of Cause & Effect Diagram with the help of case study	2 Hrs
9	Study of Process improvement cycle	2 Hrs

**b) Mini-Project:** A group of 4-6 students should be given an assignment. This should be considered as mini project in TQMT. 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	Tutorials	10 marks
3	Mini project	10 marks

**Link for online NPTEL/SWAYAM courses:**

1. <https://nptel.ac.in/courses/110/104/110104080/>
2. [https://onlinecourses-archive.nptel.ac.in/noc19\\_mg19](https://onlinecourses-archive.nptel.ac.in/noc19_mg19)
3. <https://nptel.ac.in/courses/110/104/110104085/>

Course Code	Course Name	Credits
<b>PPT702</b>	<b>Printing &amp; Packaging Costing Tutorial</b>	<b>02</b>

**Objectives:**

1. To develop the understanding of various cost elements in printing & packaging industry.
2. To learn about the effect of different designs and materials on costing.

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

1. Enlist the various cost factors involved in a package or a printed job.
2. Estimate costing for a folding carton / CFB.
3. Estimate costing for a given print job.
4. Estimate costing for print finishing and conversion.
5. Estimate costing for a flexible (laminated) pouch.
6. Estimate costing for a wooden package.

**List of Assignments:(Minimum 8 assignments to be given)**

Sr. No.	Assignments	Tutorial Sessions
1	Various costs involved in packaging.	2 Hrs
2	Various costs involved in printing.	2 Hrs
3	Estimate costing for a folding carton.	2 Hrs
4	Estimate costing for a corrugated fibreboard box.	2 Hrs
5	Estimate costing for a print job.	2 Hrs
6	Estimate costing for print finishing & conversion of a book/diary.	2 Hrs
7	Estimate costing for a flexible laminated pouch.	2 Hrs
8	Estimate costing for a wooden package.	2 Hrs

**b) Mini-Project:** A group of 4-6 students should be given an assignment. This should be considered as mini project in PPCT. 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	Tutorials	10 marks
3	Mini project	10 marks

Course Code	Course / Subject Name	Credits
PPSBL701	<b>Skill Based Lab: Packaging Distribution &amp; Logistics Laboratory</b>	<b>01</b>

**Objectives:**

1. To study Unit Load Devices & their applications
2. To learn the various tests to be performed for transport worthiness of a package.

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

1. Evaluate the compression strength of a box.
2. Perform vibration test on a box.
3. Perform drop test on a box.
4. Perform inclined impact test on a box.
5. Perform stack test on a given package.
6. Perform Pallet performance test.

**Term Work:** (Comprises both a & b)

**a) List of Practicals / Experiments (Minimum Eight)**

Module	Details	Laboratory Sessions
1	To perform Compression Test on a given secondary package	2 Hrs
2	To perform Vibration Test on a given secondary package	2 Hrs
3	To perform Drop Test for CFB Boxes	2 Hrs
4	To perform Drop Test for Drums	2 Hrs
5	To perform Inclined Impact Test on a given secondary package	2 Hrs
6	To perform Stack Test on a given secondary package	2 Hrs
7	To perform Rolling Test on a given secondary package	2 Hrs
8	To perform Pallet Performance Test on a given pallet	3 Hrs

**b) Mini-Project:** A group of 4-6 students should be given an assignment. This should be considered as mini project in PDDL. 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. Tutorials	10 marks
3. Mini project	10 marks

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

### **Industrial Training Guidelines**

1. In Professional Internship (in-plant/industrial training) students will be allotted/placed in company/industry/plant or a factory related to printing & packaging technology for duration of 24 weeks.
2. Professional Internship (PI) can also include working under a Research Scholar to assist in research, joining as a trainee in private institutes/laboratories/organizations/small firms for the said period.
3. The student shall spend the PI period for observational training and solving assignments/projects given by the organization. Students are expected to analyze the problems systematically and offer suggestion / concluding remarks.
4. Students are required to observe and learn the organization mission/vision/objective, the executive hierarchy, functioning, production, management and laws/regulation/compliance with Indian and International standards.
5. Students are required to maintain a diary to record daily activities at the organization w.r.t. processes/systems learnt, or work done.
6. Industrial training shall also include fortnightly reports submission and discussions by students with respective guides.

### **Project Guidelines**

1. The student shall submit a report on project, suggested by industry where he/she is undergoing professional/In-plant training.
2. Project may be of the following types, but not limited to:
  - Manufacturing / Fabrication of a prototype including selection, concept design, material selection, manufacturing the components, assembly of components, testing and performance evaluation.
  - Improvement of existing machine / equipment / process.
  - Design and Fabrication of parts, tools, special purpose equipment, gauges, measuring instruments, etc.
  - Computer aided design, analysis of components such as stress analysis, etc.
  - Problems related to productivity improvements.
  - Problems related to value engineering.
  - Problems related to material handling system.
  - Product design and development
  - Detailed cost estimation of product.
  - Analysis, evaluation and experimental verification of any engineering problem encountered.
  - Quality system and management, Total quality management.
  - Quality improvements In-process Inspection Online
  - Waste management system, Safety, etc.
  - Market analysis in conjunction with production, planning and control.
  - Any other relevant topic, as approved by the internal guide.
3. The student shall submit a detailed report based on the project work.
4. The topic/area should be finalized in stipulated time period.
5. Each student is to have an internal guide from the Institute and one external guide from the corresponding organization.
6. Mid semester evaluation of the project is to be done after about 9-10 weeks by internal guide
7. End-semester evaluation and viva voce will be conducted by a committee consisting of an internal examiner and external examiner approved by University of Mumbai.

~ \* ~