

# **UNIVERSITY OF MUMBAI**



## **Bachelor of Engineering**

### **Printing & Packaging Technology**

#### **Syllabus Details (REV- 2016) from Academic Year 2016 -17**

Second Year with Effect from AY 2017-18

Third Year with Effect from AY 2018-19

Final Year with Effect from AY 2019-20

**under**

## **FACULTY OF TECHNOLOGY**

**As per Choice Based Credit and Grading System**

## **Co-ordinator, Faculty of Technology's Preamble:**

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

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also 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. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

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. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit 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.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

**Dr. S. K. Ukarande**

**Co-ordinator,**

**Faculty of Technology,**

**Member - Academic Council**

**University of Mumbai, Mumbai**

**PRINTING & PACKAGING TECHNOLOGY: CBSGS 2017 S.E. - PPT**

<b>SEMESTER - III</b>																		
Sem	Paper Code	Paper Name (As displayed on Mark Sheet)	Asses- ment Method	Teaching Scheme (hr/wk)			Credits Assigned				Examination Scheme						Total Marks	
				L	T	P	L	T	P	Total	Theory Marks			Term- work	Prac- tical	Oral		
											Internal Assessment							End Sem Exam
											T1	T2	Av.					
III	PPC301	Applied Mathematics – III	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
III	PPC302	Packaging Introduction & Concepts	Theory	2	-	-	2	-	-	2	15	15	15	60	-	-	-	75
III	PPC303	Introduction to Printing Technology	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
III	PPC304	Paperbased Packaging Materials	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
III	PPC305	Glass, Metal & Textile based Packaging Materials	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
III	PPT301	Applied Mathematics– III Tutorial	TW	-	2	-	-	2	-	2	-	-	-	-	25	-	-	25
III	PPL301	Principles of Graphic Arts & Design I	TW/Pr	-	-	3	-	-	1.5	1.5	-	-	-	-	25	25	-	50
III	PPL302	Screen Printing Laboratory	TW	-	-	4	-	-	2	2	-	-	-	-	50	-	-	50
III	PPL303	Paperbased Material Testing	TW/Pr	-	-	3	-	-	1.5	1.5	-	-	-	-	25	25	-	50
III	PPL304	Glass, Metal & Textile based Packaging Material Tutorial	TW/Or	-	2	-	-	2	-	2	-	-	-	-	25	-	25	50
<b>TOTAL</b>				<b>16</b>	<b>4</b>	<b>10</b>	<b>16</b>	<b>4</b>	<b>5</b>	<b>25</b>	<b>-</b>	<b>-</b>	<b>95</b>	<b>380</b>	<b>150</b>	<b>50</b>	<b>25</b>	<b>700</b>

<b>SEMESTER - IV</b>																		
Sem	Paper Code	Paper Name (As displayed on Mark Sheet)	Asses- ment Method	Teaching Scheme (hr/wk)			Credits Assigned				Examination Scheme						Total Marks	
				L	T	P	L	T	P	Total	Theory Marks			Term- work	Prac- tical	Oral		
											Internal Assessment							End Sem Exam
											T1	T2	Av.					
IV	PPC401	Plastics in Packaging	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
IV	PPC402	Ancillary Packaging Materials	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
IV	PPC403	Colour Reproduction	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
IV	PPC404	Offset Printing	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
IV	PPC405	Digital Electronics & Microcontrollers	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
IV	PPL401	Principles of Graphic Arts & Design II	TW/Pr	-	-	3	-	-	1.5	1.5	-	-	-	-	25	25	-	50
IV	PPL402	Plastic Material Testing	TW/Pr	-	-	2	-	-	1	1	-	-	-	-	25	25	-	50
IV	PPL403	Colour Reproduction Laboratory	TW/Pr	-	-	2	-	-	1	1	-	-	-	-	25	25	-	50
IV	PPL404	Offset Printing Laboratory	TW/Or	-	-	3	-	-	1.5	1.5	-	-	-	-	25	-	25	50
IV	PPL405	Digital Electronics & Microcontrollers Laboratory	TW	-	-	2	-	-	1	1	-	-	-	-	25	-	-	25
IV	PPL406	Ancillary Packaging Material Testing	TW	-	-	2	-	-	1	1	-	-	-	-	25	-	-	25
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>14</b>	<b>18</b>	<b>-</b>	<b>7</b>	<b>25</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>400</b>	<b>150</b>	<b>75</b>	<b>25</b>	<b>750</b>

**PRINTING & PACKAGING TECHNOLOGY: CBSGS 2017 T.E. - PPT**

SEMESTER - V																		
Sem	Paper Code	Paper Name (As displayed on Mark Sheet)	Asses- ment Method	Teaching Scheme (hr/wk)			Credits Assigned				Examination Scheme						Total Marks	
				L	T	P	L	T	P	Total	Theory Marks			Term- work	Prac- tical	Oral		
											Internal Assessment							End Sem Exam
											T1	T2	Av.					
V	PPC501	Plastics Processing & Conversion Technologies	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
V	PPC502	Gravure Printing	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
V	PPC503	Theory of Machines & Design	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
V	PPC504	Instrumentation & Process Control	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
V	PPC505	Industrial Products Packaging	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
V	PPL501	Plastics Processing & Conversion Technologies	TW/Or	-	-	4	-	-	2	2	-	-	-	-	25	-	25	50
V	PPL502	Package Design & Graphics - I	TW/Pr	-	-	4	-	-	2	2	-	-	-	-	25	50	-	75
V	PPL502	Theory of Machines & Design	TW	-	-	2	-	-	1	1	-	-	-	-	25	-	-	25
V	PPL503	Instrumentation & Process Control	TW	-	-	2	-	-	1	1	-	-	-	-	25	-	-	25
V	PPL504	Business & Corporate Ethics	TW	-	-	4*	-	-	2	2	-	-	-	-	25	-	-	25
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>15</b>	<b>18</b>	<b>0</b>	<b>8</b>	<b>26</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>400</b>	<b>125</b>	<b>50</b>	<b>25</b>	<b>700</b>

SEMESTER - VI																		
Sem	Paper Code	Paper Name (As displayed on Mark Sheet)	Asses- ment Method	Teaching Scheme (hr/wk)			Credits Assigned				Examination Scheme						Total Marks	
				L	T	P	L	T	P	Total	Theory Marks			Term- work	Prac- tical	Oral		
											Internal Assessment							End Sem Exam
											T1	T2	Av.					
VI	PPC601	Packaging Machineries & Systems	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
VI	PPC602	Food & Pharmaceutical Packaging	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
VI	PPC603	Flexographic Printing	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
VI	PPC604	Colour Management	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
VI	PPC605*	Elective – I	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
VI	PPL601	Packaging Machineries & Systems	TW/Or	-	-	2	-	-	1	1	-	-	-	-	25	-	25	50
VI	PPL602	Package Design & Graphics - II	TW/Pr	-	-	4	-	-	2	2	-	-	-	-	25	50	-	75
VI	PPL603	Flexographic Printing	TW/Pr	-	-	3	-	-	1.5	1.5	-	-	-	-	25	25	-	50
VI	PPL604	Colour Management	TW/Or	-	-	2	-	-	1	1	-	-	-	-	25	-	25	50
VI	PPL605*	Elective - I	TW/Or	-	-	2	-	-	1	1	-	-	-	-	25	-	25	50
VI	PPS601	Industrial Visits	TW/Or	-	-	3	-	-	1.5	1.5	-	-	-	-	25	-	25	50
<b>TOTAL</b>				<b>18</b>	<b>0</b>	<b>16</b>	<b>18</b>	<b>-</b>	<b>8</b>	<b>26</b>	<b>-</b>	<b>-</b>	<b>100</b>	<b>400</b>	<b>150</b>	<b>75</b>	<b>100</b>	<b>825</b>

**Elective – I:** 1. Packaging Distribution & Dynamics

2. Inks & Coatings

3. Digital & Security Printing

4. Print Finishing & Converting

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SEMESTER - VII																		
Sem	Paper Code	Paper Name (As displayed on Mark Sheet)	Asses- ment Method	Teaching Scheme (hr/wk)			Credits Assigned				Examination Scheme						Total Marks	
				L	T	P	L	T	P	Total	Theory Marks			Term- work	Prac- tical	Oral		
											Internal Assessment							End Sem Exam
											T1	T2	Av.					
VII	PPC701	Sustainable Packaging	Theory	2	-	-	2	-	-	2	15	15	15	60	-	-	-	75
VII	PPC702	Packaging Laws & Regulations	Theory	2	-	-	2	-	-	2	15	15	15	60	-	-	-	75
VII	PPC703	Packaging Distribution & Logistics	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
VII	PPC704	Total Quality Management & Economics	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
VII	PPC705	Project Management& Entrepreneurship	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
VII	PPC706*	Elective - II	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
VII	PPT701	Cost Estimation& Statistical Analysis	TW	-	2	-	-	2	-	2	-	-	-	-	25	-	-	25
VII	PPT702	Project Management & Entrepreneurship	TW	-	2	-	-	2	-	2	-	-	-	-	25	-	-	25
VII	PPL703	Packaging Distribution & Logistics	TW/Or	-	-	3	-	-	1.5	1.5	-	-	-	-	25	-	25	50
VII	PPL704	Elective - II	TW/Or	-	-	3	-	-	1.5	1.5	-	-	-	-	25	-	25	50
VII	PPS701	Mini Project	TW/Or	-	-	4	-	-	2	2	-	-	-	-	50	-	25	75
<b>TOTAL</b>				<b>18</b>	<b>4</b>	<b>10</b>	<b>18</b>	<b>4</b>	<b>5</b>	<b>27</b>	<b>-</b>	<b>-</b>	<b>110</b>	<b>440</b>	<b>150</b>	<b>-</b>	<b>75</b>	<b>775</b>

**Elective – II:** 1. Advance Food Packaging      2. Advanced Industrial Products Packaging      3. Labelling Technology      4. e-Publishing

SEMESTER - VIII																		
Sem	Paper Code	Paper Name (As displayed on Mark Sheet)	Asses- ment Method	Teaching Scheme (hr/wk)			Credits Assigned				Examination Scheme						Total Marks	
				L	T	P	L	T	P	Total	Theory Marks			Term- work	Prac- tical	Oral		
											Internal Assessment							End Sem Exam
											T1	T2	Av.					
VIII	PPI801	Professional Internship	TW/Or	-	-	-	-	-	-	14	-	-	-	-	150	-	100	250
VIII	PPP801	Project	TW/Or	-	-	-	-	-	-	10	-	-	-	-	100	-	100	200
<b>TOTAL</b>				<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>24</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>250</b>	<b>-</b>	<b>200</b>	<b>450</b>

Course Code	Course / Subject Name	Credits
<b>PPC 301</b>	<b>Applied Mathematics - III</b>	<b>4</b>

**Objectives:**

1. Study Laplace Transform, Fourier series & Transform.
2. Understand the fundamental aspects of vector calculus & matrices.
3. Study the concept of probability & statistics.

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

1. Obtain and invert Laplace Transform using standard results and shifting theorem.
2. Determine eigen values & eigen vectors of a matrix and power or exponential of a matrix using them.
3. Formulate and analyze mathematical problems followed by drawing clear and reasonable conclusions.
4. Infer about a particular sample with high degree of reliability.
5. Formulate and analyze statistical problems followed by drawing clear and reasonable conclusions.
6. Apply fourier transform in engineering learning

Module	Details.	Hrs.
1	<b>Laplace Transform:</b> Definition of Laplace Transform, Laplace Transform of standard functions, Properties (Linearity, Change of scale) and theorems (First shifting, second shifting) (without proofs), Laplace Transform of Unit Step. Inverse Laplace Transform: To determine Inverse Laplace Transform by partial fraction method, Convolution Theorem (without proof). Application of Laplace Transform to solve differential equations	12
2	<b>Fourier Series &amp; Fourier Transforms:</b> Orthogonal and Orthonormal set of functions, Dirichlet's conditions, Fourier series of periodic functions, Even and Odd functions, Half range Sine and cosine series Fourier Integral theorem (Proof not required) - Fourier Sine and Cosine integral representations. Fourier Transforms - Fourier Sine and Cosine Transforms.	12
3	<b>Vector Calculus:</b> Scalar and Vector Point function, Vector differential operator. Directional derivatives, Gradient, Divergence and Curl, Conservative, Irrotational and Solenoidal fields. Scalar potential.	6
4	<b>Matrices:</b> Eigen values and Eigen vectors, properties (without proof), Cayley Hamilton Theorem (only statement) and its applications	6
5	<b>Probability &amp; Statistics:</b> Random variables - Probability distributions (Poisson & Normal) moments, moment generating functions. Testing of Hypothesis - Large sample tests - Test of Significance difference between sample mean and Population mean, means of two samples, Small sample tests (Student's t, F, Chi square).	12

### **Theory Examinations:**

**a) End Semester University examination for 80 marks will have :**

- i) Question paper with 6 questions, each of 20 marks.
- ii) Only 4 questions need to be answered.
- iii) Question 1 will be compulsory and based on maximum part of the syllabus.
- iv) Remaining each of 5 questions will be based on combination of modules.  
( e.g., Q2 has part (a) and (b) from two different modules ).

**b) Internal Assessment for 20 marks:**

Assessment consists of compulsory two tests out of which first test should be class test (on minimum 40% of curriculum) and the other is either a class test (from remaining 60% of curriculum) or assignment on live problems.

### **References :**

1. Higher Engineering Mathematics, B.V Ramana, Tata MacGrawHill.
2. Fundamentals of statistics, S.C Gupta Himalaya Publications.
3. Matrices, A.R Vasishta Krishana Prakashan media Ltd.
4. Probability statistics and Random process, T.Veerarajan, Tata MacGrawHill.
5. A text of engineering mathematics, N.P Bali, M.GoyalLaxmi Publications.

Course Code	Course / Subject Name	Credits
<b>PPC302</b>	<b>Packaging Introduction &amp; Concepts</b>	<b>2</b>

**Objectives:**

1. Study the basic concepts of packaging technology.
2. Understand marketing as an integral tool to packaging.
3. Recognize the importance of product-package interaction & its quality aspects in packaging.
4. Study the overall perspective of the packaging industry.

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

1. Effectively observe and compare the different package forms.
2. Describe the importance of compatibility studies and their associated parameters.
3. Analyze the various hazards & environmental issues related to Packaging.
4. Analyze the aesthetics of a package and the differentiating factors.
5. Elaborate the importance of quality in packaging.
6. Explain significance of packaging in terms of today's market.

Module	Details.	Hrs.
1	<b>Packaging Introduction:</b> Packaging – History, Need & Evolution; Packaging Functions – Contain, Preserve, Protect, Inform, Identify, Sell; Packaging Hazards – Storage, Transportation, Chemical, Climatic, Biological; Packaging Classifications – Primary / Secondary / Tertiary, Unit / intermediate / Bulk, Flexible & Rigid.	6
2	<b>Packaging as a Marketing Tool:</b> Market Considerations – Importance of Demography & Psychography, Retail Market (POP), Equity & Brand Name; Package Embellishment – Graphic Design Elements – Significance of Shape, Size, Colour, Font, Texture, Lines, Balance & Unity, Symmetry & Harmony; Shelf Appeal Studies - Recall Questioning, Focus Group, Eye-Tracking, S-scope studies.	6
3	<b>Product-Package Compatibility Studies:</b> Product Characteristics: Physical (nature, shape, size, texture, Centre of gravity, etc.), Chemical (Acidic, basic, reactivity etc.), Biological (Effect of micro-organisms) and Effect of moisture, oxygen and other gases; Package Characteristics: Material (Plastic, paper, wood, etc.), Physical (tensile, breaking load, burst, molecular/fibre direction, etc.), Chemical (Unreacted chemicals present, pH, etc.), Biological (sensitivity to micro-organisms), Permeability (Barrier properties – Absorption/Diffusion of moisture and gases). Live Problems / Case Studies.	6
4	<b>Introduction to Quality:</b> Quality Control – Need and importance in packaging; Significance of specifications; Significance of Testing; Introduction to Standards, Conditioning, Sampling; Examples of testing according to standards.	3



5	<b>Packaging Perspectives:</b> Packaging Costs; Packaging – Environmental considerations & waste management; Introduction to Packaging Laws & Regulations; Packaging Scenario – World & India – Comparison, Scope & Growth in India.	3
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**Theory Examinations:**

**a) End Semester University examination for 60 marks will have :**

- i) Question paper with 6 questions, each of 15 marks.
- ii) Only 4 questions need to be answered.
- iii) Question 1 will be compulsory and based on maximum part of the syllabus.
- iv) Remaining each of 5 questions will be based on combination of modules.  
(e.g., Q2 has part (a) and (b) from two different modules).

**b) Internal Assessment for 15 marks:**

Assessment consists of compulsory two tests out of which first test should be class test (on minimum 40% of curriculum) and the other is either a class test (from remaining 60% of curriculum) or assignment on live problems.

**References:**

- a. Soroka W., “Fundamentals of Packaging Technology”, 3<sup>rd</sup> Ed, IoPP, 2002.
- b. Paine F. A., “The Packaging User’s Handbook”, 1<sup>st</sup> Ed, Blackie Academic & Professional, 1991.
- c. Byett J. et al., “Packaging Technology”, 2<sup>nd</sup> Ed, The Institute of Packaging (SA), 2001.
- d. Selke, S. E. M., Culter, J. D. and Hernandez, R. J., “Plastics Packaging: Properties, processing, Applications and Regulation”, Carl Hanser Verlag, USA, 2004.
- e. Joseph F. H, Robert J. K, Hallie F, “Handbook of Package Engineering”, Third Edition, Technomic Publishing, 1998.
- f. Yam K. L., “The Wiley Encyclopedia of Packaging Technology”, Third Edition, Wiley, 2009.

Course Code	Course / Subject Name	Credits
<b>PPC303</b>	<b>Introduction to Printing Technology</b>	<b>3</b>

**Objectives:**

1. Introducing concepts of Printing technology along with its evolution & necessity in today's society.
2. Understand the basic principles of various Printing processes.
3. Study basic image reproduction process, contribution of various elements in designing & typesetting.
4. Study of various materials used in printing processes.

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

1. Distinguish various printing principles like planography, intaglio & relief.
2. Compare the process of image generation on the basis of typography, reprography & layout making.
3. Analyze the various Press configurations of Offset, Gravure, Flexography & Letterpress.
4. Classify Inks and Substrates used in various Printing technologies.
5. Recognize various materials used in printing operations and distinguish Print finishing operations.
6. Choose an appropriate Printing process for any given Printing job.

Module	Details.	Hrs.
1	<p><b>Introduction</b>            Printing – History, Need &amp; Evolution.            Definition of Printing- Various forms of communication-            Conventional Printing processes - Relief printing process, Lithography, Intaglio, Screen printing and Pad printing. Applications, advantages and their limitations.            Digital printing processes - Concept of impact and non-impact, working of electrophotography and ink jet and its application in Package Printing</p>	06
2	<p><b>Pre-Press</b>            Typography- digital font and movable type, type terminology, typeface structure and parts &amp; type family- definition            Typesetting and Measurements - measure &amp; gauge, pica, em, en. Readability &amp; legibility            Original and its types, requirements for various printing process.  <b>Films</b>            Types of films, generation of positive and negative films, line and half tone film generation, latent image formation and development.            Exposure – definition, types, effect of over and under exposure on films. Need of color separation, Additive and subtractive color theories. Layout and imposition- need and significance of imposition technique.  <b>DTP</b>            Introduction to DTP, advantages and applications. Proofing – need and significance of proofing, types of proof in brief (soft and hard proof), proofing technique: press proofers- offset, flexography and</p>	08

	gravure. Digital proofers.	
3	<b>Press</b> Letter press printing technology- Flat bed, Platen press, Rotary Press and its applications. Offset- Sheet fed & Web fed machines- Inline, Stack, CIC and Perfecting (Blanket to blanket) mechanism and its applications. Gravure and Flexography- Inline, Stack and CIC Configurations and its applications in Package Printing. Screen- Flat and Rotary printing. Hybrid press and its application in Packaging Industry. Introduction to Security features in Printing	10
4	<b>Post Press</b> Cutting, slitting, trimming. Binding- folding, types of folding (parallel and perpendicular folds), gathering, collating, inseting. Binding style-saddle stitching, section binding, perfect binding. Finishing- Diecutting, Foil stamping, Embossing, Coating, Varnishing and Lamination and it's role in enhancing Package Printing	06
5	<b>Ink and Substrate</b> Classification of ink- paste, liquid (water and solvent base). Basic ingredients of inks pigment resin, vehicle, additive etc. Printing inks-Letter press, Lithographic, Flexographic, Gravure, Screen printing and Pad printing. Rheological properties of inks: viscosity, yield value, thixotropy, flow,tack, body length. Drying methods- Chemical drying, Physical drying. Substrates used in Package printing-Standard paper sizes-British & ISO. Basic properties of Paper, Paperboard, Plastic and Foils and their importance in Package Printing	06

### Theory Examinations:

#### a) End Semester University examination for 80 marks will have:

- i) Question paper with 6 questions, each of 20 marks.
- ii) Only 4 questions need to be answered.
- iii) Question 1 will be compulsory and based on maximum part of the syllabus.
- iv) Remaining each of 5 questions will be based on combination of modules.  
(e.g., Q2 has part (a) and (b) from two different modules).

#### b) Internal Assessment for 20 marks:

Assessment consists of compulsory two tests out of which first test should be class test (on minimum 40% of curriculum) and the other is either a class test (from remaining 60% of curriculum) or assignment on live problems.

### References:

1. Handbook of Print Media, Helmet Kipphan, Springer Publications
2. Hand book of Print and Production – Michael Barnard, John Peacock.
3. Printing Materials Science & Technology Vol. 24, J. Anthony Bristow
4. The Complete technology book on Printing Inks, Asia Pacific Business Press
5. Typesetting – Composition – Geoff, Barlow
6. Hand book of Typography – Kailas Tahle
7. Printing Technology 5th edition, Michael Adams
8. The Print and Production manual, PIRA

Course Code	Course / Subject Name	Credits
<b>PPC 304</b>	<b>Paperbased Packaging Materials</b>	<b>4</b>

**Objectives:**

1. Gain the basic knowledge of pulping and paper making process.
2. Study the different types of paper based packages and their manufacturing process.
3. Understand the designing process and estimation of material requirements for major forms of paper based packaging
4. Study the major testing standards and properties of paper based packaging materials as per standards

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

1. Explain the raw materials involved in pulping and paper making process.
2. Explain the operations involved in pulping and paper making process
3. Identify the manufacturing process for different types of paper based Packages.
4. Design and estimate material requirements for major forms of paper based packaging.
5. Test and analyze the major properties of paper based packaging materials.
6. Describe the manufacturing process for different types of paper based Packages.

Module	Details.	Hrs.
1	<p><b>Raw Materials and Preparation:</b> Fibrous raw materials –Soft and Hard Wood, Wood structure and morphology, Nonwoodfibers and recycled paper, Non fibrous Additives, Sizing Agents, Binders, Fillers and Additives, Wood harvesting, logging, sorting, Debarking, Chipping, Screening &amp; Storage.</p> <p><b>Pulping:</b> Types- Mechanical, Chemical and semi-chemical- Mechanical pulping, Stone ground wood, pressurized grinding, Refiner pulping, refiner plates, Assisted mechanical pulping, thermo-mechanical, chemi-mechanical, chemithermo-mechanical, Chemical pulping- Kraft and Sulfite – Pulping Chemistry - Liquor Chemicals and reactions- Digester Temperature and Pressure - Chemical recovery and environmental effects- Pulp properties – Processing of pulp for paper making.</p>	14
2	<p><b>Paper Making:</b> Preparation of pulp – Repulping/dispersion, Beating and Refining, Bleaching, Recycled paper – Deinking, Washing and Flotation Foudrinier Paper Machine- Dry and Wet end operations- Surface treatments- Sizing, Coating and Super calendaring.</p> <p><b>Board making:</b> Multiply Board, Cylinder Forming machine, Vat types - Pressure and suction forming. Pressing, drying and finishing.</p> <p><b>Paper properties:</b> Optical properties – Colour, brightness, smoothness, gloss, opacity and rub resistance, Strength properties–thickness, grammage, tensile, tear, bursting strength, stiffness, Grain direction, Wire and Felt sides</p>	14
	<p><b>Types of papers:</b> Printing grades-uncoated papers, coated papers, Newsprint, office</p>	

3	<p>paper-Packaging paper grades, properties and applications - Tissue, Parchment, greaseproof, glassine, wet strength paper, stretchable paper, coated paper- Boards used in packaging- Solid bleached/unbleached, folding box board, white lined chip board.</p> <p><b>Paper based packaging:</b>  Paper bags &amp; Sacks–Manufacturing &amp; Applications- Types of bags- Multiwall Paper bags – Composite containers  Manufacturing &amp; Applications convolute/ spiral/lap winding –  Fiber drums- Regenerated Cellulosic films.</p>	10
4	<p><b>Cartons and Boxes:</b>  Folding Cartons – Styles and Applications- Designing and manufacturing - Set up box applications and manufacturing process- Corrugated Fiber Board(CFB) – structure and materials- Types of flutes and their characteristics- Manufacturing process of CFB- Making of CFB box- Styles of boxes- Properties of CFB  Solid Fiber board box manufacturing, materials and applications-  Moulded pulp board – moulding process, applications</p>	10

### Theory Examinations:

**a) End Semester University examination for 80 marks will have :**

- i) Question paper with 6 questions, each of 20 marks.
- ii) Only 4 questions need to be answered.
- iii) Question 1 will be compulsory and based on maximum part of the syllabus.
- iv) Remaining each of 5 questions will be based on combination of modules.  
(e.g., Q2 has part (a) and (b) from two different modules).

**b) Internal Assessment for 20 marks:**

Assessment consists of compulsory two tests out of which first test should be class test (on minimum 40% of curriculum) and the other is either a class test (from remaining 60% of curriculum) or assignment on live problems.

### References:

1. Hand book of Paper and Board, Herbert Holik, Wiley-VCH, 2006.
2. Paper and paperboard Packaging Technology, Mark J. Kirwan, Blackwell Publishing, 2005.
3. Handbook of Pulp Vol.1, Herbert Sixta, Wiley-VCH, 2005.
4. Handbook for pulp and paper technologists, G.A. Smook, Angus Wilde Publications, 2001.

Course Code	Course / Subject Name	Credits
<b>PPC 305</b>	<b>Glass, Metal &amp; Textile based Packaging Materials</b>	<b>3</b>

**Objectives:**

1. Understand the use and application of primary packaging materials i.e. glass and metal.
2. Study the types of textile materials and their application
3. Learn the basics package forms and the technology to manufacture them for the above listed materials.

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

1. Describe & interpret the various manufacturing process for glass bottles, metal cans & tubes and textile based bags .
2. Explain various design aspects for various types of package forms made up of glass.
3. Explain various design aspects for various types of package forms made up of metal.
4. Summarize the aerosol technology and its wide application in packaging.
5. Discuss various quality control and testing procedures for these package forms.
6. Describe the basics of fabric & textile technology to produce bags of various materials like jute, hemp etc.

Module	Details.	Hrs.
1	<p><b>Glass in Packaging</b>            Introduction &amp; History of Glass Materials - Composition - Chemical Structure - Raw Materials used for manufacturing glass containers - Glass properties - Glass Industry - Market Overview            Glass Manufacturing Process - Container Forming Processes - Study of important control parameters during the processes - Post forming Treatments or processes            Types of Glass - Types of glass containers - Advantages &amp; Disadvantages - Applications            Glass bottle design - Specifications &amp; Quality Control - Defects</p>	12
2	<p><b>Metals in Packaging</b>            Introduction &amp; History of Metals - Overview of Extraction Processes - Important Metals in Packaging &amp; their properties - Market &amp; Industry Overview            Aluminium based: Conversion processes for Sheets - Aluminium Foil, properties &amp; their applications            Steel based: Stainless &amp; Galvanized Steel - Coated steels like Tinsplate, Tinfree Steel, Polymer coated - Manufacturing Process &amp; Description            Metal Cans: History of Metal Cans - Three piece &amp; Two piece Cans - Draw &amp; redraw, Draw &amp; iron, Walled iron Cans - Welded &amp; Seamless Cans - Can Dimensioning - Specifications &amp; Quality Control - Defects            Collapsible Tubes - Manufacturing process - Design of Metal Collapsible Tubes - Advantages &amp; Disadvantages of Metal Collapsible tubes            Aerosol Containers - Classification of Aerosols - Design <b>Features</b></p>	16

	- Components - Filling Process - Advantages & Disadvantages of Aerosols - Applications Overview of metal corrosion and anticorrosion techniques	
3	<b>Textile based Packaging</b> Materials for textile based packaging - Raw materials like Jute, Hemp etc. - Terminologies - Sack Manufacturing Process - Jute Bag classification like Hessians, Tarpaulins & Twilled - Finishing Treatments -Standardization of Sizes - Lining & its Significance - Applications - Comparison with Plastic Bags	8

### Theory Examinations:

**c) End Semester University examination for 80 marks will have :**

5. Question paper with 6 questions, each of 20 marks.
6. Only 4 questions need to be answered.
7. Question 1 will be compulsory and based on maximum part of the syllabus.
8. Remaining each of 5 questions will be based on combination of modules.  
(e.g., Q2 has part (a) and (b) from two different modules).

**d) Internal Assessment for 20 marks:**

Assessment consists of compulsory two tests out of which first test should be class test (on minimum 40% of curriculum) and the other is either a class test (from remaining 60% of curriculum) or assignment on live problems.

### References:

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

Course Code	Course Name	Credits
<b>PPT 301</b>	<b>Applied Mathematics – III Tutorial</b>	<b>2</b>

**Objectives:**

1. Study Laplace Transform, Fourier series & Transform.
2. Understand the fundamental aspects of vector calculus & matrices.
3. Study the concept of probability & statistics

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

1. Obtain and invert Laplace Transform using standard results and shifting theorem.
2. Determine eigen values & eigen vectors of a matrix and power or exponential of a matrix using them.
3. Formulate and analyze mathematical problems followed by drawing clear and reasonable conclusions.
4. Infer about a particular sample with high degree of reliability.
5. Formulate and analyze statistical problems followed by drawing clear and reasonable conclusions.
6. Apply fourier transform in engineering learning

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

**a) Minimum Eight tutorials**

**b) Assignments:** Minimum two numericals on each of the following topics:

1. Fourier series & Fourier Transforms
2. Probability & Statistics.
3. Laplace Transform.
4. Vector Calculus.
5. Matrices.

( **Note:** Preferably the assignments shall be given on the basis of live problems.)

Distribution of marks for Term Work shall be as follows:

Tutorial work	:	15 Marks.
Assignments	:	05 Marks
Attendance (Theory and Tutorial)	:	05 marks.



Course Code	Course / Subject Name	Credits
<b>PPL301</b>	<b>Principles of Graphic Arts &amp; Design-I</b>	<b>1.5</b>

**Objectives:**

1. Study the basics of how to create a design.
2. Understand the fundamental principles of graphic design & their types.
3. Study the concept of colour and their effects on design.
4. Understand the method to create visual image and layout.
5. Learn and understand the various softwares used for designing.

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

1. Create a design based on specific requirement.
2. Analyze the usage of particular colour & text in Package design.
3. Generate various design layouts with proper visual impacts.
4. Create a design for folding carton with appropriate software.
5. Edit an image and use it in a Package design.
6. Generate Logos for a given concept or product.

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

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

Module	Details	Laboratory Sessions
1	To create thumbnails and rough sketches based on theme selected for the design.	3 Hrs
2	To prepare an appropriate Layout for the selected design.	3 Hrs
3	To edit an image using Adobe Photoshop	3 Hrs
4	To create a logo design using Corel DRAW	3 Hrs
5	To apply various effects on the image using editing software	3 Hrs
6	To prepare a brochure using Corel DRAW	3 Hrs
7	To create a design layout for folding carton of given dimensions	3 Hrs
8	To create a label design for any given product	3 Hrs
9	To design commercial print products	3 Hrs

**b) Assignments:** Minimum one write-up on each of the following topics:

1. Case study of Layout and Typography used in current Package design
2. Case study of any current Folding carton design
3. Case study of Flexible package design
4. Case study of Label design

(**Note:** Preferably the assignments shall be given on the basis of live problems.)

Distribution of marks for Term Work shall be as follows:

Laboratory work	:	15marks.
Assignments	:	05 Marks
Attendance (Theory and Practical)	:	05 marks.

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

Course Code	Course Name	Credits
<b>PPL302</b>	<b>Screen Printing Laboratory</b>	<b>2</b>

**Objectives:**

1. Introduce the concept of screen printing techniques.
2. Understand the screen printing technology for four color printing.
3. Gain knowledge about different applications of screen printing.

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

1. Prepare screen printing image carrier by direct, indirect photographic methods.
2. Demonstrate the use of different photographic films for mesh preparation according to image.
3. Produce different printed samples for various substrates like fabric, glass, acrylic, wood by selecting suitable inks & coatings for that material.
4. Produce & analyze a halftone dot image generated for four color printing and registration of color.
5. Analyze the common faults in Screen Printing Process

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

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

Module	Details	Laboratory Sessions
1.	Study of screen printing process, equipment and chemicals used.	4 Hrs
2	Determining optimum exposure for various stencil methods.	4 Hrs
3	Centering the image for various size stocks.	4 Hrs
4	Screen preparation and printing by direct method.	4 Hrs
5	Screen preparation and printing by indirect method.	4 Hrs
6	Screen preparation and printing by direct indirect method.	4 Hrs
7	Printing two colour image on paper and textile.	4 Hrs
8	To Planning, Designing& Production of 16 page brochure using screen printing.	4 Hrs
9	Screen Printing on textile/PVC/Glass – T-Shirt.	4 Hrs

**b) Assignments:** Minimum two question on each of the following topics:

1. Screen Printing on different substrate
2. Chemical Used in Screen Printing
3. Common Fault in screen printing
4. Screen Printing automatic press
5. Screen Process Stencils/fabrics

( **Note:** Preferably the assignments shall be given on the basis of live problems.)

Distribution of marks for Term Work shall be as follows:

Laboratory work	:	30 Marks.
Assignments	:	10 Marks
Attendance (Theory and Practicals)	:	10 marks.

Course Code	Course Name	Credits
<b>PPL303</b>	<b>Paperbased Material Testing</b>	<b>1.5</b>

**Objectives:**

1. To determine bursting strength burst factor of paper.
2. To compare Stiffness of board on machine and cross direction.
3. To compare Tearing strength of paper on machine and cross direction.

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

1. Check grammage and thickness of paper & paperboard.
2. Find out burst factor of paper.
3. Perform stiffness test.
4. Perform Puncture resistance of CFB.
5. Identify flute types in CFB.
6. Make paper carry bags as per the standard.

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

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

Module	Details	Laboratory Sessions
1	To find Grammage and thickness of paper and paperboard	3 Hrs
2	To find Cobb value of paper and board	3Hrs
3	To find Bursting strength and burst factor of paper	3Hrs
4	To find Tearing Strength of paper and grain direction	3Hrs
5	To find Stiffness of board	3Hrs
6	To find Puncture resistance of CFB	3 Hrs
7	To Identify flute types in CFB	3Hrs
8	To find BCT, ECT and RCT of CFB	3Hrs
9	To make paper carry bags	3Hrs

**b) Assignments:** Minimum onenumerical on each of the following topics:

1. Cost of CFB.
2. Weight of CFB.

(Note: Preferably the assignments shall be given on the basis of live problems.)

Distribution of marks for Term Work shall be as follows:

Laboratory work	:	15marks.
Assignments	:	05 Marks
Attendance (Theory and Practicals )	:	05 marks.

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

Course Code	Course Name	Credits
<b>PPL304</b>	<b>Glass, Metal &amp; Textile based Packaging Materials Tutorial</b>	<b>2</b>

**Objectives:**

1. To understand testing procedures for glass, metal & textile based packages
2. To interpret test results for various standard testing procedures.
3. To describe and conduct the various testing procedures for glass, metal & textile packages based on specific requirements.

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

1. Use various testing standards
2. Calculate capacity & dimensions for containers
3. Analyze Thermal shock & chemical resistance for glass bottles
4. Perform & Analyze coating related tests for metals used for cans
5. Analyze corrosion tests for metals
6. Conduct tests for textile based materials

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

**a) List of Tutorials (minimum eight)**

Tutorials to be covered on the basis of ASTM/ISO/IS or any other suitable standards for testing of glass, metal, textile based packaging. Tutorials should be uniformly conducted from following listed areas for various materials. Demonstration would be beneficial for the learner. Some of them can be listed as follows:

Glass - Alkalinity, verticality test, Annealing defects, dimensions & capacity along with its significance, melting point of glass, thermal shock, chemical resistance, constituents testing etc.

Metal - Coating thickness, Scotch Tape test for tin lacquers, lacquer curing test for metals, rust resistance (visual & comparative, thiosulphate method), salt drop test for corrosion etc.

Textile - Weight of Hessian, Tensile strength & elongation, seam strength, oil content of Hessian cloth etc.

**b) Assignments:** Minimum one numerical on each of the following topics:

1. Cost of Glass Container.
2. Cost of Metal Container (Cans/Tube)
3. Design parameter & effects on cost reduction.
4. Package considerations for jute bags for bulk materials (chemicals/agro)

(Note: Preferably the assignments shall be given on the basis of live problems.)

Distribution of marks for Term Work shall be as follows:

Tutorial work	:	15marks.
Assignments	:	05 Marks
Attendance (Theory and Tutorials )	:	05 marks.

**End Semester Oral Examination (for 25 marks):** Under single head of examination, oral to be conducted by internal and external examiners.

Course Code	Course / Subject Name	Credits
<b>PPC401</b>	<b>Plastics in Packaging</b>	<b>4</b>

**Objectives:**

1. Understand the fundamentals of polymer science.
2. Study and appreciate the macro, micro & molecular level interaction in polymers.
3. Learn the factors that affect rheological properties of plastics.
4. Study the different types of plastics and their associated properties.
5. Understand the various testing methods employed on plastic materials.

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

1. Describe the various polymerization mechanisms and techniques.
2. Differentiate between thermoplastics & thermosets.
3. Effectively communicate the relation between effects of temperature and crystallinity of polymers.
4. Identify and categorize various plastics by chemical and instrumentation methods.
5. Choose a plastic material for a specific application based on their physical and chemical properties.
6. Describe the properties that are important from the point of view of plastic processing.

Module	Details.	Hrs.
1	<b>Introduction to Polymers</b> Introduction to Historical Background of Polymer Science, Various applications of polymers, Raw materials, Market and future of polymers, India in global scenario. Macromolecular concept, structural features of polymers, Basic concepts and terminology like monomers, oligomers, telomers, polymers low polymers, high polymers, copolymers, functionality, degree of polymerization, thermoplastics, thermosets, elastomers/rubbers, plastics, fibers, adhesives.	8
2	<b>Classification of Polymers</b> Classification based on structure, origin, fabrication, properties etc. Linear, branched, crosslinked polymers etc. Classification Nomenclature of polymers, Crystalline and Amorphous polymers. Brief idea of Adhesives, Fibers and surface coatings, Blends, alloys. Polymerization reaction -Polymerization mechanisms (Addition & Condensation), Types of polymerization (Bulk, Solution, Suspension & Emulsion).	8
3	<b>Molecular Weight &amp; Molecular Weight Distribution:</b> Concept of average molecular weight of polymers Molecular Weight Distribution , Mw, Mn, Mv and Mz, Polydispersity index. Thermal changes – Glass Transition Temperature (Tg), Softening/ Melting Temperature (Tm), Degradation Temperature (Td). Heat Distortion Temperature, understanding Melt Flow Index of plastics.	10
4	<b>Structure –Property Relationship:</b> Glass transition temperature, factors affecting glass transition temperature, melting point and factors affecting it, melt viscosity, Factors affecting Tensile strength, yield strength, modulus,	7

	density, impact strength. Heat Distortion Temperature, Vicat Softening Point, and hardness.	
5	<b>Commodity Plastics in Packaging:</b> Polyethylene (PE): Types, Properties & Applications. Polypropylene (PP): Varieties, Properties & Applications. Polyvinyl Chloride (PVC): Properties, Compounding & Applications. Polystyrene (PS): Types, Properties & Applications. Copolymerization, Alloying and Blending.	7
6	<b>Engineering &amp; Speciality Plastics in Packaging:</b> Properties & Applications of Engineering Plastics: Thermoplastics Polyesters (PET & PBT), Polycarbonate (PC), Acrylics (PAN & PMMA), Polyamide (PA 6 & PA 6,6). Properties & Applications of Speciality Plastics: Polyvinylidene chloride (PVdC), Ethyl Vinyl Acetate (EVA), Ethyl Vinyl Alcohol (EVOH), Ionomer, Polychlorotrifluoroethylene (PCTFE)	5
7	<b>Thermoset plastics in packaging:</b> Applications of Amino plastics (Urea Formaldehyde & Melamine Formaldehyde), Phenolics, Epoxies, Unsaturated Polyesters, Polyurethane.	3

#### **Theory Examinations:**

##### **a) End Semester University examination for 80 marks will have :**

- i) Question paper with 6 questions, each of 20 marks.
- ii) Only 4 questions need to be answered.
- iii) Question 1 will be compulsory and based on maximum part of the syllabus.
- iv) Remaining each of 5 questions will be based on combination of modules. ( e.g., Q2 has part (a) and (b) from two different modules ).

##### **b) Internal Assessment for 20 marks:**

Assessment consists of compulsory two tests out of which first test should be class test ( on minimum 40% of curriculum ) and the other is either a class test ( from remaining 60% of curriculum ) or assignment on live problems.

#### **References :**

1. Strong A. B., "Plastics: Materials and Processing", 3<sup>rd</sup>Ed, Pearson-Prentice Hall, 2006.
2. Gowariker V. R., Viswanathan N. V., Sreedhar J., " Polymer Science", 1<sup>st</sup>Ed, New Age International Publishers, 1986.
3. Selke, S. E. M., Culter, J. D., Hernandez, R. J., "Plastics Packaging: Properties, processing, Applications and Regulation", Carl HanserVerlag, USA, 2004.
4. Margolis J. M., "Engineering Plastics Handbook", 1<sup>st</sup>Ed., McGraw-Hill, 2006.
5. Athalye A. S., "Handbook of Packaging Plastics", 1<sup>st</sup>Ed., Multi Tech Publishing Co., 1999.
6. Yam K. L., "The Wiley Encyclopedia of Packaging Technology", 3<sup>rd</sup>Ed., Wiley, 2009.

Course Code	Course / Subject Name	Credits
<b>PPC402</b>	<b>Ancillary Packaging Materials</b>	<b>3</b>

**Objectives:**

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

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

1. Analyze various cushioning materials and describe their properties.
2. Analyze the types of adhesives and apply the concept of adhesion in the packaging.
3. Elaborate the functions of various closures and choose a closure for a specific application.
4. Choose the right label for a specific packaging application.
5. Analyze the types of straps & tapes and describe their application in different packages.
6. Describe the significance of codings and coatings in packaging.

Module	Details.	Hrs.
1	<b>Cushioning materials:</b> Packaging hazards –Drop, Vibration, Shock- Functions of cushioning materials– Type- flexible, semi-rigid and fillers. Materials – paper, plastic and wood based, foams and rubber, 2 component systems. Properties of Cushioning materials – Creep, moisture and fungus resistance; Introduction to Fragility Factor and Cushion Factor	6
2	<b>Adhesion:</b> Principles of Adhesion- Mechanical Interlocking, Molecular diffusion, Electrostatic theory, Chemical Bonding; Surface Properties – wetting, contact angle, surface energy; Surface preparation – cleaning, etching, Corona and plasma treatment, Flame treatment; Types of adhesives – Natural/Synthetic adhesives – Water based/Solvent based/Hot melt – Adhesive applicators; Adhesives and adhesive strength evaluation – Bond, Peel, Shear; Adhesive and cohesive strength – Rheological Properties – Viscosity / Tack / wetting / yield Climatic / environmental influences.	9
3	<b>Closures:</b> Functions of caps and closures, Types of closures – Once only – Membranes, Crowns, Re-usable- Roll on – ROPP&RSNP, Lug caps, Plug type, Snap on/slip lid, lever and ring – single/double. Design features of threaded closures – Wads– Wadding Materials, properties, selection Criteria Special closures – Child resistant, New generation dispensing closures; Materials- plastics – thermoplastics and thermosets, Metals – Manufacturing process for closures.	7
4	<b>Labels:</b> Applications – purpose& objective, Contents of a Label – Classification – self-adhesive, wet glue, in-mould, inserts, tags, shrink and stretch sleeve, heat sealable, thermal transfer, properties and applications. Label stocks – paper, films, Al foil – specifications and applications – Manufacturing Process –	6

	Pressure sensitive, Shrink sleeve – Labelling process, equipments and mechanism – Smart and intelligent Labels / Security labels.	
5	<b>Reinforcements:</b> Strapping- functions; Materials- Metal-steel, Plastics- HDPE / PP / PET / Nylon; Types of loads –rigid, compressible, stretching, shrinkable; Properties and Criteria for Selection of strapping Materials; Tensioning; Crimping and Sealing of straps; Taping – functions- Kraft paper tapes- properties and types- white and coloured - BOPP/PVC self-adhesive tapes- properties and manufacturing; Tape dispensing – Manual, hand held and automatic.	5
6	<b>Coatings and coding:</b> Lacquers for Metal plate / Cans, Flexible substrates / Laminates- types and functions; Over print varnishes and coatings – spot varnish and overprint – purpose; Decorative coatings; Functional coatings – heat seal, barrier and protective – coating equipment. Bar Coding- Significance, structure, parts of the code.	3

#### **Theory Examinations:**

##### **a) End Semester University examination for 80 marks will have :**

- i) Question paper with 6 questions, each of 20 marks.
- ii) Only 4 questions need to be answered.
- iii) Question 1 will be compulsory and based on maximum part of the syllabus.
- iv) Remaining each of 5 questions will be based on combination of modules. (e.g., Q2 has part (a) and (b) from two different modules).

##### **b) Internal Assessment for 20 marks:**

Assessment consists of compulsory two tests out of which first test should be class test (on minimum 40% of curriculum) and the other is either a class test (from remaining 60% of curriculum) or assignment on live problems.

#### **References:**

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



Course Code	Course / Subject Name	Credits
<b>PPC403</b>	<b>Colour Reproduction</b>	<b>3</b>

### Objectives:

1. Introducing concept of colour theory and colour Vision
2. Understand the basic colour reproduction techniques and their applications
3. Study the importance of media or substrate in colour perception
4. Study Standardization of colour and its reproduction
5. Apply Colour corrections and Image adjustments

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

1. Summarize the Colour Vision theory and its concept.
2. Discuss & summarize the conventional and digital method of colour separation.
3. Examine images and modify them with colour correction.
4. Measure the densitometric terms and analyze graphically.
5. Summarize the spectrophotometric terms and perform relative measurements of various printed samples.
6. Recognize the input & output devices being used.

Module	Details.	Hrs.
1	<b>Introduction</b> Electromagnetic spectrum, Light, Definition of colour, Light sources, Sample, Observer, Relationship between the triad- Colour vision, Colour matching experiment, Tristimulus values, Chromaticity diagram, Colour attributes- Hue, Value and saturation- Various effects of Colour vision viz., After image effect, Simultaneous contrast effect, Edge contrast-Chromatic adaptation-Metamerism; Colour spaces – Munsell, NCS, CIELAB, CIELUV, CIELCH, Colour difference equations	06
2	<b>Principle of Colour Reproduction</b> Additive and Subtractive colour theory, Pros and Cons of additive and subtractive colour theory- Colour originals for reproduction. Reproduction objectives, Image Acquisition – Types of scanners, Scanner working principles – Flatbed – Drum – Image capture elements – CCD /PMT - dynamic range – bit depth – resolution – Workflow – scanner types & selection. digital cameras; Colour separation techniques, Screen angles and moire patterns.	10
3	<b>Significance of Substrate and Ink in Reproduction</b> Substrate – Whiteness, Brightness, Fluorescence, Gloss, Smoothness, Texture, Absorptivity; Ink – Pigment colour, transparency, opacity, mass tone, undertone; Optics of ink film – first surface reflection, multiple internal reflections. Additivity and Proportionality rules and failure	08
	<b>Print Control and Densitometry</b> Densitometry - Density - secular - defuse - double defuse -	

4	Working principle of Densitometer - Polarized filter - color filters. Color control Strip-gray scale - Ink density – trapping – contrast – dot gain – slur – punch register system - Dot area measurement - Murray Davis Equation & Yule Neilson Correction and Milton-Pearson Factor	06
5	<b>Image adjustments and Colour Correction</b> Image Masking and its principles, Balanced inks, Tone reproduction-Jones Diagram; Gray balance- Concept and application, Masking equations, Neugebauer equation, Application in Look Up Table, Image Adjustments – Colour correction, White point & Black point, Colour cast removal, USM, Black generation techniques- UCR, GCR, UCA.	06

**Theory Examinations:**

**a) End Semester University examination for 80 marks will have :**

- i) Question paper with 6 questions, each of 20 marks.
- ii) Only 4 questions need to be answered.
- iii) Question 1 will be compulsory and based on maximum part of the syllabus. Remaining each of 5 questions will be based on combination of modules. (e.g., Q2 has part (a) and (b) from two different modules).

**b) Internal Assessment for 20 marks:**

Assessment consists of compulsory two tests out of which first test should be class test (on minimum 40% of curriculum) and the other is either a class test (from remaining 60% of curriculum) or assignment on live problems.

**References:**

1. Phill Green, “Understanding Digital Color”, 2nd Ed, GATF Press
2. Garry Field, “Color & its reproduction”, 3rd Ed, GATF Press
3. J. Micheal Adams, “Printing Technology”, 5th Ed, Delmer Publication
4. Helmut Kipphan, “Handbook of Printmedia”, Springer
6. Michael Barnard, “Print Production Manual”, 8th Ed, PIRA International.
8. “Precise color Communication” Konica Minolta Reading material.
9. Gavin Ambrose, “The Production Manual, a graphic design Handbook”
10. R. W. G. Hunt, “The Reproduction of Colour”, 6th Edition, Wiley, 2004.

Course Code	Course / Subject Name	Credits
<b>PPC404</b>	<b>Offset Printing</b>	<b>4</b>

**Objectives:**

1. Gain the technical knowledge in offset printing.
2. Understand advance and integral plate making technologies used in printing industry.
3. Understand coherent challenges in page layout & pressroom.
4. Provide knowledge of finishing techniques associated with offset printing process.
5. Study web offset presses operations.

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

1. Describe the various terminologies in offset printing process.
2. Operate offset machines and evaluate single colour sheet feed press.
3. Identify and rectify suitable solutions for errors associated with platemaking and pressroom.
4. Analyze troubles related with quality and can produce possible remedies to minimize print problems.
5. Identify the conversion technology of offset printed jobs
6. Plan & Layout the imposition of commercial jobs.

Module	Details.	Hrs.
1	<p><b>Introduction to Offset Lithographic Press</b> Introduction, Basic working Principle of lithography, Elementary components of offset press, Press Configurations. Function and construction sheet fed printing unit,</p> <p><b>The Printing Unit</b> Blanket: types, grade, requirements, Cylinder setting. Packing and Printing Pressure, Problems and handling &amp; storage. Impression Cylinder, Transfer Cylinder, Delivery Cylinder &amp; Plate Cylinder</p>	6
2	<p><b>Image Carrier</b> Characteristics of image carrier for lithography, Plate making materials and chemicals, Chemistry of plate making, Light sources Premakeready of plate making process, Surface plate making, Deep-etch plate process, multimetal plates, Presensitised plates, Electrostatic plate process, Diffusion transfer process, Variable in plate preparation, Characteristics of wettability, CTF, CTP, Types of CTP, CTP,CTCP workflow.</p>	8
3	<p><b>Inking System</b> Introduction of typical inking system, Roller covering, Ink film thickness, Setting of rollers, Ink system operation, Inking system problems, Maintenance, Auxiliary devices.</p> <p><b>Dampening System</b> Dampening: Composition of dampening solution, Variables in dampening solution. Types of dampening system: Intermittent, Continuous and Combination. Roller covers, operating dampening system, Refrigeration, Alcohol substitute, Alcohol substitute issues, Maintenance, Operating problems.</p> <p><b>Dryers</b></p>	6

	Types of dryer and working principle.	
4	<p><b>Sheet Control</b> - Introduction, Working and elements of Stream feeder, Pile Table, Sheet Separation Unit, Feed board, Sheet detectors and its various types, Working of single sheet feeder, Sheet Separation Unit, Infeed section, Sheet transfer section, Delivery section: Sheet guiding devices, delivery assist devices.</p> <p><b>Premakeready and Makeready Operations</b> - Printing plant layout: space allocation, accessibility of tools, floor layout and aisles. Tools, Materials: Stock Control, Paper, Inks etc. Inking and Dampening system wash up. Teamwork, Training and Scheduling. Makeready: Introduction and types of makeready, makeready procedures, preparation of press for new pressrun, Checking trial impressions.</p>	8
5	<p><b>The Pressrun</b> - Inspection of press sheets, use of tags, Control of press functions: maintaining inking, dampening and other units. Quality control during the pressrun: densitometry, colour control bars, Controlling colour during the pressrun, Light and standard viewing conditions.</p> <p><b>Troubles &amp; Trouble Shooting</b> - Causes and remedies: Printing unit troubles, defects in inking system, dampening troubles, plate defect, Blanket troubles, Paper troubles, Ink defects.</p>	6
6	<p><b>Web Offset Presses</b> - Sections of web offset presses: Infeed unit, Printing unit, Dryers and Chillers, Folders and structures, sheet delivery unit. Ink supply, Dampening system. Web Travel: Web tension control, web guide control, slitters, turner bar, Former and types of folders, Types of web presses: Typical configurations and various formats. Troubleshooting.</p> <p><b>Web Reel Cost Estimation</b> Sheets in a reel, length of the paper, paper consumption for a specific job.</p>	6
7	<p><b>Finishing &amp; Conversion</b> Page Layout, Imposition, Folding types, Stages of proofing, Gathering, Collating, Insetting, Bundling, Tipping, Guarding, Punching &amp; Drilling, Creasing &amp; Scoring, Perforation, Index Cutting, Banding &amp; Counting, Padding</p> <p><b>Recent Trends &amp; Advancement</b> <b>Toshiba: Erasable offset printing, Kodak: Sinora Process free plate, Technova: Innovative Plate Making, EFI: Print ERP, Komori: Digital Offset, Heidelberg: Print on demand, Parkson: Innovative Folding cartons using Manroland</b></p>	8

### Theory Examinations:

#### a) End Semester University examination for 80 marks will have :

- i) Question paper with 6 questions, each of 20 marks.
- ii) Only 4 questions need to be answered.
- iii) Question 1 will be compulsory and based on maximum part of the syllabus. Remaining each of 5 questions will be based on combination of modules.

( e.g., Q2 has part (a) and (b) from two different modules ).

**b) Internal Assessment for 20 marks:**

Assessment consists of compulsory two tests out of which first test should be class test ( on minimum 40% of curriculum ) and the other is either a class test ( from remaining 60% of curriculum ) or assignment on live problems.

**References :**

1. Lloyod P., De Jidas & Thomas M. Destree “Sheet fed Offset Press Operating” GATF
2. Helmut Kipphan “Handbook of Print Media” Heidelberg
3. J. Michael Adams “Printing Technology” 5<sup>th</sup> Edition, Delmar
4. Michael Barnard “The Print & Production Manual” PIRA
5. C. S. Mishra “Lithographic Image Carrier” AnupamPrakashan Allahabad
6. C. S. Mishra “Technology of Offset Printing” AnupamPrakashan Allahabad
7. Prakash Shetty “Science and Technology of Printing Materials” MJP Publishers.

Course Code	Course / Subject Name	Credits
<b>PPC405</b>	<b>Digital Electronics &amp; Microcontrollers</b>	<b>4</b>

**Objectives:**

1. Understand the concepts of digital logic & Boolean algebra.
2. Study the combinational & sequential circuits.
3. Study reduction techniques of logical expressions.
4. Understand the basic concept of microcontroller and its application in the field of packaging & printing technology.

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

1. Describe any logical expression using basic gates.
2. To examine the structure of various number systems and its application in digital design
3. Discuss the combinational & sequential circuits like encoder, decoder, flip-flop, registers & counters.
4. Identify features of various Microcontroller.
5. Write and execute assembly language programs.
6. Summarize the need and functioning of microcontroller in various machines of Printing and Packaging.

Module	Details.	Hrs.
1	<b>Logic gates and Boolean Algebra</b> Basic Logic gates, universal gates, EX-OR and EX-NOR gates (symbol, equation and truth table, Boolean laws, D-Morgan's theorem, Realization of Boolean expressions using basic logic gates and universal gates	7
2	<b>Number system and combinational circuits</b> Binary, Octal, Decimal and Hexadecimal number systems and conversion. Binary arithmetic including 1's complement and 2's complement, BCD code, Canonical logic forms, Sum Of Product (SOP) form, reduction of Boolean expression using K-MAP (upto 4 variables only), Introduction to combinational circuits, encoders, decoders, buffers, MUX, DEMUX. Implementation of Combinational circuits using Multiplexers and Demultiplexers.	10
3	<b>Sequential Circuits</b> Introduction to sequential circuits, Flip Flop and its types, clocked and edge triggered flip flops. Introduction to counters and registers (Description and types only).	7
4	Overview of generic microprocessor, architecture and functional block diagram, Comparison of microprocessor and microcontroller. <b>Introduction to 8051 microcontroller and Architecture</b> Introduction, Architecture, Memory Organization, Special function Registers, Pins and Signals, Timing and control, Port Operation, Memory and I/O interfacing basics.	12

5	<b>8051 Instruction Set and Programming</b> 8051 addressing modes, instruction set, Simple Assembly language programming	12
6	<b>Application of microcontroller in Printing and Packaging</b> Industrial automation using Microcontroller:-Eg. Applications of Microcontroller in Form, Fill & Seal Machines for various fillers, Controlled injection moulding machines; Microcontroller based printing systems for Inkjet, Gravure techniques etc.	4

### Theory Examinations:

#### a) End Semester University examination for 80 marks will have :

- i) Question paper with 6 questions, each of 20 marks.
- ii) Only 4 questions need to be answered.
- iii) Question 1 will be compulsory and based on maximum part of the syllabus.
- iv) Remaining each of 5 questions will be based on combination of modules.  
( e.g., Q2 has part (a) and (b) from two different modules ).

#### b) Internal Assessment for 20 marks:

Assessment consists of compulsory two tests out of which first test should be class test (on minimum 40% of curriculum) and the other is either a class test (from remaining 60% of curriculum) or assignment on live problems.

### References :

1. R. P. Jain, "Modern Digital electronics", TMH 2001
2. M. Morris Mano, "Digital Design" by Pearson Education
3. Malvino, "Digital electronics", TMH
4. Douglas V Hall, "Microprocessors and Interfacing", TATA McGRAW HILL, Rev 2<sup>nd</sup> edition
5. Barry B. Bery, "The Intel Microprocessors", 8<sup>th</sup> edition, Pearson Education.
6. Yu-Cheng Liu & Glenn A Gibson, "Microcomputer systems 8086/8088 family, Architecture, Programming and Design", 2nd Edition- July 2003, Prentice Hall of India.
7. The 8051 Microcontrollers - Architecture, Programming and Applications by K. J. Ayala, Penram International Publishing (I) Pvt Ltd.
8. The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2/e by Muhammad Ali Mazidi, Janice GillispieMazidi and RolinMcKinlay( Second Edition , Pearson Education).

Course Code	Course / Subject Name	Credits
<b>PPL401</b>	<b>Principles of Graphic Arts and Design-II</b>	<b>1.5</b>

**Objectives:**

1. Study the basics of how to create a design for Package.
2. Understand the fundamental principles of graphic design for websites.
3. Study the concept of colour and their effects on Package.
4. Learn and understand the various softwares used for designing.

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

1. Create a Package design based on specific requirement.
2. Create Ups using the editing software for given substrate dimension.
3. Generate various design layouts with proper visual impacts.
4. Create a design for folding carton with appropriate software.
5. Edit an image and use it in a Package design
6. Design a Website and Upload in Internet.

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

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

Module	Details	Laboratory Sessions
1	To design Newspaper page layout in Adobe InDesign.	3 Hrs
2	To design a folding carton using Adobe illustrator	3 Hrs
3	To create a Package template using Adobe Illustrator	3 Hrs
4	To design a logo using Adobe Illustrator	3 Hrs
5	To create a Vector graphic and use in Package design using Adobe Illustrator	3 Hrs
6	To Preflight a given Package design using Indesign	3 Hrs
7	To create three dimensional Package design using Adobe Illustrator	3 Hrs
8	To create a website layout and place design elements using	3 Hrs

**b) Assignments:** Minimum one write-up on each of the following topics:

1. Comparison of Adobe Illustrator and Indesign
2. Case study of a current Package design and its prospective improvements
3. Case study of a Current Website
4. Case study of current layout of any newspaper

(Note: Preferably the assignments shall be given on the basis of live problems.)

Distribution of marks for Term Work shall be as follows:

Laboratory work	:	15marks.
Assignments	:	05 Marks
Attendance (Theory and Practical)	:	05 marks.

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



Course Code	Course Name	Credits
<b>PPL402</b>	<b>Plastic Material Testing</b>	<b>01</b>

**Objectives:**

1. To determine the strength of materials under different loading conditions.
2. To understand and perform the practical as per the standard procedure given by ASTM/IS

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

1. Identify plastic material by chemical and instrumentation method.
2. Perform simple tensile test on UTM.
3. Determine ESCR of a plastic sample.
4. Perform impact test using dart impact method.
5. Determine coefficient of friction of plastic films.
6. Analyze thermogram from a DSC.

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

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

Module	Details	Laboratory Sessions
1	Identification of Plastics by Chemical method	2 Hrs
2	Determination of tensile strength of a plastic film.	2 Hrs
3	Determination of bonding strength of a plastic laminate.	2 Hrs
4	Determination of Impact resistance on packaging/plastic specimen – Dart Impact test	2 Hrs
5	Identification of Plastics/Layers in a laminate by Instrumentation Method – FTIR	2 Hrs
6	Performing thermal analysis of Plastics by Differential Scanning Calorimeter.	2 Hrs
7	Determination of specular gloss of plastic films.	2 Hrs
8	Determination of Coefficient of friction of plastic films.	2 Hrs
9	Study of Environmental Stress Crack Resistance of plastic items.	2 Hrs

**b) Assignments:** Minimum three assignments to be given. Assignments can also involve Quiz. Preferably the assignments shall be given on the basis of live problems/case studies.

Distribution of marks for Term Work shall be as follows:

Laboratory work	:	15 Marks.
Assignments	:	05 Marks
Attendance ( Theory and Practicals )	:	05 marks.

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

Course Code	Course / Subject Name	Credits
<b>PPL403</b>	<b>Colour Reproduction Laboratory</b>	<b>1</b>

**Objectives:**

1. Study the effects of triad viz., Observer, Object and Light source
2. Understand Densitometric terms and their importance in Print quality
3. Study the concept of colour difference and its importance in industry
4. Understand various colour reproduction techniques and their applications

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

1. Match any two given colours under prescribed light source
2. Measure density and compare with the standards.
3. Analyse the colour difference between any two given printed samples
4. Measure various vitals of Print quality such as Dot gain, Print contrast, Hue error & Grayness and Trapping
5. Comment on Print quality based on measured values
6. Suggest Corrections required to achieve better print quality

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

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

Module	Details	Laboratory Sessions
1	To match two given printed samples under prescribed light source	2 Hrs
2	To measure density values and compare print quality of any two given samples.	2 Hrs
3	To measure dot gain and thereby draw Print Characteristic curve	2 Hrs
4	To measure auto and reverse trapping of ink in given sample and suggest an appropriate ink sequence	2 Hrs
5	To measure Hue error & Grayness and compare the ink Quality	2 Hrs
6	To measure Print contrast and comment on tone reproduction	2 Hrs
7	To measure the Colour difference for any given Reference and Sample patch under all available formulae	2 Hrs
8	To apply UCR and GCR using editing software and record the difference	2 Hrs
9	To prepare an image for conventional printing using parameters viz., Dot gain compensation, Colour curves etc.,	2 Hrs

**b) Assignments:** Minimum one write-up on each of the following topics:

1. Case study of Effect of colour perception affecting the buyer
2. Printing Standards for Package Industry
3. Image corrections using editing software
4. Case study of any live industry define problem.

**(Note:** Preferably the assignments shall be given on the basis of live problems.)

Distribution of marks for Term Work shall be as follows:

Laboratory work	:	15marks.
Assignments	:	05 Marks
Attendance (Theory and Practical)	:	05 marks.

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

Course Code	Course Name	Credits
<b>PPL404</b>	<b>Offset Printing*</b>	<b>1.5</b>

**Objectives:**

1. To determine the troubleshooting of printed sheets
2. To understand the offset printing process

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

1. Analyse the problem of printed sample & troubleshoot it
2. Perform printing on single color offset printing machine
3. Evaluate the number of sheets required for printing a particular job.
4. Evaluate the inking & dampening system condition through testing.
5. Plan & provide a dummy pack for a particular product.
6. Evaluate the conversion technologies used for a commercial pack.

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

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

Module	Details	Laboratory Sessions
1.	To prepare page layout for given size of job using appropriate utilization of paper and the plate size.	3 Hrs
2	Introduction to offset machine parts & workflow of Printing Industry	3 Hrs
3	Preparation of in-feed and delivery unit for given stock.	3 Hrs
4	Offset plate mounting.	3 Hrs
5	Study of packing and printing pressure on print.	3 Hrs
6	Preparation of inking and dampening system for pressrun	3 Hrs
7	Printing single colour job on sheetfed press.	3 Hrs
8	To Planning ,Designing & Production of 16 page inside & 4 page cover of Book/Magazine/Brochure	3 Hrs
9	To Planning ,Designing & Production of folding carton	3 Hrs

**b) Assignments:** Minimum two question on each of the following topics:

1. Press Configuration
2. Planning & layout
3. Printing Units
4. Plate Making
5. Pre Makeready&Makeready

( **Note:** Preferably the assignments shall be given on the basis of live problems.)

Distribution of marks for Term Work shall be as follows:

Laboratory work	:	15 Marks.
Assignments	:	05 Marks
Attendance ( Theory and Practicals )	:	05 marks.

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

Course Code	Course Name	Credits
<b>PPL 405</b>	<b>Digital Electronics &amp; Microcontrollers Laboratory</b>	<b>01</b>

**Objectives:**

1. To reinforce learning in the accompanying (PPC 405) course through hands-on experience with design, construction, and implementation of digital circuits.
2. To understand the instruction set and programming of 8051.

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

1. To demonstrate the knowledge of operation of logic gates.
2. To apply Boolean theorems, DeMorgan's theorems and Karnaugh maps reduction method to simplify logic problems.
3. Create the appropriate truth table from a description of a combinational logic functions.
4. Demonstrate the knowledge of operation of basic types of flip-flops.
5. To analyze and design digital combinational circuits including arithmetic circuits (half adder, full adder, half subtractor and full subtractor).
6. Develop skill in simple program writing for 8051.

**Term Work:** (Comprises a, b & c)

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

Module	Details	Laboratory Sessions
1	Verification of logic gates.	2 Hrs
2	Verification of Boolean laws and theorem using logic gates.	2 Hrs
3	Half adder and half subtractor	2 Hrs
4	Full adder and full subtractor	2 Hrs
5	Study of Flip Flop	2 Hrs
6	Programs based on Data Transfer Instructions	2 Hrs
7	Programs based on Data Exchange Instructions	2 Hrs
8	Programs based on Arithmetic Instructions	2 Hrs
9	Programs based on Logical Instructions	2 Hrs
10	Relay/LED Interfacing ( Demonstration only)	2 Hrs

**b) Assignments:**

1. Designing simple combinational circuits.
2. Application of Boolean theorems, De Morgan's theorems and Karnaugh map reduction method.
3. Flip flop and conversion using K map and application of sequential circuits.
4. Case study on application of microcontroller in industrial automation.

**c). Course Project:**

In course project students shall integrate and apply the knowledge gained during the course. The projects shall be developed by team of maximum four students. Further, course project shall demonstrate design, setup, and implementation of a simple system.

(**Note:** Preferably the assignments shall be given on the basis of live problems.)

Distribution of marks for Term Work shall be as follows:

Laboratory work	:	10marks.
Assignments	:	05 Marks
Course Project	:	05 Marks
Attendance (Theory and Practical)	:	05 marks.

Course Code	Course Name	Credits
<b>PPL406</b>	<b>Ancillary Packaging Material Testing</b>	<b>01</b>

**Objectives:**

1. To learn the various testing procedures for ancillary packaging materials.
2. To understand the significance of the tests and use them for finding out the required property of the ancillary packaging material.

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

1. Determine peel / bond strength of an adhesive.
2. Perform shear resistance test on tape/label.
3. Determine the grammage of all components in a label.
4. Determine tack of a self-adhesive tape or a label by Rolling Ball Tack Tester.
5. Determine opening and closing torque for closures.
6. Effectively perform strapping and taping of a CFB Box.

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

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

Module	Details	Laboratory Sessions
1	To find adhesive coating weight and GSM of all the components in a label.	2 Hrs
2	To find shear resistance of an adhesive on a tape/label.	2 Hrs
3	To find peel strength, bond strength of an adhesive on label.	2 Hrs
4	To find the tack of self-adhesive tape or a label by rolling ball tack test.	2 Hrs
5	To find opening and closing torque for closures.	2 Hrs
6	To perform strapping on a CFB box.	2 Hrs
7	To perform taping on a CFB box.	2 Hrs
8	To find the scuff resistance of printed label.	2 Hrs
9	To find tensile strength of a label.	2 Hrs

**b) Assignments:** Minimum three assignments on any of the following topics:

1. Adhesion.
2. Cushioning.
3. Closures.
4. Labelling.

(**Note:** Preferably the assignments shall be given on the basis of live problems.)

Distribution of marks for Term Work shall be as follows:

Laboratory work	:	15 Marks.
Assignments	:	05 Marks
Attendance ( Theory and Practicals )	:	05 marks.