

UNIVERSITY OF MUMBAI



Bachelor of Engineering

in

Printing and Packaging Technology

Second Year with Effect from AY 2020-21

Third Year with Effect from AY 2021-22

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	Second Year B.E. in Printing and Packaging Technology
2	Eligibility for Admission	After Passing First Year Engineering as per the Ordinance 0.6242
3	Passing Marks	40%
4	Ordinances / Regulations (if any)	Ordinance 0.6242
5	No. of Years / Semesters	8 semesters
6	Level	P.G. / U.G./ Diploma / Certificate (Strike out which is not applicable)
7	Pattern	Yearly / Semester (Strike out which is not applicable)
8	Status	New / Revised (Strike out which is not applicable)
9	To be implemented from Academic Year	From Academic Year: 2020-2021

Date

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Preamble

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

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

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

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

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Incorporation and implementation of Online Contents from NPTEL/ Swayam Platform

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

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

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

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Preface

University of Mumbai being the first University in India to approve and start the Bachelor of Engineering Program in Printing and Packaging Technology in the year 2006-07, has stayed abreast with the various technologies in this field in the years that have followed with significant updates and revision in the Curriculum. With the help of Packaging and Printing Industry Experts, Academicians, and other stake holders, in this 4th revision, the curriculum for B. E. Printing and Packaging Technology has been kept relevant to the requirements of current national and international trends.

Printing & Packaging Technology is a niche field which involves multi-disciplinary courses to enable the learners to apply their engineering knowledge and skills, right from materials used such as Wood, Paper, Glass, Metals and Plastics to their conversion processes. Printing Industry has survived the onslaught of Digital Communication and the standard Printing Technologies are co-existing with Digital and Hybrid Print Technologies. 3D Printing is another area where the additive manufacturing has helped the industry to develop prototypes rapidly during product development. Effort has been put to expose learners to the newer technologies along with a strong base in the existing concepts.

Emphasis has been given to improve the skills, knowledge, and attitude of the learners in line with the Outcome-Based Education, with case-studies and real-life examples from the Printing & Packaging Industry. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The Program Educational Objectives finalized for the undergraduate program in Printing & Packaging Technology are listed below:

1. Pursue higher studies and / or contribute to Printing & Packaging Industry at national and international levels.
2. Become a principal professional with good technical and management skills to solve economic, environmental, and industrial / societal problems.
3. Become an entrepreneur serving the needs of the society.

We trust this revised version of syllabus come up to the expectations of all stakeholders. We wish to place on record our sincere thanks and appreciations to the various contributors from the academia and industry for their most learned inputs in framing this syllabus.

Board of Studies in Mechanical Engineering

Dr. Vivek K. Sunnapwar	: Chairman
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**Program Structure for Second Year Engineering
Semester III & IV
UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)
Semester III**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total	
PPC301	Engineering Mathematics – III	3	--	1	3	--	1	4	
PPC302	Packaging Introduction and Concepts	3		--	3		--	3	
PPC303	Introduction to Printing Technology	3	--	--	3	--	--	3	
PPC304	Paper based Packaging Materials	3	--	--	3	--	--	3	
PPC305	Glass, Metal and Textile based Packaging Materials	3	--	--	3	--	--	3	
PPL301	Principles of Graphic Arts and Design I	--	3	--	--	1.5	--	1.5	
PPL302	Screen Printing Laboratory	--	4	--	--	2	--	2	
PPSBL301	Packaging Material Testing - I	--	3	--	--	1.5	--	1.5	
PPPBL301	Mini Project – 1 A	--	4 ^s	--	--	2	--	2	
Total		15	14	1	15	07	1	23	
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.					
PPC301	Engineering Mathematics – III	20	20	20	80	3	25	--	125
PPC302	Packaging Introduction and Concepts	20	20	20	80	3	--	--	100
PPC303	Introduction to Printing Technology	20	20	20	80	3	--	--	100
PPC304	Paper based Packaging Materials	20	20	20	80	3	--	--	100
PPC305	Glass, Metal and Textile based Packaging Materials	20	20	20	80	3	--	--	100
PPL301	Principles of Graphic Arts and Design I	--	--	--	--	--	25	25	50
PPL302	Screen Printing Laboratory	--	--	--	--	--	50	--	50
PPSBL301	Packaging Material Testing - I	--	--	--	--	--	25	25	50
PPPBL301	Mini Project – 1 A	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	150	75	725

\$ indicates work-load of Learner (Not Faculty), for Mini Project

PBL – Project Based Learning

SBL – Skill Based Laboratory

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
PPC401	Engineering Mathematics - IV	3	--	1	3	--	1	4
PPC402	Plastics in Packaging	3	--	--	3	--	--	3
PPC403	Colour Reproduction	3	--	--	3	--	--	3
PPC404	Offset Printing	3	--	--	3	--	--	3
PPC405	Digital Electronics and Microcontrollers	3	--	--	3	--	--	3
PPL401	Principles of Graphic Arts and Design II	--	3	--	--	1.5	--	1.5
PPL402	Colour Reproduction Laboratory	--	2	--	--	1	--	1
PPL403	Offset Printing Laboratory	--	2	--	--	1	--	1
PPL404	Digital Electronics and Microcontrollers Laboratory	--	2	--	--	1	--	1
PPSBL401	Packaging Material Testing – II	--	3	--	--	1.5	--	1.5
PPPBL401	Mini Project – 1 B	--	4 ^{\$}	--	--	2	--	2
Total		15	16	1	15	8	1	24

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
PPC401	Engineering Mathematics - IV	20	20	20	80	3	25	--	125
PPC402	Plastics in Packaging	20	20	20	80	3	--	--	100
PPC403	Colour Reproduction	20	20	20	80	3	--	--	100
PPC404	Offset Printing	20	20	20	80	3	--	--	100
PPC405	Digital Electronics and Microcontrollers	20	20	20	80	3	--	--	100
PPL401	Principles of Graphic Arts and Design II	--	--	--	--	--	25	25	50
PPL402	Colour Reproduction Laboratory	--	--	--	--	--	25	25	50
PPL403	Offset Printing Laboratory	--	--	--	--	--	25	25	50
PPL404	Digital Electronics and Microcontrollers Laboratory						25	--	25
PPSBL401	Packaging Material Testing – II	--	--	--	--	--	25	25	50
PPPBL401	Mini Project – 1 B	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	175	125	800

\$ indicates work-load of Learner (Not Faculty), for Mini Project

PBL – Project Based Learning

SBL – Skill Based Laboratory

Students group and load of faculty per week.

Mini Project 1A / 1B: Students can form groups with minimum 2 (Two) members and not more than 4 (Four) members

Faculty Load: 1 hour per week per four groups

Course Code	Course / Subject Name	Credits
PPC 301	Engineering Mathematics - III	4

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II,

Course Objectives: The course is aimed

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills
3. To familiarize with the concept of complex variables, C-R equations with applications.
4. To study the application of the knowledge of matrices and numerical methods in complex engineering problems.

Course Outcomes: On successful completion of course learner/student will be able to:

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variable theory.
5. Apply Matrix algebra to solve the engineering problems.
6. Solve Partial differential equations by applying numerical solution and analytical methods for one dimensional heat and wave equations

Module	Detailed Contents	Hrs.
01	<p>Module: Laplace Transform</p> <p>1.1 Definition of Laplace transform, Condition of Existence of Laplace transform, 1.2 Laplace Transform (L) of Standard Functions like e^{at}, $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n, where $n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation.</p> <p>Self-learning topics: Heaviside's Unit Step function, Laplace Transform. of Periodic functions, Dirac Delta Function.</p>	07
02	<p>Module: Inverse Laplace Transform</p> <p>2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivative 2.2 Partial fractions method & first shift property to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof)</p> <p>Self-learning Topics: Applications to solve initial and boundary value problems involving ordinary differential equations.</p>	06
03	<p>Module: Fourier Series:</p> <p>3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof) 3.2 Fourier series of periodic function with period 2π and $2l$, 3.3 Fourier series of even and odd functions 3.4 Half range Sine and Cosine Series.</p> <p>Self-learning Topics: Complex form of Fourier Series, orthogonal and orthonormal set of functions, Fourier Transform.</p>	07

04	<p>Module: Complex Variables: 4.1 Function $f(z)$ of complex variable, limit, continuity and differentiability of $f(z)$, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof) 4.3 Milne-Thomson method to determine analytic function $f(z)$ when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations</p>	07
05	<p>Module: Matrices: 5.1 Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (No theorems/ proof) 5.2 Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix. 5.3 Functions of square matrix 5.4 Similarity of matrices, Diagonalization of matrices Self-learning Topics: Verification of Cayley Hamilton theorem, Minimal polynomial and Derogatory matrix & Quadratic Forms (Congruent transformation & Orthogonal Reduction)</p>	06
06	<p>Module: Numerical methods for PDE 6.1 Introduction of Partial Differential equations, method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems) 6.2 Crank Nicholson method 6.3 Bender Schmidt method Self-learning Topics: Analytical methods of solving two and three dimensional problems.</p>	06

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. 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.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.

4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S.R.K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, H.K. Das, S. Chand Publication
5. Higher Engineering Mathematics B.V. Ramana, McGraw Hill Education
6. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education,
7. Text book of Matrices, Shanti Narayan and P K Mittal, S. Chand Publication
8. Laplace transforms, Murray R. Spiegel, Schaum's Outline Series

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/111/104/111104085/>
2. <https://nptel.ac.in/courses/111/106/111106139/>

Course Code	Course / Subject Name	Credits
PPC302	Packaging Introduction and Concepts	3

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 and 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 and 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	Packaging Introduction: Packaging – History, Need and 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 and Rigid. Importance of Packaging in Supply Chain	08
2	Packaging as a Marketing Tool: Market Considerations – Importance of Demography and Psychography, Retail Market (POP), Equity and Brand Name; Package Embellishment – Graphic Design Elements – Significance of Shape, Size, Colour, Font, Texture, Lines, Balance and Unity, Symmetry and Harmony; Shelf Appeal Studies - Recall Questioning, Focus Group, Eye-Tracking, S-scope studies.	07
3	Product-Package Compatibility Studies: 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.	10
4	Introduction to Quality: Quality Control and Quality Assurance - Significance in packaging; Role of specifications in defect free packaging; Significance of Testing; Introduction to Standards, Conditioning, Sampling; How to read and understand the standards and their revisions and Examples of testing according	07

	to standards; Certification for product safety and quality	
5	Packaging Perspectives: Packaging Costs – Various elements of costing; Packaging – Environmental considerations and waste management; Introduction to Packaging Laws and Regulations; Packaging Scenario – World and India – Comparison, Scope and Growth in India.	07

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:

- a. Soroka W., “Fundamentals of Packaging Technology”, 3rd Ed, IoPP, 2002.
- b. Paine F. A., “The Packaging User’s Handbook”, 1st Ed, Blackie Academic & Professional, 1991.
- c. Byett J. et al., “Packaging Technology”, 2nd 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
PPC303	Introduction to Printing Technology	3

Objectives:

1. Introducing concepts of printing technology along with its evolution and 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 and 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 and relief.
2. Compare the process of image generation based on typography, reprography and layout making.
3. Analyze the various Press configurations of Offset, Gravure, Flexography and 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>Introduction Printing – History, Need and 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>	07
2	<p>Pre-Press Typography- digital font and movable type, type terminology, typeface structure and parts and type family- definition Typesetting and Measurements - measure and gauge, pica, em, en. Readability and legibility Original and its types, requirements for various printing process. Films 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. DTP 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 gravure. Digital proofers.</p>	08
	<p>Press Letter press printing technology- Flat bed, Platen press, Rotary Press and its applications. Offset- Sheet fed and Web fed</p>	

3	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	Post Press Cutting, slitting, trimming. Binding- folding, types of folding (parallel and perpendicular folds), gathering, collating, inseting. Binding style-saddle stitching, section binding, perfect binding. Finishing- Die-cutting: Flat and Rotary their significance, Foil stamping, Embossing, Coating, Varnishing and Lamination and its role in enhancing Package Printing	07
5	Ink and Substrate 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 and ISO. Basic properties of Paper, Paperboard, Plastic and Foils and their importance in Package Printing	07

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

Course Code	Course / Subject Name	Credits
PPC 304	Paper based Packaging Materials	3

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.
- 7.

Module	Details.	Hrs.
1	<p>Raw Materials and Preparation:</p> <p>Fibrous raw materials –Soft and Hard Wood, Wood structure and morphology, Non-wood fibers and recycled paper, Non fibrous Additives, Sizing Agents, Binders, Fillers and Additives, Wood harvesting, logging, sorting, Debarking, Chipping, Screening and Storage.</p> <p>Pulping:</p> <p>Types- Mechanical, Chemical and semi-chemical- Mechanical pulping, Stone ground wood, pressurized grinding, Refiner pulping, thermo-mechanical, chemi-mechanical, chemi-thermo-mechanical, Chemical pulping- Kraft and Sulfite - Chemical recovery and environmental effects- Pulp properties – Processing of pulp for paper making.</p>	08
2	<p>Paper Making:</p> <p>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>Board making:</p> <p>Multiply Board, Cylinder Forming machine, Vat types - Pressure and suction forming. Pressing, drying and finishing.</p>	08
3	<p>Paper properties:</p> <p>Optical properties – Colour, brightness, smoothness, gloss, opacity and rub resistance, Strength properties–thickness, grammage, tensile, tear, bursting strength, stiffness, Grain direction, Wire and</p>	05

	Felt sides	
4	<p>Types of papers: Printing grades-uncoated papers, coated papers, Newsprint, office 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>Paper based packaging: Paper bags and Sacks–Manufacturing and Applications- Types of bags- Multiwall Paper bags – Composite containers Manufacturing and Applications convolute/ spiral/lap winding – Fiber drums- Regenerated Cellulosic films.</p>	09
5	<p>Cartons and Boxes: Folding Cartons – Styles and Applications- Designing and manufacturing Set up – Creasing and Cutting operations - Box applications. Corrugated Fiber Board(CFB) – structure and materials- Types of flutes and their characteristics- Manufacturing process of CFB- Properties and Significance of starch glue and Making of CFB box- Styles of boxes- Properties of CFB – Calculation on weight of box of various styles.</p> <p>Solid Fiber board box manufacturing, materials, and applications- Moulded pulp board – moulding process, applications</p>	09

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. 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
PPC 305	Glass, Metal and Textile based Packaging Materials	3

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 and interpret the various manufacturing process for glass bottles, metal cans and 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 and textile technology to produce bags of various materials like jute, hemp etc.

Module	Details.	Hrs.
1	<p>Glass in Packaging Introduction and 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 and Disadvantages - Applications</p>	09
2	<p>Glass Design and Testing Glass bottle design - Specifications and Quality Control - Defects Standards for Testing: Glass - Alkalinity, verticality test, Annealing defects, dimensions and capacity along with its significance, melting point of glass, thermal shock, chemical resistance, constituents testing etc.</p>	05
3	<p>Metals in Packaging - I Introduction and History of Metals - Overview of Extraction Processes - Important Metals in Packaging and their properties - Market and Industry Overview Aluminium based: Conversion processes for Sheets - Aluminium Foil, properties and their applications Steel based: Stainless and Galvanized Steel - Coated steels like Tinsplate, Tin-free Steel, Polymer coated - Manufacturing Process and Description Metal Cans: History of Metal Cans – Three-piece and Two-piece Cans - Draw and redraw, Draw and iron, Walled iron Cans - Welded and Seamless Cans - Can Dimensioning - Specifications and Quality Control – Defects</p>	08
	<p>Metals in Packaging - II Collapsible Tubes - Manufacturing process - Design of Metal</p>	

4	Collapsible Tubes - Advantages and Disadvantages of Metal Collapsible tubes Aerosol Containers - Classification of Aerosols - Design Features - Components - Filling Process - Advantages and Disadvantages of Aerosols - Applications Overview of metal corrosion and anticorrosion techniques Standards for testing: Metal - Coating thickness, Scotch Tape test for tin lacquers, lacquer curing test for metals, rust resistance (visual and comparative, thiosulphate method), salt drop test for corrosion etc.	10
5	Textile based Packaging Materials for textile-based packaging - Raw materials like Jute, Hemp etc. - Terminologies - Sack Manufacturing Process - Jute Bag classification like Hessians, Tarpaulins and Twilled - Finishing Treatments -Standardization of Sizes - Lining and its Significance - Applications - Comparison with Plastic Bags Standards for testing: Textile - Weight of Hessian, Tensile strength and elongation, seam strength, oil content of Hessian cloth etc. Woven and Nonwoven plastics bags	07

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. 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

Link for online NPTEL/SWAYAM courses:

1. https://www.youtube.com/watch?v=wO8l6_dEpfq

Course Code	Course / Subject Name	Credits
PPL301	Principles of Graphic Arts and Design-I	1.5

Objectives:

1. Study the basics of how to create a design.
2. Understand the fundamental principles of graphic design and 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 software 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 and 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)

Sr. No.	Details
1	To create thumbnails and rough sketches for logos, visiting cards as well as stationery design using Corel DRAW
2	To prepare a brochure using Corel DRAW
3	To create a label design for any given product using Corel DRAW
4	To create a design layout for folding carton of given dimensions using Corel DRAW
5	To create step and repeat (ups) using Corel DRAW
6	To create a social media ad newspaper ad using Corel DRAW
7	To cut-out an image using Adobe Photoshop
8	To apply various effects on the image using Adobe Photoshop
9	To used curves on image using Adobe Photoshop

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

The distribution of Term Work marks will be as follows –

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

End Semester Practical/Oral 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.

Link for online NPTEL/SWAYAM courses:

1. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module Ug.php/135

Course Code	Course Name	Credits
PPL302	Screen Printing Laboratory	2

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 and coatings for that material.
4. Produce and 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)

Sr. No.	Details
1.	Study of screen-printing process, equipment and chemicals used.
2	Determining optimum exposure for various stencil methods.
3	Centering the image for various size stocks.
4	Screen preparation and printing by direct method.
5	Screen preparation and printing by indirect method.
6	Screen preparation and printing by direct indirect method.
7	Printing two colour image on paper and textile.
8	To Planning, Designing and Production of 16 page brochure using screen printing.
9	Screen Printing on textile/PVC/Glass – T-Shirt.

b) Mini Project: A group of 4-6 students should be assigned a mini project on Screen Printing. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

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

Course Code	Course Name	Credits
PPSBL301	Skill Based Lab: Packaging Material Testing - I	1.5

Objectives:

1. To understand various standards w.r.t testing of paper, paper board and plastic films.
2. To understand the difference in physical properties of paper and plastics used in packaging.

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

1. Check grammage and thickness of paper, paper board and plastic films.
2. Find out water absorption capacity of paper / board.
3. Perform strength tests related to Stiffness, Burst, Puncture and Tear.
4. Evaluate the strength characteristics of paper and plastic films.
5. Analyse the plies in a CFB and identify its flute type.
6. Evaluate the strength of a CFB.

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Ten)

Sr. No.	Details
1	To find Grammage and thickness of paper, paperboard and plastic films.
2	To find the grain direction, felt and wire side of paper.
3	To find Cobb value of paper and board.
4	To find Bursting strength and burst factor of paper and CFB.
5	To find Tearing Strength of paper.
6	To find Stiffness of board.
7	To Identify flute types and dimensions of CFB.
8	To find individual grammage of CFB plies.
9	To find Box Compression strength of a CFB
10	To find RCT of paper and ECT of CFB
11	To perform tensile strength on paper and plastic films.
12	To perform Dart Impact Test on Plastic Films.
13	To find the specular gloss of plastics / paper / paperboard.

b) Mini Project: A group of 4-6 students should be assigned a mini project on various aspects of Packaging Material Testing. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

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

End Semester Practical/Oral 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
PPPBL301	Mini Project 1A	2

Objectives

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

Outcome: Learner will be able to...

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

Guidelines for Mini Project

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

Guidelines for Assessment of Mini Project:

Term Work

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

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

One-year project:

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

Half-year project:

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

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria:

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

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

Guidelines for Assessment of Mini Project Practical/Oral Examination:

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

Mini Project shall be assessed based on following points:

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

Course Code	Course Name	Credits
PPC401	Engineering Mathematics-IV	4

Pre-requisite: Engineering Mathematics-I, Engineering Mathematics-II, Engineering Mathematics-III, Binomial Distribution, Physical Interpretation of Vector differentiation, Vector differentiation operator, Gradient of scalar point function, Directional derivative, Divergence of vector point function, Curl of vector point function.

Course Objectives:

1. To study the concept of Vector calculus & its applications in engineering.
2. To study Line and Contour integrals and expansion of complex valued function in a power series.
3. To familiarize with the concepts of statistics for data analysis.
4. To acquaint with the concepts of probability, random variables with their distributions and expectations.
5. To familiarize with the concepts of probability distributions and sampling theory with its applications.

Course Outcomes: On successful completion of course learner/student will be able to:

1. Apply the concept of Vector calculus to evaluate line integrals, surface integrals using Green's theorem, Stoke's theorem & Gauss Divergence theorem.
2. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
3. Apply the concept of Correlation, Regression and curve fitting to the engineering problems in data science.
4. Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
5. Apply the concept of probability distribution to engineering problems & testing hypothesis of small samples using sampling theory.
6. Apply the concepts of parametric and nonparametric tests for analyzing practical problems.

Module	Detailed Contents	Hrs.
01	<p>Module : Vector Calculus</p> <p>1.1 Solenoidal and irrotational (conservative) vector fields.</p> <p>1.2 Line integrals – definition and problems.</p> <p>1.3 Green's theorem (without proof) in a plane, Stokes' theorem (without Proof), Gauss' Divergence theorem (without proof) and problems (only evaluation).</p> <p>Self Learning Topics: Identities connecting Gradient, Divergence and Curl, Angle between surfaces. Verifications of Green's theorem, Stoke's theorem & Gauss-Divergence theorem, related identities & deductions.</p>	07
02	<p>Module: Complex Integration</p> <p>2.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).</p> <p>2.2 Taylor's and Laurent's series (without proof).</p> <p>2.3 Definition of Singularity, Zeroes, poles of $f(z)$, Residues, Cauchy's Residue Theorem (without proof)</p> <p>Self-learning Topics: Application of Residue Theorem to evaluate real integrations.</p>	07
03	<p>Module: Statistical Techniques</p> <p>3.1 Karl Pearson's Coefficient of correlation (r) and related concepts with problems</p> <p>3.2 Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks problems)</p> <p>3.3 Lines of regression</p> <p>3.4 Fitting of first and second degree curves.</p> <p>Self-learning Topics: Covariance, fitting of exponential curve.</p>	06

04	<p>Module: Probability Theory: 4.1 Conditional probability, Total Probability and Baye's Theorem. 4.2 Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, 4.3 Expectation, Variance, Co-variance, moments, Moment generating functions, (Four moments about the origin & about the mean). <u>Self-learning Topics:</u> Properties variance and covariance,</p>	06
05	<p>Module: Probability Distribution and Sampling Theory-I 5.1 Probability Distribution: Poisson and Normal distribution 5.2 Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom. 5.3 Students' t-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t- test) <u>Self-learning Topics:</u> Test of significance of large samples, Proportion test, Survey based project.</p>	07
06	<p>Module: Sampling theory-II 6.1 Chi-square test: Test of goodness of fit and independence of attributes (Contingency table) including Yate's Correction. 6.2 Analysis of variance: F-test (significant difference between variances of two samples) <u>Self-learning Topics:</u> ANOVA: One way classification, Two-way classification (short-cut method).</p>	06

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. 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.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,
4. Vector Analysis, Murray R. Spiegel, Schaum Series
5. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education
6. Probability, Statistics and Random Processes, T. Veerarajan, Mc. Graw Hill education.

Links for online NPTEL/SWAYAM courses:

1. <https://www.youtube.com/watch?v=2CP3m3EgLIQ&list=PLbMVogVj5nJQrzbAweTVvnH6-vG5A4aN5&index=7>
2. <https://www.youtube.com/watch?v=Hw8KHNgRaOE&list=PLbMVogVj5nJQrzbAweTVvnH6-vG5A4aN5&index=8>
3. <https://nptel.ac.in/courses/111/105/111105041/>

Course Code	Course / Subject Name	Credits
PPC402	Plastics in Packaging	3

Objectives:

1. Understand the fundamentals of polymer science.
2. Study and appreciate the macro, micro and 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 and 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	Introduction to Polymers 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.	07
2	Classification of Polymers 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 and Condensation), Types of polymerization (Bulk, Solution, Suspension and Emulsion).	07
3	Molecular Weight and Molecular Weight Distribution: 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.	07
4	Structure –Property Relationship: Glass transition temperature, factors affecting glass transition temperature, melting point and factors affecting it, melt viscosity, Factors affecting Tensile strength, yield strength, modulus, density, impact strength. Heat Distortion Temperature and hardness.	07
5	Commodity Plastics in Packaging: Polyethylene (PE): Types, Properties and Applications. Polypropylene (PP): Varieties, Properties and Applications. Polyvinyl Chloride (PVC): Properties, Compounding and	05

	Applications. Polystyrene (PS): Types, Properties and Applications. Copolymerization, Alloying and Blending.	
6	<p>Engineering and Speciality Plastics in Packaging: Properties and Applications of Engineering Plastics: Thermoplastics Polyesters (PET and PBT), Polycarbonate (PC), Acrylics (PAN and PMMA), Polyamide (PA 6 & PA 6,6). Properties and Applications of Speciality Plastics: Polyvinylidene chloride (PVdC), Ethyl Vinyl Acetate (EVA), Ethyl Vinyl Alcohol (EVOH), Ionomer, Polychlorotrifluoroethylene (PCTFE)</p> <p>Thermoset plastics in packaging: Applications of Amino plastics (Urea Formaldehyde and Melamine Formaldehyde), Phenolics, Epoxies, Unsaturated Polyesters, Polyurethane.</p> <p>Brief introduction on Biodegradable plastics / Bioplastics</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.

References :

1. Strong A. B., "Plastics: Materials and Processing", 3rdEd, Pearson-Prentice Hall, 2006.
2. Gowariker V. R., Viswanathan N. V., Sreedhar J., " Polymer Science", 1stEd, 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", 1stEd., McGraw-Hill, 2006.
5. Athalye A. S., "Handbook of Packaging Plastics", 1stEd., Multi Tech Publishing Co., 1999.
6. Yam K. L., "The Wiley Encyclopedia of Packaging Technology", 3rdEd., Wiley, 2009.

Links for online NPTEL/SWAYAM courses:

1. Swayam Course: Polymers: concepts, properties, uses and sustainability – IIT Madras
https://swayam.gov.in/nd1_noc20_ch41/preview

Course Code	Course / Subject Name	Credits
PPC403	Colour Reproduction	3

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 and 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 and output devices being used.

Module	Details.	Hrs.
1	Introduction 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	07
2	Principle of Colour Reproduction 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 and selection. digital cameras; Colour separation techniques, Screen angles and moire patterns.	10
3	Significance of Substrate and Ink in Reproduction 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
4	Print Control and Densitometry Densitometry - Density - secular - defuse - double defuse - working principle of Densitometer - Polarized filter - color filters. Color control Strip- various standards as per industry - gray scale - Ink density – trapping – contrast – dot gain – slur – punch register system - Dot area measurement - Murray Davis Equation and Yule Neilson Correction and Milton-Pearson	07

	Factor	
5	Image adjustments and Colour Correction 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 and Black point, Colour cast removal, USM, Black generation techniques- UCR,GCR, UCA.	07

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. Phill Green, "Understanding Digital Color", 2nd Ed, GATF Press
2. Garry Field, "Color and 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
PPC404	Offset Printing	3

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 and 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 and Layout the imposition of commercial jobs.

Module	Details.	Hrs.
1	<p>Introduction to Offset Lithographic Press Introduction, Basic working Principle of lithography, Elementary components of offset press, Press Configurations. Function and construction sheet fed printing unit,</p> <p>The Printing Unit Blanket: types, grade, requirements, Cylinder setting. Packing and Printing Pressure, Problems, and handling and storage. Impression Cylinder, Transfer Cylinder, Delivery Cylinder and Plate Cylinder</p>	05
2	<p>Image Carrier 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 workflow.</p> <p>Recent Trends and Advancement Toshiba: Erasable offset printing, Kodak: Sinora Process free plate, Technova: Innovative Plate Making</p>	07
3	<p>Inking System Introduction of typical inking system, Roller covering, Ink film thickness, Setting of rollers, Ink system operation, Inking system problems, Maintenance, Auxiliary devices.</p> <p>Dampening System 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>Recent Trends and Advancement</p>	06
	Sheet Control - Introduction, Working and elements of Stream feeder, Pile Table, Sheet Separation Unit, Feed board, Sheet	

4	<p>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>Dryers Types of dryer and working principle. Relation of drying mechanism and inks used.</p> <p>Troubles and Trouble Shooting - Causes and remedies: Printing unit troubles, defects in inking system, dampening troubles, plate defect, Blanket troubles, Paper troubles, Ink defects.</p> <p>Recent Trends and Advancement</p>	07
5	<p>Web Offset Presses - 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>Web Reel Cost Estimation Sheets in a reel, length of the paper, paper consumption for a specific job.</p> <p>Troubles and Trouble Shooting - Causes and remedies: Printing unit troubles, defects in inking system, dampening troubles, plate defect, Blanket troubles, Paper troubles, Ink defects.</p>	06
6	<p>Pre-makeready and Makeready Operations - 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>	04
7	<p>The Pressrun - Inspection of press sheets, use of tags, Control of press functions: maintaining inking, dampening and other units. Quality control during the pressrun: paperboard, densitometry, colour control bars, Controlling colour during the pressrun, Light and standard viewing conditions, electronic verification system.</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.

References:

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

Course Code	Course / Subject Name	Credits
PPC405	Digital Electronics and Microcontrollers	3

Objectives:

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

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

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

Module	Details.	Hrs.
1	Logic gates and Boolean Algebra 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)	06
2	Number system and combinational circuits 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 (up to 4 variables only), Introduction to combinational circuits, encoders, decoders, buffers, MUX, DEMUX. Implementation of Combinational circuits using Multiplexers and Demultiplexers.	07
3	Sequential Circuits Introduction to sequential circuits, Flip Flop and its types, clocked and edge triggered flip flops. Introduction to counters and registers (Description and types only).	06
4	Overview of generic microprocessor, architecture and functional block diagram, Comparison of microprocessor and microcontroller. Introduction to 8051 microcontroller and Architecture Introduction, Architecture, Memory Organization, Special function Registers, Pins and Signals, Timing and control, Port	08

	Operation, Memory and I/O interfacing basics.	
5	8051 Instruction Set and Programming 8051 addressing modes, instruction set, Simple Assembly language programming	08
6	Application of microcontroller in Printing and Packaging Industrial automation using Microcontroller: - Eg. Applications of Microcontroller in Form, Fill and Seal Machines for various fillers, Controlled injection moulding machines; Microcontroller based printing systems for Inkjet, Gravure techniques etc.	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.

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 2nd edition
5. Barry B. Bery, "The Intel Microprocessors", 8th 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 Gillispie Mazidi and Rolin McKinlay(Second Edition, Pearson Education).

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/108/105/108105113/>
2. <https://nptel.ac.in/courses/117/103/117103064/>
3. <https://nptel.ac.in/courses/117/104/117104072/>

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

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 software 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

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Eight)

Module	Details
1	To design a logo using Adobe Illustrator
2	To design a folding carton using Adobe illustrator
3	To create a label design for any given product Adobe Illustrator
4	To create step and repeat (ups) using Adobe Illustrator
5	To create a Vector graphic and use in flexible Package design using Adobe Illustrator
6	To Preflight a given Package design
7	To create three-dimensional Package design using Adobe Photoshop
8	To design Newspaper page layout in Adobe InDesign.

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

The distribution of Term Work marks will be as follows –

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

End Semester Practical/Oral 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.

Link for online NPTEL/SWAYAM courses:

1. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/135

Course Code	Course / Subject Name	Credits
PPL402	Colour Reproduction Laboratory	1

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

b) Mini Project: A group of 4-6 students should be assigned a mini-project on various aspects of Colour Reproduction. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

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

End Semester Practical/Oral 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
PPL403	Offset Printing	1

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

b) Mini Project: A group of 4-6 students should be assigned a mini project on various aspects of Offset Printing. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

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

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

Course Code	Course Name	Credits
PPL404	Digital Electronics and Microcontrollers Laboratory	1

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)

a) List of Experiments (Minimum Eight)

Module	Details
1	Verification of logic gates and Boolean laws.
2	Simplification of given Boolean expression and to realize them using logic gates/universal gates.
3	Design and implementation of Code converter.
4	Half and Full adder and Half and full subtractor.
5	Study of Flip Flop and conversion of JK to D and T flipflop.
6	Programs based on Data Transfer Instructions
7	Programs based on Data Exchange Instructions
8	Programs based on Arithmetic Instructions
9	Programs based on Logical Instructions
10	Relay/LED Interfacing (Demonstration only)

b) Mini Project: Students shall integrate and apply the knowledge gained during the course. The mini project shall be developed by team of 4-6 students. Further, mini project shall demonstrate design, setup, and implementation of a simple system.

The distribution of Term Work marks will be as follows –

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

Course Code	Course Name	Credits
PPSBL401	Skill Based Lab: Packaging Material Testing - II	1.5

Objectives:

1. To understand the testing principles of plastic and ancillary packaging materials.
2. To learn about the physical properties of various ancillary packaging materials

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

1. Identify plastic material by chemical and instrumentation method.
2. Determine the strength of an adhesive used.
3. Find closure dimensions and its opening and closing torque.
4. Find the GSM of all layers in a label.
5. Perform taping and strapping of a box.
6. Analyze thermogram from a DSC.

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Ten)

Module	Details
1	Identification of Plastics by Chemical method
2	Identification of Plastics/Layers in a laminate by Instrumentation Method – FTIR
3	Performing thermal analysis of Plastics by Differential Scanning Calorimeter.
4	Determination of bond strength of a plastic laminate.
5	To find adhesive coating weight and GSM of all the components in a label.
6	To find shear resistance of an adhesive on a tape/label.
7	To find 90° & 180° peel strength of an adhesive on label.
8	To find the tack of self-adhesive tape or a label by rolling ball tack test.
9	To perform dimensional analysis on closures.
10	To find opening and closing torque for closures.
11	To perform strapping on a box.
12	To perform taping on a box.
13	To find the scuff resistance of printed label.

b) Mini Project: A group of 4-6 students should be assigned a mini project on various aspects of Packaging Material Testing. This project should be graded for 10 marks depending on the performance of the students

The distribution of Term Work marks will be as follows –

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

End Semester Practical/Oral 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
PPPBL401	Mini Project 1B	2

Objectives

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

Outcome: Learner will be able to...

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

Guidelines for Mini Project

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

Guidelines for Assessment of Mini Project:

Term Work

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

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

One-year project:

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

Half-year project:

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

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria:

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

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

Guidelines for Assessment of Mini Project Practical/Oral Examination:

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

Mini Project shall be assessed based on following points:

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