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)

AC 23/07/2020

Item No. 121

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

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

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

Preamble

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

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

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

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

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Incorporation and implementation of Online Contents from NPTEL/ Swayam Platform

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

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

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

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

04	**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). **Self- learning Topics:** Properties variance and covariance,	**06**
05	**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) **Self -learning Topics:** Test of significance of large samples, Proportion test, Survey based project.	**07**
06	**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) **Self- learning Topics:** ANOVA**:** One way classification, Two-way classification (short-cut method).	**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 4sub-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=2CP3m3EgL1Q&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/ MeltingTemperature (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	**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) **Thermoset plastics in packaging:** Applications of Amino plastics (Urea Formaldehyde and Melamine Formaldehyde), Phenolics, Epoxies, Unsaturated Polyesters, Polyurethane. Brief introduction on Biodegradable plastics / Bioplastics	**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", 3rd Ed, Pearson-Prentice Hall, 2006.
2. Gowariker V. R., Viswanathan N. V., Sreedhar J., " Polymer Science", 1st Ed, New Age International Publishers, 1986.
3. Selke, S. E. M., Culter, J. D., Hernandez, R. J., "Plastics Packaging: Properties, processing, Applications and Regulation", Carl HanserVerlag, USA, 2004.
4. Margolis J. M., "Engineering Plastics Handbook", 1st Ed., McGraw-Hill, 2006.
5. Athalye A. S., "Handbook of Packaging Plastics', 1st Ed., Multi Tech Publishing Co., 1999.
6. Yam K. L., "The Wiley Encyclopedia of Packaging Technology", 3rd Ed., 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 andselection. 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, "Colorand 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	**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, **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	**05**
2	**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. **Recent Trends and Advancement** **Toshiba: Erasable offset printing, Kodak: Sinora Process free plate, Technova: Innovative Plate Making**	**07**
3	**Inking System** Introduction of typical inking system, Roller covering, Ink film thickness, Setting of rollers, Ink system operation, Inking system problems, Maintenance, Auxiliary devices. **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. **Recent Trends and Advancement**	**06**
	Sheet Control - Introduction, Working and elements of Stream feeder, Pile Table, Sheet Separation Unit, Feed board, Sheet	

4	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. **Dryers** Types of dryer and working principle. Relation of drying mechanism and inks used. **Troubles and Trouble Shooting** - Causes and remedies: Printing unit troubles, defects in inking system, dampening troubles, plate defect, Blanket troubles, Paper troubles, Ink defects. **Recent Trends and Advancement**	**07**
5	**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. **Web Reel Cost Estimation** Sheets in a reel, length of the paper, paper consumption for a specific job. **Troubles and Trouble Shooting** - Causes and remedies: Printing unit troubles, defects in inking system, dampening troubles, plate defect, Blanket troubles, Paper troubles, Ink defects.	**06**
6	**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.	**04**
7	**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.	**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, decode, 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 andGrayness 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^{o} & 180^{o} 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